Conference *Science, Innovation and Society:*
achieving Responsible Research and Innovation
Rome, 19-21 November
2014

THE CONTRIBUTION OF THE EUROPEAN COMMISSION TO RESPONSIBLE RESEARCH AND INNOVATION. A REVIEW OF THE SCIENCE AND SOCIETY(FP6) AND SCIENCE IN SOCIETY (FP7) PROGRAMMES

Prepared by the Local Scientific Committee

Daniele Archibugi (coordinator),

Ilaria Ampollini, Carla Basili, Massimiano Bucchi, Tommaso Castellani, Rossella Palomba, Emanuela Reale, Angela Taraborrelli, Brian Trench, Adriana Valente

PUBLIC ENGAGEMENT

GENDER EQUALITY

SCIENCE EDUCATION

ETHICS

OPEN SCIENCE

GOVERNANCE

GLOBAL TRENDS IN SCIENCE IN SOCIETY

Table of Contents

Message from the President of the Italian Republic, Giorgio Napolitano

To the Conference Participants and Organisers

On the occasion of this international conference, "Science, Innovation and Society: achieving Responsible Research and Innovation",which has been organized on behalf of the European commission under the framework of the Italian presidency of the Union – by CNR and the agency for the promotion of European research, I want to express my appreciation of this important moment in which wewill reflect upon and confront the issues of responsible research and innovation.

In our current context, in which the prospects of a stable economic recovery and rising employment in Europe, and the hopes of its citizens for a general improvement in the conditions of life depends on the capacity to innovate, the strengthening of the dialogue among researchers, governments and civil society is of crucial importance.

I am confident that the relevant contributions on these themes can serve as a message that inspires trust in future generations. I am certain that this will emerge from the recommendations included in the "Rome declaration on responsible research and innovation," document that will contain the final suggestions of the conference.

In this spirit, I sincerely wish all of you, the president, the organisers, and the participants of this event, good luck with your work.

Giorgio Napolitano

Rome Declaration

21 November 2014

Rome Declaration on Responsible Research and Innovation in Europe

Responsible Research and Innovation (RRI) is the on-going process of aligning research and innovation to the values, needs and expectations of society.

Decisions in research and innovation must consider the principles on which the European Union is founded, i.e. the respect of human dignity, freedom, democracy, equality, the rule of law and the respect of human rights, including the rights of persons belonging to minorities.

RRI requires that all stakeholders including civil society are responsive to each other and take shared responsibility for the processes and outcomes of research and innovation. This means working together in: science education; the definition of research agendas; the conduct of research; the access to research results; and the application of new knowledge in society- in full respect of gender equality, the gender dimension in research and ethics considerations[1].

More than a decade of research and pilot activities on the interplay between science and society points to three main findings. First, we cannot achieve technology acceptance by way of good marketing only. Second, diversity in research and innovation as well as the gender perspective is vital for enhancing creativity and improving scientific quality. And third, early and continuous engagement of all stakeholders is essential for sustainable, desirable and acceptable innovation. Hence, excellence today is about more than ground-breaking discoveries – it includes openness, responsibility and the co-production of knowledge.

The benefits of Responsible Research and Innovation go beyond alignment with society: it ensures that research and innovation deliver on the promise of smart, inclusive and sustainable solutions to our societal challenges; it engages new perspectives, new innovators and new talent from across our diverse European society, allowing to identify solutions which would otherwise go unnoticed; it builds trust between citizens, and public and private institutions in supporting research and innovation; and it reassures society about embracing innovative products and services; it assesses the risks and the way these risks should be managed.

European regions and countries are already engaged in this approach. Societal demands for ambitious environmental policies led to creative social and technological innovations such as fuel efficient vehicles, solar devices or mobility and recycling solutions based on sharing.

Therefore, we, the participants and organisers of the conference "Science, Innovation and Society: achieving Responsible Research and Innovation" held in Rome on 19-21 November 2014 under the auspices of the Italian Presidency, consider it as our collective duty to further promote Responsible Research and Innovation in an integrated way.

We call on European Institutions, EU Member States and their R&I Funding and Performing Organisations, business and civil society to make Responsible Research and Innovation a central objective across all relevant policies and activities, including in shaping the European Research Area and the Innovation Union.

The present declaration builds on the 2009 Lund Declaration, which called for an emphasis on societal challenges, and on the 2013 Vilnius Declaration, which underlined that a resilient partnership with all relevant actors is required if research is to serve society.

We believe the conditions are now right for responsible research and innovation to underpin European research and innovation endeavour and therefore call on all stakeholders to work together for inclusive and sustainable solutions to our societal challenges.

[1] A description of the six dimensions of RRI can be found on http://ec.europa.eu/research/science-society/document_library/pdf_06/responsible-research-and-innovation-leaflet_en.pdf

1 Introduction

Daniele Archibugi
Institute for Research on Population and Social Policies,
National Research Council of Italy

The scientific community is facing increasing demands from society at large; it is being asked to provide results and innovations that fulfil greater expectations and apply to the economic sphere, as well as the scientific, and to interact with stakeholders as much as possible. Yet there are growing concerns about the direction that science has taken regarding new opportunities, to such a degree that societal monitoring is becoming routine. GM foods, DNA manipulation, and ICT surveillance, to cite a few hot topics, are producing fresh dilemmas for society and academia to address. Satisfying the contrasting requests and pacifying concerns, especially in a period in which public budgets have been, especially in Europe, under pressure, often leading to substantial cuts in governmental expenditure, is difficult.

The European Union has for many years recognised the crucial role that science, technology, and innovation have in ensuring its prosperity. Already in the March 2000, the European Council in Lisbon launched the ambitious target of making Europe the largest knowledge-based economy in the world. Subsequently in March 2002, the European Council in Barcelona further specified this target to an EU-wide ratio of R&D to GDP of 3 per cent. Although this target has not yet been reached, backing for it is strong as there is consensus that the benefits provided by science to society exceed the resources that it absorbs. Along with necessary funding, it is vital that there are strong interactions with stakeholders in order to understand not only which scientific and technological fields have greater potential, but also how, and which, societal groups can benefit from them.

The scientific community already interacts with many different stakeholder groups on a daily basis: policymakers and policy advisers, who decide the nature and amount of resources that should be devoted to research, the business community, which is looking to use research-generated knowledge for commerce, and civil society, which eventually assesses the promise and dangers associated with innovative know-how and practices. Could greater integration with these groups improve the activities of the scientific community?

The European Union plays a crucial role in integrating scientific activities into the economic, social, cultural, and political landscape, by carrying out research in its own centres and promoting and financing a wide range of scientific, technological, and innovative activities. The EU has also tried to provide original forms of organization for scientific and technological activities. From the very beginning, it has promoted collaboration across different countries, within and outside the EU, and it has fostered integration between the public and the business sectors. The schemes and the programmes promoted have also developed and applied standards and practices to match ethical issues, gender equality, regional cohesion, research integrity, and evaluation, to mention just a few. Most of the practices introduced at the European level have been considered and sometimes

imitated by EU Member States, by countries in other continents, and by other international organizations.

The innovations that the EU has helped introduce into the operation of the scientific and technological community are not the result of improvisation. They are usually based on reflections carried out by scientists in each discipline and scholars working on research policy, the economics and sociology of science and technology, and what, more generally, can be labelled 'the science of science'. The European Commission has played a pioneering role in mapping and exploring the new landscape in which the knowledge community is operating. Promoting and financing a large battery of activities in emerging areas, the European Commission has also managed to identify new concerns and explore how the scientific and technological community could respond to unexpected challenges.

This report, associated with the conference Science, Innovation and Society: achieving Responsible Research and Innovation, which was held in Rome on the 19-21 November 2014, emphasises what has been done and highlights lessons learnt from the past and that can be important in preparing for the future. The aim of the conference is to explore these issues in light of the role played by the European Union through its Framework Programmes and the on-going Horizon 2020 programme. In particular, the conference will discuss the research carried out through the schemes 'Science and Society' (SaS-FP6) and 'Science in Society' (SiS-FP7). These activities have been crucial for improving the organization of the whole European Research Area and have provided inspiration to the scientific and technological research carried out in member countries as well as in other regions of the world. As the Horizon 2020 Work Programme (2014-2015) has already allocated 91 million euros to the programme 'Science with and for Society' (SwafS-Horizon 2020), it is crucial to reflect on what has already been learnt and what the future perspective will be. Among the objectives of the conference are to:

(a) garner analysis, recommendations and best practices;

(b) provide a platform for stakeholders, from member states and others, to discuss further developments in the Responsible Research and Innovation framework;

(c) federate the Science in Society Community and provide input for future collaboration within 'Science with and for Society';

(d) present the international perspective of Science in Society projects over the FP6 and FP7, and further discuss and reflect on the international dimension of Science in Society.

This report contributes towards the fulfilment of the conference's objectives. It is devoted to reviewing the activities that constitute the background of the conference, namely the activities carried out by SaS-FP6 (2002-2006) and SiS-FP7 (2007-2013), identifying the main priorities and achievements, and it singles out the projects that, in our judgement, could be useful for planning future activities.

The change in names that the Framework Programmes have implemented are already 'programmatic': the word 'and' used in FP6 indicates that the two sets, science on the one hand and society on the other hand, were somehow separate and that they needed to be combined. In contrast,

the word 'in' used in FP7 calls for a greater integration between the two. Horizon 2020 has become even more explicit, requiring the scientific community to be of service to society at large. With these apparently small linguistic changes, it is possible to trace how the relationship between science and society has evolved in a relatively short time.

Classifying and categorizing the activities promoted, funded, and carried out over 14 years has not been easy. The conference and this report are organized around six principal themes: (1) public engagement, (2) gender equality, (3) science education, (4) open access, (5) ethics, and (6) governance. We are aware that these themes do not fully encapsulate all of the projects and that some projects belong to more than one theme. However, we believe that these six themes are indicative of the core areas into which the activities promoted by the Commission have been allocated.

The European Commission is, of course, not alone in addressing these issues. National governments, including EU member countries, the business sector, and other institutions have often discussed similar questions and have provided a wealth of analyses that shape science, technology, and innovation in an evolving social and economic context. A report of some of these activities is provided in the last chapter 'Global Trends in Science in Society'. The European Commission itself has not only offered inspiration for some of these activities, but has fostered international cooperation with non-EU countries and institutions also in the specific domain of the 'science of science'.

Many of the scholars who have contributed to SaS-FP6 and SiS-FP7, and who will contribute to SwafS-Horizon 2020, have attended the conference. This gave us the opportunity to gather additional information about the work that they have carried out and to receive original feedback. The analysis of what has already been done is specifically designed to capitalise on past lessons and to envisage a better role for science, technology, and innovation in the future. We are particularly happy that this hat taken place under the auspices of the Italian Presidency of the European Union.

Due to time and space constraints, we have not covered all of the projects. We have been forced to choose a selection and give more space to those activities that seems to us both paradigmatic and that could serve a source of inspiration for future research, especially under SwafS-Horizon 2020. In order to identify these projects, under the Terms of Reference provided by the Commission, we have used the diction 'best practice'. As it has been often signalled, this wording is highly controversial and many would recommend substituting it with the less judgemental term 'good practice', but after discussion with our colleagues of the Commission we have adopted the terminology of the Terms of Reference. Besides the wording, we hope that the cases we have pointed out will provide food for thought.

The Local Scientific Committee wishes to first thank Riccardo Pozzo, the Director of the Department of Social Sciences and Humanities at the Italian National Research Council. He has been the mastermind behind the organization of the conference, including its innovative way of linking academic contents to extra-academic activities. The conference has been a successful example of how insightful and novel ideas can be generated in an entertaining social environment.

It is with great pleasure that we reproduce here the Rome Declaration on Responsible Research and Innovation, a declaration that can be seen as a bridge between the knowledge and achievements of the past and the challenges of the future.

Our colleagues organizing the programme of the conference have provided constant feedback, and we wish to thank Rosaria Conte. Giulia Bonelli and Federica Mattei have provided help and stimulus. The conference itself has been co-organized with the Italian Agenzia per la Promozione della Ricerca Europea (Agency for the Promotion of European Research, APRE). Emanuela Danè has been particularly helpful in organizing the printing and the graphic design of the report.

Several colleagues at the European Commission, D.G. Research and Innovation, have been very generous in providing comments, suggestions, and integration with our previous drafts.

A special thank you to our colleagues at CNR who have shared this journey with us, in particular Azzurra Malgieri and Giulia Antonini. Luigia Montenora and Maurizio Gentilini have had to deal with the tedious job of standardizing the various chapters.

2 Evolution of Public Engagement in European Programmes

Tommaso Castellani
Science Communication and Education Research Unit,
Institute for Research on Population and Social Policies,
National Research Council of Italy

Abstract

Public Engagement in Responsible Research and Innovation has acquired increasing importance. Its definition is still evolving; it includes and broadens the concept of science communication, going beyond a 'transmission model' and developing a more participatory involvement between science and society.

The European FP6 Science and Society (SaS-FP6) and FP7 Science in Society (SiS-FP7) programmes have contributed to shaping the concept of Public Engagement and aim to build an effective and democratic European knowledge-based society. With respect to SaS-FP6, SiS-FP7 acknowledged the need for more participatory involvement of the public via two-way communication allowing the public and stakeholders to engage with science, and scientists to engage with the public.

Some projects have been specifically devoted to Public Engagement activities and the majority of the SaS-FP6 and SiS-FP7 projects, as well as those outside the SaS-SiS domains, have involved some aspects of Public Engagement.

In the SwafS-Horizon 2020 Work Programme, Public Engagement is included in the concept of Responsible Research and Innovation (RRI), raising many old and new challenges.

2.1 Public Engagement in Science and Technology

'Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits'. This is written in article 27 of the Universal Declaration of Human Rights, and it is recalled at the beginning of the 2009 MASIS Report (European Commission, 2009), one of the main evaluation documents on the European projects concerning Science in Society. Public Engagement in science and technology refers to the modes and the extent of this sharing.

In the European context, as in the whole world, Public Engagement in research and innovation has acquired increasing importance, as a means through which science and society may interact. 'In Europe, as elsewhere in the world, considerations about the place of science in society are thus not new. But the intensity with which these issues have been discussed, the prominence that science policy has had on political agendas, and the breadth of reform processes that have been implemented in recent years, are far greater than in the past' (Mejlgaard and Bloch, 2012).

In the framework of policy making, it has been increasingly recognized over the last decades that research is only one of the many sources of evidence that needs to be combined with other forms of knowledge from several different stakeholders, including citizens. This entails that 'in the work of

politically relevant knowledge production [...] citizens play an indispensable role, supplementing the contributions of professional experts' (Jasanoff, 2004). According to Jasanoff, it is only recently that 'ruling institutions have recognized to varying degrees that members of contemporary polities are epistemic actors'. This new form of citizenship has been called 'scientific citizenship', and consists in the active and knowledge-driven participation of citizens in the democratic processes, including agenda setting, information gathering, co-creation, and evaluation.

In its present context, Public Engagement implies inclusive multi-actor dialogues and exchanges between different stakeholders including researchers, policy makers, industry, civil society organisations, NGOs, and citizens. Public Engagement in science and technology is a means to 'co-create the future with citizens and civil society organisations, by bringing on board the widest possible diversity of actors that would not normally interact with each other' (European Commission, 2013a). This definition includes and goes well beyond all those activities traditionally called 'science communication'.

2.2 Public Engagement in SaS -FP6and SiS -FP7

The Science and Society FP6 (SaS-FP6) and Science in Society FP7 (SiS-FP7) programmes have helped shape Public Engagement in Responsible Research and Innovation andaim to contribute to the building of an effective and democratic European knowledge-based society. This process is continuing with the new Horizon 2020 Science with and for Society (SwafS-Horizon 2020) programme. The interim evaluation report on Science in Society recognized that 'arguably the greatest impact of the SaS-FP6 and SiS-FP7 has been to raise the political importance of science in society [...], raising awareness of the problems and the need for all actors to work together' and 'enhancing the understanding of the nature of problems' (Technopolis-Fraunhofer, 2012).

According to the interim report, both programmes have contributed to the development of new tools and methods of participation, significantly enhancing the engagement of the public, policymakers, and businesses in scientific debate. 'The programmes have made advances in establishing new ways to engage, in particular, civil society organisations and public bodies at local and regional levels' (Technopolis-Fraunhofer, 2012). A particularly positive role has been recognized for Mobilisation and Mutual Learning (MML) Action Plans, a particular kind of project designed to foster close collaboration between scientists, policymakers, civil society organisations, and citizens, in key policy areas. The MML provide an effective model for enhanced integration of stakeholders in European research(Technopolis-Fraunhofer, 2012).

The SiS-FP7 programme acknowledged the need for greater participatory involvement of the public via 'two-way communication channels that enable the public and policy-makers to engage with science, and scientists to engage with the public'. The specific SiS-FP7 objectives addressed in the third action line, entitled 'Science and society communicate', included the need 'to enable the public to engage with scientists', 'to enable closer dialogue between scientists and the media', 'to provide tools for the public to express views on science', and 'to provide the wider public with more scientific information'.

However, Public Engagement was also included in other action lines. From an analysis of project abstracts, we have identified more than 40 projects in SaS-FP6 and more than 60 projects in SiS-FP7 that have main aims that include Public Engagement issues (Figure2.1). This assessment did not consider the degree to which public engagement was also embedded in other FP programmes so the above figures are an underestimate of the true uptake of public engagement in science.

2.2.1 Overview of FP6 Science and Society Projects

We can identify a variety of approaches represented in the SaS-FP6 projects. A significant number of them deal with traditional science communication activities. Among these, many are devoted to the implementation of science festivals, science weeks, and similar events; ESCIENTIAL, ESOF, SKY WATCH, WONDERS are some of the projects that can be placed in this category. Also in this category is the EC-supported European Science Open Forum (ESOF) that has led to recurring bi-annual conferences fostering discussion about science in society issues. Other projects have organised contests for young people (e.g. EUROBOT), or have contributed to specific events, like VENUS TRANSIT 2004, which was organised for the occasion of Venus passing between the Sun and the Earth.

Figure 2.1 Public Engagement in FP6-SaS/FP7-SiS

Note: Some FP6-SaS and FP7-SiS projects which include public engagement issues in their main aims (font dimension indicates the project duration, lighter blue stands for more recent projects. FP6: serif font, FP7: sans serif font.)

Another batch of projects was devoted to the use of media in science communication, as SCIRAB, ESCW, EARTHWAKE, and others.

There were also projects that had the broad aim of fostering awareness of societally relevant scientific issues, for instance, related to the environment and sustainability (e.g. SHIELD), or the impact of science and technology on everyday life (e.g. SUPERLIFE, COT-2). Others focused on very specific topics, like WESPA on microelectronics and semiconductor physics, or SWEETS on space weather.

Another approach is the Public Engagement of society, which is intended to involve different actors in the science-society relationship. This topic is not present in the first SaS-FP6 calls, but appears later, and is more fully developed in SiS-FP7. An example of a project with this approach is PATH, which states in its abstract that the 'deliberation of science-based issues and formulation of policy is no longer the exclusive realm of politicians and experts'. Some of the projects that embraced this approach dealt with issues like risk governance (e.g. STARC), citizens and civil society participation (e.g. CIPAST and PSX2), or the involvement of public institutions at the local level (e.g. ESCITY). Others focused in on specific topics like fisheries management (SAFMANS) or were addressed to specific target groups like patient organisations (CAPOIRA), or NGOs (INRE). Other projects focused on holding deliberative debates (e.g. DECIDE and ECD).

Then there were projects specifically aimed to implement activities in collaboration with science museums and science centres, like DOTIK, EuEv, or Discovery Days. The topic of science and art, which can be explicitly found in more recent calls, was already anticipated in the HULDA experience and developed in projects like ISWA, STUDIOLAB, CISCI (specifically on cinema and science) or DNA-TEST (which involves science-theatre).

Finally, some of the projects lay on the boundary between public engagement and other areas including science education (e.g. FW-SCIENCE 2004 and ECFUN), ethics (e.g. HEALTHRESEARCHETHICS), and gender (e.g. CEC-WYS and FEMSTART).

2.2.2 Overview of FP7 Science in Society Projects

Some of the calls in SiS-FP7 concerning science communication follow the same scheme as those in SaS-FP6 did, and were aimed to maintain prior initiatives considered particularly successful; the continued support of ESOF and other events like the EUCYS contest are some examples.

Many other calls integrate innovative and developing issues, like the notion of scientific citizenship, which were not directly addressed in SaS-FP6. In SiS-FP7, we find projects specifically devoted to the relationship between science and politics, like MACOSPOL and MIRRORS, and a large number of projects that deal with public debate and deliberative processes. At the beginning, this topic appeared in the calls only related to very specific scientific questions, like nanotechnologies (which is implemented within projects like NANOPLAT and FRAMINGNANO) or education (implemented in projects like COREFLECT). However, some subsequent calls are entirely devoted to the topic of deliberation, public debate on S&T, participatory democracy, without reference to any specific scientific issues. Under these calls, we find projects like CASC, COMSCIENCE, SCICAFE, FUND, PACITA, and others. Among these projects, some are focused on the

relationship that citizens have with public institutions, like cities (for instance in the projects PLACES and CREATIVECH). Others are linked to related themes, as education (e.g. SIS-CATALYST) or governance issues (e.g. STEPS and CONSIDER). In SiS-FP7 calls, there is an increased attention to the involvement of stakeholders, implemented in projects like GAP1 and GAP2, or CEECEC (this last has a particular focus on civil society organisations).

Another innovative topic of SiS-FP7 is the relationship between research institutions, the media, and the public. We find projects specifically addressed to scientists in order to improve their science communication skills (e.g. ESCONET) and projects aimed to improve the relationship between the scientific community and the media (e.g. RELATE and MYSCIENCE).

Other themes of SiS-FP7 follow on from topics present in the previous framework programme and integrate new dimensions. The topic of science and the media is still present but more focused on ICT, and more generally to science-society interactions in the digital era. This approach is implemented in projects like AVSA or EMAPS, in which particular attention is placed on the use of the web for participatory communication between scientists and different publics.

The implementation of projects with museums, science centres, and science shops in order to connect the general public to scientific achievements is also continued within SiS-FP7. Examples of such projects are SCICOM, 2WAYS, ACCENT, EUZOOS-XXI, VOICES, and PERARES. PERARES addresses science shops and includes a variety of objectives that encompass participatory democracy issues.

Calls fostering the awareness of societally relevant scientific issues were continued and expanded in SiS-FP7, as a means to raise public awareness and participation towards tackling societal challenges. We find several projects devoted to such themes, like health (EUROCANCER COMS), food (INPROFOOD), marine environments (MARLISCO, SFS, GAP2), ageing (SIforAGE), energy (R&DIALOGUE), water (BEWATER), pandemics (ASSET), neuro-enhancement (NERRI), and sustainable Innovation (CASI). There are also projects that aim to assess the social impact of scientific research (e.g. SIAMPI).

From 2012 we also find projects focused on Responsible Research and Innovation (NERRI and PIER), a new narrative central to SwafS-Horizon 2020 issues.

A particular highlight of SiS-FP7 is VOICES, a pilot launched by the EC and implemented by the ECSITE network of European Science Museums. The aim of this initiative was to develop and implement a citizen engagement methodology through which the EC could design Horizon 2020 calls for the area of waste research. According to project documentation, one thousand citizens took part in the participatory process, which held focus groups in 27 countries and 23 languages. The outcome led to the definition of five waste research topics under the Horizon 2020 2014-2015 calls, for an EC contribution of 116 million euros. This represented the first time that citizen deliberations directly contributed to the setting of the European research agenda.

2.3 Public Engagement in the whole FP7

The 2009 MASIS report highlighted that 'a major weakness of FP7-SiS was that science and society issues were embedded in other parts of the Framework Programmes' (European Commission, 2009). However, the 2012 interim report recognized that considerable progress had been made in increasing 'both the horizontal and vertical integration of FP7-SiS elements in all areas' (Technopolis-Fraunhofer, 2012). The enhancement of the vertical dimension of Science in Society aspects in the whole FP7 arguably represents one of the most important achievements of the FP7.

Public Engagement issues are particularly suited to be developed in a vertical dimension, and it has been noted that 'the majority of the projects supported across the FP6-SaS and FP7-SiS programmes have involved, to a greater or lesser degree, aspects of public engagement and the two-way interaction between scientists and non-scientists' (Technopolis-Fraunhofer, 2012). One of the need that emerged from the feedback of project participants was to 'continue ensuring that good engagement and communication practices are embedded in all parts of the programme' (Technopolis-Fraunhofer, 2012).

Exploring other FP7 programmes, we found several examples of projects centred on Public Engagement. Some of these examples are the projects NANOPINION, funded under FP7-NMP and aiming at information, outreach, and dialogue nanotechnologies; OPEN:EU, funded under FP7-ENVIRONMENT, which aimed to develop a online network of decision-makers, civil society organisations and businesses leaders; EVERYAWARE, funded within FP7-ICT, which aimed to integrate different phases environmental management embedding a strong citizen science dimension.

The interim report also contains data derived from questionnaires that were administered to project coordinators and other stakeholders (Technopolis-Fraunhofer, 2012). It reveals that among the FP7 projects that engaged actors beyond academic communities, 70% 'had engaged with citizens or organised civil society, mostly through the communication, dissemination and use of projects results, but also to a lesser extent in determining and implementing the research' (Technopolis-Fraunhofer, 2012). In addition, 43% of projects 'involved actors whose role was mainly to organise the dialogue with citizens and civil society (e.g. professional mediators, communication companies, and science museums)' (Technopolis-Fraunhofer, 2012). This demonstrates that Public Engagement issues are extending to areas different from those covered by SaS-FP6/SiS-FP7/SwafS-Horizon 2020, addressing a need for more inclusive and participatory science. However, the know-how required for this involvement is not necessarily present in a research entity. 'Scientists are increasingly expected to engage in public communication, though they frequently report that they feel inadequately prepared for such activity' (Trench and Miller, 2012). Consequently, a need that seems to be utterly relevant for fostering Public Engagement dimension is the enhancement of the Public Engagement know-how in research infrastructures and amongst researchers. This issue, which began to be addressed via some SiS-FP7 calls, will be further developed within SwafS-Horizon 2020, as we will see in the next paragraph.

2.4 The Future of Public Engagement: SwafS-H2020 and Perspectives

It has been observed that 'even after several decades of political, academic and broader societal attention, and after a focused research and practical implementation effort under the "Science in society" scheme of the European Commission, the issue of public engagement has in no way become trivial, and there is no homogeneous European model of public engagement with science' (Mejlgaard et al., 2012). At the same time, 'the most appropriate conditions and mechanisms for achieving science in society objectives are not yet fully understood' (Technopolis-Fraunhofer, 2012). However, one clear direction was envisaged as early as 2007: the transformation of Europeans 'From passive consumers to concerned citizens' (European Commission, 2007).

Looking to the SaS-FP6 and SiS-FP7 projects, significant room for improvement can be found within the so-called 'dissemination' activities. The interim report revealed 'no significant differences' in SaS-FP6 and SiS-FP7 project-level dissemination activities, and primarily consisted of events (workshops, conferences, and information days), online information, articles, and media. Among these activities, only workshops seem to include the interactive, two-way dimension that has been considered so important. One possibility could be to integrate the Public Engagement dimension within the dissemination activities. This alone however may not lead to the desired impact whereby outcomes of deliberations are effectively fed back into the research and innovation process. Ideally, public engagement should be, in particular, fostered through dedicated (or within) topics calling for transdisciplinary and participatory research and innovation actions, and Mobilisation and Mutual Learning actions. Such topics would then be responsive to mainstreaming RRI as a crosscutting issue.

This implies a further broadening of the concept of 'science communication', a process that started with the acknowledgement of the necessity of a transition from a 'transmission model' to a 'transaction model' (European Commission, 2012). In the interim report, doubts are expressed about the aim of science communication: 'it is not quite clear whether science communication is about ensuring public trust in the science system, about improving the image of science [...], about increasing awareness and understanding so that stakeholders can engage and interact more fully with science, or about increasing the utility of science by connecting it more closely to societal (industrial, policy, public) needs. Experts tell us that the European Commission itself does not seem to be very clear about the aims and objectives of science communication' (Technopolis-Fraunhofer, 2012).

On the one hand, 'a notable common trend is that the efforts and attention paid to science communication in general and communication aimed at young people in particular is on the rise in most of Europe' (European Commission, 2012), on the other hand, the aim of communication is often still seen as 'ensuring the viability of policy options' (European Commission, 2012). If 'the number of actors involved in science communication is increasing, adding to the complexity of the field, but also involving new formats and modes of communication, particularly through web-based media but also large-scale interactive initiatives such as science festivals' (European Commission, 2012), the dissemination strategies of SiS-FP7 projects have still not fully integrated an active role for the citizens and stakeholders.

This reflects a societal trend. The 2013 Special Eurobarometer of RRI (Responsible Research and Innovation), Science and Technology reveals that television is still the main source of information

about developments in science and technology, with 65% preferring television against a mere 35% who prefer the internet (European Commission, 2013c). Notably, television is the less interactive media, while the Internet may include – but not necessarily – more two-directional options. Moreover, the 2007 ERA Survey showed that 'a significant body of opinion that is also concerned to improve and deepen the reciprocal engagement of "science" with "society"' (European Commission, 2007). The 2013 Eurobarometer showed that 31% of respondents report that 'citizens should only be informed' concerning decisions about science and technology, while 39% believe that 'citizens should be consulted and their opinion should be considered', and 12% that 'citizens should participate and have an active role' (Figure2.2).

The integration of Public Engagement aspects in the 'dissemination' activities seems to be particularly necessary regarding the dissemination to specific groups of stakeholders, especially policymakers. 'Policymakers and other stakeholder groups, including relevant national officials, find it difficult to engage with the large volume of work ... there is an evident "gap" 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' (Technopolis-Fraunhofer, 2012). Among the policy makers, European Commission officers do not seem to represent an exception: 'there are problems for the Commission itself to gain a good overview or insight into the results of the SiS-FP7 programme and individual projects' (Technopolis-Fraunhofer, 2012).

Regarding these aspects, initial doubts have been expressed about the Horizon 2020 setup emerging from the early documents. 'Experts expressed some concern about the Science in Society element in the next generation of the Framework Programme – Horizon 2020. Both the FP6 and FP7 programming periods have allowed for a mix of bottom-up and top-down approaches to science and society issues, but Horizon 2020 looks more like a top-down programme. Moreover, in the Commission documentation relating to Horizon 2020, European citizens are predominantly portrayed as users or consumers, whereas their role as active participants in science, or as being engaged and having an interest in science is not emphasised' (Technopolis-Fraunhofer, 2012). The same concern appeared in the FP6 evaluation, in which it was claimed that 'a new bottom-up format (inspired by NEST in FP6) should be introduced to test research directions and original ways of achieving collaboration' (Rietschel and Arnold, 2009).

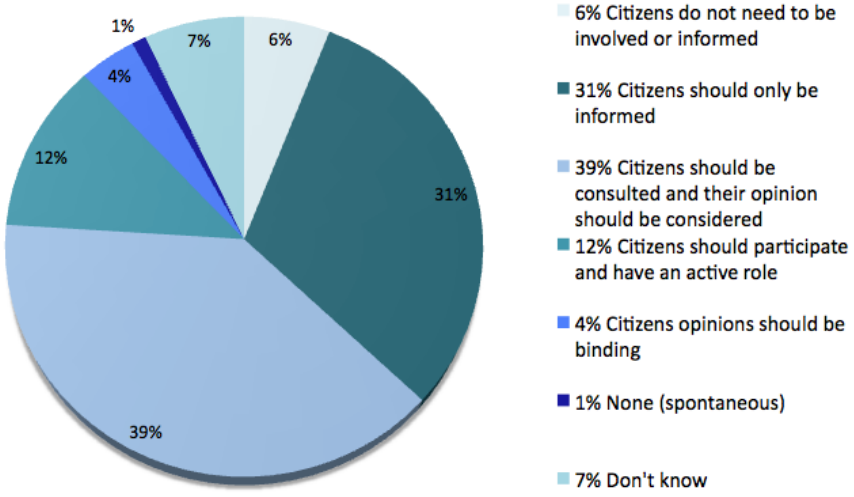


Figure 2.2 Desired Involvement of Citizens in Science and Technology

Source: European Commission 2013c, p. 37 (here represented in pie chart). The question was: 'What is the level of involvement citizens should have when it comes to decisions made about science and technology?'

In its final form, the first SwafS-Horizon 2020 Work Programme seems to take these aspects into serious consideration, through their inclusion in the conception of Responsible Research and Innovation (RRI): 'Citizens interests and values need to be better integrated into science, technology, research and innovation issues, policies and activities. This integration will increase the quality, relevance, social acceptability, and sustainability of research and innovation outcomes in various fields of activity from social innovation to nanotechnology. This integration will be made possible by promoting Responsible Research and Innovation, i.e. the engagement of citizens and society in a co-creative research and innovation process' (European Commission, 2013b).

Several topics of this first set of calls address relevant questions on Public Engagement. The topic ISSI.2.2014 aims 'to empower and draw on the collective intelligence of citizens to examine the role of research and innovation via future scenarios and visions of desirable sustainable futures'. This call takes inspiration from the SiS-FP7 VOICES project, but is far more ambitious in its aim, seeking to provide citizen-inspired ideas for at least three of the societal challenges of Horizon 2020. Topic ISSI.5 aims to promote instructional change in research organisations to take-up and build capacity for public engagement in research and innovation. Also notable is the topic ISSI.4.2015, for knowledge-based decision-making with the involvement of citizens and stakeholders. As mentioned in the previous paragraph, a specific topic (SEAC.2.2014, Responsible Research and Innovation in Higher Education Curricula) answers the need of the integration of Public Engagement issues in the educational programmes for science and engineering studies, contributing to 'shape more responsible and responsive researchers, able to better frame their research in a societal context, necessary for tackling societal challenges more effectively and in a more transdisciplinary manner' (European Commission, 2013b). Other topics are related to Public Engagement in a more traditional way, continuing to develop and improve the trajectory started in SaS-FP6.

2.5 Public Engagement from the stakeholders' perspective: insights from the SIS-RRI conference

This section presents some further issues related to Public Engagement that emerged from two of the sessions of the conference 'Science, Innovation and Society: achieving Responsible Research and Innovation', held in Rome on 19-21 November 2014, which involved many stakeholders working in the field of science-society issues. The first session, entitled 'Public Engagement', was co-chaired by the author of this chapter and involved Jacqueline Broerse, Catherine Franche, Niels Mejlgaard, and Rinie van Est as speakers and Norbert Steinhaus as chairperson; the second session, entitled 'What's next: development of Science with and for Society programme' was chaired by the author of this chapter and involved Claudia Neubauer and Lars Klüver as speakers. Both sessions were followed by debates with the audience; in particular, in the second session, a World Café discussion was performed. The content of this chapter mostly include some of the results of these discussions; the author wishes to thank all the speakers and participants for their contributions.

A major issue that emerged from discussions with the stakeholders concerns the roles of the actors in the Public Engagement processes. In particular, the role of citizens was deeply analysed: what to do when the citizens' response to Public Engagement actions is not 'positive', e.g. they are not interested in participating, or do not believe they must be involved in decisions? (The pie chart in Figure 2.2 shows that a large percentage of citizens have this opinion). Provocatively, we discussed whether it is necessary to 'change the citizens' or the image that we have of them in Public Engagement processes. It was also noted that, in many Public Engagement activities, most efforts are placed on 'seducing actors to act', since citizens' motivation to participate is perceived as the most critical objective. It was discussed how some features of the present times may be specifically unfavourable to citizens' participation, e.g. the crisis of democracy, or the economic model which may not leave sufficient time to citizens for dealing with public issues. It was also observed that motivation can drop if the engagement process is not developed properly, e.g. with the wrong timeline (so that involved actors feel that their contribution will not actually influence decision making), or just seeking for people consensus, or only involving topics that the actors believe to be unimportant.

Indeed, the definition itself of 'citizens' and 'general public' may be further investigated, since it is not always clear to what extent specific stakeholders like politicians, scientists, etc. are, or are not included in these categories. The European Commission is making a great effort to clarify these definitions.

Another role that is perceived as central and critical in the Public Engagement in Science and Technology processes is the scientists' role. Whereas social scientists are broadly represented in the 'Science with and for Society community', natural scientists (and in particular physical scientists) are much less present, despite many Public Engagement activities pertaining to natural science themes, as biology and medicine, Earth sciences, physics, and astronomy. On the one hand, this is evidence of the fact that for science and society issues specific preparation is needed: in order to work on Public Engagement, as on other topics, the importance of having specific professional skills is nowadays recognised. Arguably, this is an achievement that has arisen from decades of research and experimentation on the topic. On the other hand, it must be stressed that among the protagonists of Public Engagement in Science and Technology there

must be the researchers who develop Science and Technology: one of the challenges seems to be to strengthen their involvement. Several H2020 topics move in this direction (as ISSI.5 and SEAC.2, as discussed in Section 4).

The discussion addressed another important issue, which is the balance between the need for strong contextualization of Public Engagement activities and the need for results that can be generalised. This question seems to need deeper examination. Interestingly enough, the VOICES project showed that on the topic of urban waste, some participatory activities produced very similar results in 27 different countries. To what extent can general lessons be learnt from the specific and contextualized experiences? Related to this point, whether we have enough theoretical results on Public Engagement was also questioned. Again, two contrasting issues emerged from the discussion: first, that it is important to have strong epistemological theory for designing and implementing public engagement activities; second, that theoretical claims are not necessarily so relevant for the concrete implementation of projects, for which practice may be more important than theory. One problem that has been stressed as particularly relevant in European projects is the fact that innovative results may be achieved too late, near the end of the project, when there may be not enough time to further explore and assess them. This is one aspect of what has been defined as a trade-off between 'creativity' and 'impact': European programmes should at the same time encourage innovative and original issues, and reinforce the impact of well-established and already experienced activities. In any case, a more systemic programming of Public Engagement projects in Europe is perceived as a need, also considering the uneven development of this sort of activities over the different countries.

In the discussion, some suggestions and recommendations for the evolution of the European programmes were raised and commented. Among these:

- It is important that the Public Engagement and in general RRI agenda is not dominated by technology. There are issues from social sciences and humanities, as ethics, human rights, etc. that are of the utmost importance.
- In the design and implementation of new activities and projects, it is important to connect existing local experiences and use existing capacities. A recommendation is to take greater advantage of crowd-innovation, with a more bottom-up approach.
- European programmes should increasingly encourage the consideration of Public Engagement among the evaluation criteria of excellence of research centres and universities. RRI should be institutionalised and fully recognized in scientific careers.
- The training to Public Engagement and other RRI aspects should start as early as possible, maybe already in primary school. A stronger link between public engagement and education is recommended.
- Public Engagement needs the involvement of more and more entities and communities, e.g. NGOs. Specific activities may address this need, e.g. non-university institutions should be able to participate in programmes like the Erasmus.
- In order to continue to explore the potentials and the different dimensions of Public Engagement, it is important that its definition remains open and that European programmes recognise this openness. This is true for RRI in general, which needs a lot of practice to continue to be developed.

References chapter 2

European Commission. 2007. "Public Engagement in Science. Report of the Science in Society session, The Future of Science and Technology in Europe." Brussels : European Commission
http://ec.europa.eu/research/science-society/document_library/pdf_06/public-engagement-081002_en.pdf

European Commission. 2009. "Challenging Futures of Science in Society. Emerging Trends and cutting-edge issues. The MASIS report." Brussels : European Commission
https://europa.eu/sinapse/sinapse/index.cfm?&fuseaction=lib.detail&LIB_ID=216410DF-0754-3E38-FA0CABB78A41EDE4&backfuse=lib.last&page=8&bHighlight=false

European Commission. 2012. "Monitoring Policy and Research Activities on Science in Society in Europe (MASIS). Final synthesis report." Brussels : European Commission
http://ec.europa.eu/research/science-society/document_library/pdf_06/monitoring-policy-research-activities-on-sis_en.pdf

European Commission. 2013a. "Draft document on Public Engagement in Horizon 2020". Brussels : European Commission
http://ec.europa.eu/research/horizon2020/pdf/work-programmes/science_with_and_for_society_draft_work_programme.pdf

European Commission. 2013b. "Horizon 2020 Work Programme 2014-2015, Science with and for Society." Brussels: European Commission
http://ec.europa.eu/programmes/horizon2020/en/h2020-section/science-and-society

European Commission. 2013c. "Special Eurobarometer 401 - Responsible Research and Innovation (RRI), Science and Technology. Report." Brussels : European Commission
http://ec.europa.eu/public_opinion/archives/ebs/ebs_401_en.pdf

Jasanoff, Sheila. 2004. "Science and citizenship: a new synergy."*Science and Public Policy*, 31: 90–94. DOI:10.3152/147154304781780064.

Mejlgaard, Niels. and Bloch, Carter. 2012. "Science in Society in Europe."*Science and Public Policy*, 39: 695–700. DOI: 10.1093/scipol/scs087.

Mejlgaard, Niels et al. 2012. "Locating science in society across Europe: Clusters and consequences", *Science and Public Policy*, 39: 741–750. DOI: 10.1093/scipol/scs092.

Rietschel, Ernst Th. et al. 2009. "Evaluation of the sixth framework programmes for research and technological development 2002-2006. Report of the Expert Group."
http://ec.europa.eu/research/reports/2009/pdf/fp6_evaluation_final_report_en.pdf

Technopolis-Fraunhofer. 2012. "Interim evaluation & assessment of future options for Science in Society Actions. Final Report."
http://ec.europa.eu/research/science-society/document_library/pdf_06/phase01-122012_en.pdf

Trench, Brian. and Miller. 2012. "Policies and practices in supporting scientists' public communication through training."*Science and Public Policy*, 39(6): 722–731. DOI: 10.1093/scipol/scs090.

Annex 2 – Main Projects in the Public Engagement Area.

These tables have been completed in cooperation with EC officiers. FP6 and FP7 lists include projects in the Science Communication and Public Engagement areas according to EC internal criteria.

FP6 projects

Project Acronym	Project Title	Coordinator (Name of the Organization and Country)	Number of Partners Involved	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type**
ANTARCTICSUMMER	An Antarctic Summer	DRY VALLEYS PRODUCTIONS, FRANCE	1	01-01-07	30-06-08	18	100000	100000	SSA
CAPOIRA	Capacity-Building For Patient Organisations To Participate In Research Activities	EUROPEAN ORGANISATION FOR RARE DISEASES, FRANCE	5	01-01-07	30-06-08	18	154581	154581	SSA
CIPAST	Citizen Participation In Science And Technology	CITE DES SCIENCES ET DE L 'INDUSTRIE, FRANCE	12	01-04-05	31-03-08	36	750000	750000	CA
CLIMER	Climate Research On Mediterranean Radio Stations	ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA, ITALY	6	na	na	na	175920	175920	SSA
COT-2	Composites-On-Tour-2	KATHOLIEKE UNIVERSITEIT LEUVEN, BELGIUM	8	01-03-06	30-11-07	21	308245	308245	SSA
DISCOVERY DAYS	Discovery Days: Advanced Technology Meets Science And Culture. Using Advanced Technological Applications To Improve Visitors Experience In	INTERNATIONAL ENVIRONMENT AND QUALITY SERVICES S.A.	10	01-01-07	31-12-07	12	350000	350000	SSA

	Museums, Science Centres And Archaeological Sites								
DNA-TEST	Dna Traveling Exhibition And Science Theatre	FLANDERS INTERUNIVERSITY INSTITUTE FOR BIOTECHNOLOGY VZW, BELGIUM	3	01-02-07	31-07-08	18	230000	230000	SSA
DOE	Damocles Over Europe	INTERNATIONAL POLAR FOUNDATION, BELGIUM	2	01-11-06	31-10-08	24	190000	190000	SSA
DOTIK	European Training For Young Scientists And Museum Explainers	SCUOLA INTERNAZIONALE SUPERIORE DI STUDI AVANZATI, ITALY	4	01-02-05	31-03-07	26	328200	328200	SSA
E-CASTEX	Promotion And Support Of The Transfer Of Scientific Touring Exhibitions At European Level	ROYAL BELGIAN INSTITUTE OF NATURAL SCIENCES, BELGIUM	5	01-01-07	31-12-08	24	348600	272000	SSA
EARTHWAKE	European Television? A Workshop To Prepare A New Agenda For Science Communication	EUROPEAN ASSOCIATIONF THE PROMOTION OF SCIENCE AND TECHNOLOGY, FRANCE	4	01-01-07	30-11-07	11	64800	64800	SSA
ECD	'Meeting Of Minds. European Citizens' Deliberation On Brain Science'	KING BAUDOUIN FOUNDATION, BELGIUM	12	01-11-04	31-10-06	24	1360352	800000	CA
ESCIENTIAL - I.E.	European Science Festival: Itinerant Exhibitions	ASSOCIAZIONE FESTIVAL DELLA SCIENZA, ITALY	9	01-07-06	30-09-07	15	199500	199500	SSA
ESCITY	Europe Science And The City: Promoting Scientific Culture At Local Level	INSTITUT DE CULTURA DE BARCELONA, SPAIN	6	01-03-06	29-02-08	24	192000	192000	SSA
ESCW	Escw: The European Science	UNIVERSITY COLLEGE	18	01-07-05	31-08-08	38	323760	323760	SSA

	Communication Workshops	LONDON, UK							
EUEV	Joint Exhibition On Evolution	STIFTUNG DEUTSCHES HYGIENE-MUSEUM, GERMANY	3	01-07-05	30-06-08	36	357290	299540	SSA
EUROBOT 2006	Eurobot: Robotic Educational Events To Promote A Dissemination Of Science And Technology Among Young People In Europe.	VM GROUP SA, FRANCE	6	02-01-06	01-02-07	13	885667	691749	SSA
EYSCTS	European Young Scientist Contest Television Series	MEDIA AND EDUCATION PRODUCTIONS BV., NETHERLANDS	1	01-05-07	31-01-08	9	150000	150000	SSA
FUTURE DECTECTIVES	Co-Production On European Research And Future Studies Targeted At Young People	MONDAY PRODUCTION APS, DENMARK	12	01-09-07	28-02-09	18	250000	250000	SSA
FUTURE ENERGY	Les Energies Du Futur: L'environnement, Prise De Conscience Et Source D'emplois	LOUVRANGES BROADCAST SPRL, BELGIUM	2	19-03-07	18-03-08	12	130000	130000	SSA
FUTURESHOCK	Baltic Popular Science Tv Show "Futureshock"	HANSAMEDIA, LATVIA	3	01-09-07	30-11-08	15	150000	150000	SSA
GENIUS	Television Magazine "Genius"	RTC TELE-LIEGE ASBL, BELGIUM	10	01-01-08	28-02-09	14	200000	200000	SSA
INRE	Involving Ngos In Renewable Energy Research	BLACK SEA REGIONAL ENERGY CENTRE, BULGARIA	4	01-02-07	31-01-08	12	115651	115651	SSA
LERU-KIDS	Leru-Kids-University	RUPRECHT-KARLS-UNIVERSITAET HEIDELBERG, GERMANY	12	01-03-05	28-02-06	12	297600	297600	SSA

LETS!	Let_S Talk About Science	FREIER RUNDFUNK SALZBURG - VEREIN ZUR FOERDERUNG VON FREIEN, LOKALEN RADIO UND FERNSEHPROJEKTEN – RADIOFABRIK, AUSTRIA	4	01-01-07	29-02-08	14	130000	130000	SSA
MESSENGER	Media, Science And Society: Governance And Engagement In Europe	SOCIAL ISSUES RESEARCH CENTRE, UK	2	15-02-05	14-02-06	12	267480	267480	SSA
MEYPS SC2	European Mobility Of Young People And Scientists In Scientific Culture Context	UNIVERSITE DES SCIENCES ET TECHNOLOGIES DE LILLE, FRANCE	3	01-01-07	31-03-09	27	200000	200000	SSA
PARCEL	Participatory Communication Activities On E-Learning	WISENSCHAFTSLADEN WIEN, AUSTRIA	5	01-06-05	30-11-07	30	175983	175983	SSA
PATH	Participatory Approaches In Science And Technology	THE MACAULAY LAND USE RESEARCH INSTITUTE, UK	8	01-04-04	31-12-06	33	200000	200000	CA
PSX2	Participatory Science And Scientific Participation: The Role Of Civil Society Organisations In Decision Making About Novel Developments In Biotechnologies	CONSIGLIO DEI DIRITTI GENETICI ONLUS, ITALY	8	01-02-07	30-11-08	22	434332	434332	CA
RISK-BRIDGE	Building Robust, Integrative Interdisciplinary, Governance Models For Emerging And Existing Risks	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK,NETHERLANDS	6	01-07-06	31-03-09	33	776105	776105	CA
RISK-	Risk Communication Network	LUDWIG-MAXIMILIANS-UNIVERSITAET	8	01-06-05	30-11-07	30	500000	500000	SSA

NETWORK		MUENCHEN, GERMANY							
SAFMAMS	Scientific Advice For Fisheries Management At Multiple Scales	INSTITUTE FOR FISHERIES MANAGEMENT AND COASTAL COMMUNITY DEVELOPMENT, DENMARK	7	15-04-05	14-04-08	36	690120	690120	SSA
SCIRAN	Creating A Science And Research Radio Programme Network For Internet And Air Broadcast	EUTEMA TECHNOLOGY MANAGEMENT GMBH, AUSTRIA	4	na	na	na	198292	198292	SSA
SKOOL	Skool	KAOS FILMS, BELGIUM	4	na	na	na	954922	655000	SSA
SKY WATCH	Sky Watch: Introducing European Youth In The World Of Scientific Research Through Interactive Utilisation Of A Global Network Of Robotic Telescopes	INTERNATIONAL ENVIRONMENT AND QUALITY SERVICES S.A., GREECE	8	01-02-05	31-01-06	12	495040	495040	SSA
STACS	Science, Technology And Civil Society - Civil Society Organisations, Actors In The European System Of Research And Innovation	CYPRUS INTERNATIONAL INSTITUTE FOR THE ENVIRONMENT AND PUBLIC HEALTH IN ASSOCIATION WITH HARVARD SCHOOL OF PUBLIC HEALTH EPE, CYPRUS	1	01-03-07	30-04-09	26	415847	389177	SSA
STARC	Stakeholders In Risk Communications	ELECTRICITE DE FRANCE S.A., FRANCE	6	01-06-05	30-11-06	18	337491	337491	CA
SVALBARD	Students Of The Arctic	MOSTRA S.A., BELGIUM	2	na	na	na	359534	359534	SSA
SWEETS	Space Weather And Europe And Education Tool With The Sun	ERNST-MORITZ-ARNDT-UNIVERSITY OF GREIFSWALD,	17	01-01-07	31-12-07	12	500185	500185	SSA

		GERMANY							
TRAMS	Training And Mentoring Of Science Shops	UNIVERSITEIT UTRECHT, THE NETHERLANDS	18	01-05-05	30-04-08	36	449250	449250	CA
TRUSTNET	The Making Of Inclusive Risk Governance: Trustnet-In-Action	MUTADIS CONSULTANTS SARL, FRANCE	16	01-01-04	31-12-06	36	799623	799623	CA
VIA	Véhicule Innovants D'avenir	UNIVERSITÉ NANCY 2, FRANCE	8	01-02-07	31-12-09	35	150000	150000	SSA
WONDERS	Wonders - Welcome To Observations, News And Demonstrations Of European Research And Science	EUROPEAN SCIENCE EVENTS ASSOCIATION, AUSTRIA	3	01-01-06	28-02-07	14	799982	799982	CA
WONDERS07	Welcome To Observations, News And Demonstrations Of European Research And Science 2007	EUROPEAN SCIENCE EVENTS ASSOCIATION, AUSTRIA	3	01-01-07	31-12-07	12	450000	450000	CA
WYP2005 EUROPE	World Year Of Physics 2005: Activities In Europe	EUROPEAN PHYSICAL SOCIETY, FRANCE	24	01-01-05	31-01-06	13	3390864	2083300	SSA
XJENZA-TV	Science Popularisation Tv Bringing Those The Knoweldge Society To Those Not Yet Participating.	UNIVERSITY OF MALTA, MALTA	4	01-04-07	30-06-09	27	425000	340000	SSA

Source: CORDIS Open Data - provisional list to be refined for the Stocktaking Final Report

**SSA - Specific Support Action; CA- Coordination action

FP7 projects

Project Acronym	Project Title	Coordinator (Name of The Organization and Country)	Number of Partners Involved	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type**
2WAYS	Two Ways For Communicating European Research About Life Sciences With Science Festivals & Science Centres/Museums, Science Parliaments Impact Survey	EUROPEAN SCIENCE EVENTS ASSOCIATION, AUSTRIA	7	01-01-09	31-12-10	24	992076	966600	CSA-SA
4SEAS	Synergies Between Science And Society For A Shared Approach To European Seas	ISTITUZIONE MUSEI DEL MARE E DELLA NAVIGAZIONE, ITALY	7	01-03-08	28-02-10	24	512894	439085	CSA-CA
ACCENT	Action On Climate Change Through Engagement, Networks And Tools	FONDAZIONE IDIS-CITTÀ DELLA SCIENZA, ITALY	15	01-04-09	31-03-11	24	1348965	1017880	CSA-CA
ASSET	Action Plan On Sis Related Issues In Epidemics And Total Pandemics*	VITAMIB SAS, FRANCE	15	01-01-14	31-12-17	48	4496454	3939880	CSA-SA
AVSA	Audio Visual Science Audiences (Avsa). A Comparative Study	FREIE UNIVERSITA ET BERLIN, GERMANY	5	01-04-08	31-03-10	24	638576	499831	CP-FP
BEWATER	Bewater - Making Society An Active Participant In Water Adaptation To Global Change*	CENTRO DE INVESTIGACION ECOLOGICA Y APLICACIONES FORESTALES, SPAIN	12	01-10-13	31-03-17	42	3588713	2934724	CSA-SA
CASC	Cities And Science Communication: Innovative Approaches To Engaging The Public	BIRMINGHAM CITY COUNCIL, UK	20	01-05-09	28-02-11	22	1119582	870980	CSA-CA
CASI	Public Participation In Developing A Common Framework For Assessment And Management Of Sustainable	APPLIED RESEARCH AND COMMUNICATIONS	19	01-01-14	30-06-17	42	4473404	3897381	CSA-SA

	Innovation*	FUND, BULGARIA							
COMSCIENCE	Comscience Network: Providing Added Value To Eu Research Dissemination Efforts At Regional Level	LUDWIG-MAXIMILIANS-UNIVERSITA ET MUENCHEN, GERMANY	8	01-04-09	30-06-12	39	1032150	794720	CSA-CA
CONSIDER	Civil Society Organisaions In Designing Research Governance*	DE MONTFORT UNIVERSITY, UK	8	01-02-12	31-01-15	36	1849467	1499381	CP-FP
EJOLT	Environmental Justice Organizations, Liabilities And Trade*	UNIVERSITAT AUTONOMA DE BARCELONA, SPAIN	23	15-03-11	14-03-15	48	4078038	3651921	CSA-SA
EMAPS	Esafety Digital Maps Public Private Partnership Support Action	FONDATION NATIONALE DES SCIENCES POLITIQUES, FRANCE	6	01-09-11	28-02-13	18	452861	399000	CP
ENGAGE2020	Engaging Society In Horizon 2020*	FONDEN TEKNOLOGIRÅDET, DENMARK	6	01-09-13	30-11-15	27	1224310	998123	CP-FP
ESCONET	Esconet Trainers	UNIVERSITY COLLEGE LONDON, UK	1	01-01-09	31-07-11	31	609778	543827	CSA-SA
ESOF2010	Euroscience Open Forum 2010	ASSOCIAZIONE TORINO PER ESOF 2010 - TOPESOF, ITALY	1	01-02-10	31-12-10	11	557467	300000	CSA-SA
ESOF2012	Euroscience Open Forum 2012	FORFAS, IRELAND	1	02-02-12	01-12-12	10	1099200	599000	CSA-SA
EUCYS 2008	The European Union Contest For Young Scientists 2008	UNGE FORSKERE APS, DENMARK	1	01-01-08	30-06-09	18	1985437	600000	CSA-SA
EUCYS 2012	European Union Contest For Young Scientists 2012	MLADI VEDCI SLOVENSKA, SLOVAKIA	1	10-01-12	09-01-13	12	850400	600000	CSA-SA
EUCYS 2013	European Union Contest For Young Scientists 2013	AKADEMIE VED CESKE REPUBLIKY, CZECH	1	01-02-13	31-01-14	12	845200	600000	CSA-SA

		REPUBLIC							
EUCYS2009	European Union Contest For Young Scientists 2009	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, FRANCE	1	01-11-08	30-04-10	18	1067403	600000	CSA-SA
EUCYS2010	European Contest For Young Scientists	FUNDACAO DA JUVENTUDE, PORTUGAL	1	03-03-10	02-03-11	12	1047256	600000	CSA-SA
EUCYS2011	European Union Contest For Young Scientists 2011	TEKNIIKAN AKATEEMISET RY, FINLAND	1	19-11-10	18-05-12	18	944000	600000	CSA-SA
EUZOOS-XXI	Eu Zoos And Science In The 21st Century: Engaging The Public In Nature Conservation	NORDECONSULT SWEDEN AB, SWEDEN	7	01-09-09	31-08-12	36	862134	758178	CSA-CA
FUND	Facilitators' Units Network For Debates	ASSOCIATION EUROPEENNE DES EXPOSITIONS SCIENTIFIQUES, TECHNIQUES ET INDUSTRIELLES, BELGIUM	3	01-03-09	28-02-11	24	317600	295110	CSA-SA
GAP2	Bridging The Gap Between Science, Stakeholders And Policy Makers Phase 2:Integration Of Evidence-Based Knowledge And Its Application To Science And Management Of Fisheries And The Marine Environmen*	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS, UK	39	01-04-11	31-03-15	48	7483566	5913773	CSA-SA
HULDA	Hulda, The European Arts And Sciences Sailing Festival	ILHAN KOMAN KULTUR VE SANAT VAKFI, TURKEY	14	01-05-08	31-12-10	32	1011619	800000	CSA-CA

INPROFOOD	Towards Inclusive Research Programming For Sustainable Food Innovations	UNIVERSITAET HOHENHEIM, GERMANY	18	01-11-11	31-10-14	36	4553171	3893991	CSA-SA
ISWA	Immersion In The Science Worlds Through Arts	UNIVERSITÀ POLITECNICA DELLE MARCHE, ITALY	16	01-03-11	28-12-13	24	1225522	1103791	CSA-SA
MAPPING	Managing Alternatives For Privacy, Property And Internet Governance*	RIJISKUNIVERSITEIT GRONIGEN,NETHERLANDS	13	01-03-14	28-02-18	48	4642522	3995765	CSA-SA
MARLISCO	Marine Litter In Europe Seas: Social Awareness And Co-Responsability*	PROVINCIA DI TERAMO, ITALY	20	01-06-12	31-05-15	36	4544747	4119358	CSA-SA
MY SCIENCE	My Science European Program For Young Journalists	ACCADEMIA EUROPEA PER LA RICERCA APPLICATA ED IL PERFEZIONAMENTO PROFESSIONALE BOLZANO (ACCADEMIA EUROPEA BOLZANO), ITALY	3	01-01-09	30-06-10	18	279779	252612	CSA-SA
NERRI	Neuro-Enhancement: Responsible Research And Innovation*	CIENCIA VIVA, PORTUGAL	17	01-03-13	29-02-16	36	3783868	3312430	CSA-SA
PACITA	Parliaments And Civil Society In Technology Assessment*	FONDEN TEKNOLOGIRÅDET, DENMARK	16	01-04-11	31-03-15	48	5141402	4437730	CSA-SA
PE2020	Public Engagement Innovations For Horizon 2020*	KULUTTAJATUTKIMUS KESKUS, FINLAND	5	01-02-14	31-01-17	36	1229660	999341	CP-FP
PERARES	Public Engagement With Research And Research Engagement With Society	RIJISKUNIVERSITEIT GRONIGEN, THE NETHERLANDS	28	01-05-10	31-10-14	54	3085511	2728041	CSA-SA
PLACES	Platform Of Local Authorities And Cities Engaged In Science	ASSOCIATION EUROPEENNE DES	9	01-06-10	31-05-14	48	5916108	5190000	CSA-SA

		EXPOSITIONS SCIENTIFIQUES, TECHNIQUES ET INDUSTRIELLES, BELGIUM							
R&DIALOGUE	Research And Civil Society Dialogue Towards A Low-Carbon Society*	TRIARII BV,NETHERLANDS	15	01-06-12	31-05-15	36	4482268	4131441	CSA-SA
RELATE	Research Labs For Teaching Journalists	MINERVA CONSULTING & COMMUNICATION, BELGIUM	5	01-02-09	31-01-11	24	345982	312709	CSA-SA
ROBOLAW	Regulating Emerging Robotic Technologies In Europe: Robotics Facing Law And Ethics	SCUOLA SUPERIORE DI STUDI UNIVERSITARI E PERFEZIONAMENTO SANT'ANNA, ITALY	5	01-03-12	31-05-14	26	1908342	1497966	CSA-SA
SATORI	Stakeholders Acting Together On The Ethical Impact Assessment Of Research And Innovation	UNIVERSITEIT TWENTE, NETHERLANDS	16	01-01-14	30-09-17	45	4723129	3662800	CSA-SA
SCICAFE	Scicafe: The Science Cafes Network	IKNOWHOW INFORMATICS, GREECE	14	01-09-09	31-08-12	36	916704	798862	CSA-CA
SCICOM	European Network Of Science Centres In Communicating Energy-Related Topics	WELIOS BETRIEBS GMBH, AUSTRIA	11	01-04-08	31-07-11	40	1000927	894609	CSA-CA
SEISMIC	Societal Engagement In Science, Mutual Learning In Cities*	AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH, AUSTRIA	13	29-10-13	28-10-16	36	3358158	2995118	CSA-SA
SFS	Sea For Society*	SOCIETE D'EXPLOITATIO DU CENTRE NATIONAL DE LA MER, FRANCE	20	01-06-12	30-11-15	42	4893285	4259077	CSA-SA
SIforAGE	Social Innovation On Active And Healthy Ageing For Sustainable	UNIVERSITAT DE BARCELONA, SPAIN	19	01-11-12	31-10-16	48	4093588	3484788	CSA-SA

	Economic Growth*								
SISCATALYST	Sis Catalyst: Children As Change Agents For The Future Of Science In Society*	THE UNIVERSITY OF LIVERPOOL, UK	19	01-01-11	31-12-14	48	4561513	4090120	CSA-SA
STUDIOLAB	Studiolab - A New European Platform For Creative Interactions Between Art And Science	THE PROVOST FELLOWS & SCHOLARS OF THE COLLEGE OF THE HOLY AND UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN, IRELAND	14	01-07-11	30-06-14	36	1652634	1496348	CSA-SA
SYN-ENERGENE	Synthetic Biology – Engaging With New And Emerging Science And Technology In Responsible Governance Of The Science And Society Relationship*	KARLSRUHER INSTITUT FUR TECHNOLOGIE, GERMANY	28	01-07-13	30-06-17	38	4590081	3960810	CSA-SA
VOICES	Voices	ASSOCIATION EUROPEENNE DES EXPOSITIONS SCIENTIFIQUES, TECHNIQUES ET INDUSTRIELLES, BELGIUM	1	16-01-13	15-07-14	18	1629969	1496624	CSA-SA

Source: CORDIS Open Data - provisional list to be refined for the Stocktaking Final Report

* Project under execution

**CSA-SA: Support actions ; CSA-CA: Coordination (or networking) actions; CP: Collaborative project (generic); CP-FP: Small or medium-scale focused research project

3 Gender Equality

Rossella Palomba
Institute for Population Research and Social Policies,
National Research Council of Italy

Abstract

The European Commission started discussing the issue of women in science over 20 years ago. Several millions EUR have been invested by European Commission in the promotion of gender equality in science and in modernising research institutions and universities from a gender perspective. While progress has been made in reducing gender imbalances, changes come about very slowly. The gendering of innovation policies is still lacking behind; the question of re-addressing power in governing research bodies is far to be solved. Gendering research policy relies on a soft-policy mode i.e. it is based on the good-will of member states, stake-holders, managers of research institutions. Gender equality is one the six pillars RRI is built on, and we are confident that RRI will let scientific community thoroughly understand the relevance of implementing a gender-sensitive science.

3.1 EU Strategy on Gender Equality

Equality between women and men is a fundamental principle of Community law. The European Union's objectives on gender equality are to ensure equal opportunities and equal treatment for women and men, and to combat any form of discrimination on the grounds of gender. With the entry into force of the Treaty of Amsterdam in 1999, the promotion of equality between men and women throughout the European Community became one of the essential tasks of the EU. This principle was reinforced by the Treaty of Lisbon (2007/2009) that in the paragraphs on the values and objectives preceding the Treaty, made explicit reference to equality between women and men and to the furtherance of such by the EU. The promotion of equality between women and men was also listed among the tasks of the Union, together with the obligation to eliminate inequalities and to promote equality between men and women in all of the Union's activities. Thus, the Lisbon Treaty clearly underlines the obligation of gender mainstreaming for the Union.

The European Commission started discussing the issue of women in science over 20 years ago. It has been a long path since then and remarkable progress has been made on the grounds of gender equality in science. Despite the progress that has been achieved, gender inequalities in science tend to persist. In 2010, while 59 percent of EU graduate students and 46 percent of EU PhD graduates were female, only 33 percent of active researchers and 20 percent of full professors were women (European Commission, She Figures 2012).

Faced with this unacceptable and unaffordable waste of human resources in research and technological development, the European Commission has made considerable effort to promote more systematic participation of women in every sector and aspect of scientific activities and research management: project activities, presence of women in advisory boards and evaluation

committees, career advancements, creation of networks, setting targets of women, just to mention some of them.

BOX 3.1 What is gender mainstreaming?

"Mainstreaming a gender perspective is the process of assessing the implications for women and men of any planned action, including legislation, policies or programmes, in any area and at all levels. It is a strategy for making the concerns and experiences of women as well as of men an integral part of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres, so that women and men benefit equally, and inequality is not perpetuated. The ultimate goal of mainstreaming is to achieve gender equality."

July 1997, the United Nations Economic and Social Council

There is no doubt that the European Commission has been a pioneer in implementing gender mainstreaming in science over the years. In order to do so, a number of Expert Groups were charged with deepening various topics linked to women in science, and received support from the European Commission. The results of the debate within the Expert Groups have been collected in various reports and discussed in numerous workshops and conferences. Among others, are the ENWISE report (2003), the Gender and Excellence in the Making report (2004), the WIRDEM report (2008), the Benchmarking report (2008), and last but not least the ETAN report (2000). Their conclusions and recommendations have contributed to enriching the knowledge base on women scientists' situation as well as identifying and reviewing positive actions and gender equality measures at the institutional and national levels that may help the Commission in setting the political agenda.

In the Sixth Framework Programme (FP6), a specific budget for funding projects focusing on women in science was made available within the Science and Society sub-programme of the 'Structuring the ERA' programme. This dedicated budget was maintained and increased in the Seventh Framework Programme (FP7). Over the years, the European Commission has invested almost 20 million EUR in FP6 and almost 40 million EUR in FP7 on 'Women in Science'.

A timeline of the relevant initiatives undertaken by the European Commission in the field of gender equality and gender mainstreaming is presented and commented upon below.

3.1.1 The ETAN Report

In 1998, the Directorate General for Research of the European Commission set up the expert group 'European Technology Assessment Network (ETAN)', in order to explore the issue of women and science in the EU and make recommendations for change. The ETAN group produced a report of paramount importance in promoting activities aimed to increase the awareness about the under-representation and under-promotion of women in the research sector and finalizing the European Commission's agenda on gender equality in research.

The ETAN report identified three major strategic objectives to be fulfilled in order to promote female scientists. These strategic objectives were the following:

- Raising awareness about the situation of women in science.
- Empowering women in science, engineering, and technology.
- Mainstreaming gender in all other policies, specifically research.

To achieve these recommendations, under FP6, DG Research launched a series of activities, namely funding research projects, convening Experts' Groups, and promoting gender statistics collection.

3.1.2 The Helsinki Group on Gender in R&I

In November 1999, the advisory group called 'the Helsinki Group on Women and Science'was established with the tasks of monitoring the implementation of the 'gender priority' (i.e. gender equality and gender mainstreaming in research). Over the years, the mandate of the Helsinki Group has been enlarged and reinforced (European Commission2010). Currently the Helsinki Group provides an important forum for dialogue about national policies and for sharing and comparing experiences. The members of the Helsinki Group are representatives of Member States and Associated Countries.

3.1.3 Facts and Figures: the She Figures.

Sex-disaggregated statistics are crucial for monitoring the participation of women and men at different seniority levels, sectors, and scientific fields in European Research. In 1999 the information need in terms of primary statistics in European research, was identified. At that time, no systematic or centrally co-ordinated collection of sex-disaggregated data on R&D staff existed at the European level. A programme of statistical work was therefore initiated and the group of Statistical Correspondents was created as a subgroup of the Helsinki Group on Women and Science in 2001. This activity has stimulated a number of publications, including She Figures, which contains the widest collection of European data on women and science ever produced. The first issue of She Figures was published in 2003. Since then, She Figures has been issued every 3 years, presenting data and indicators on the situation of women in science. She Figures 2015 is now under preparation.

3.1.4 Networking

A relevant activity supported by the European Commission was networking. In July 1999, the representatives of networks of women scientists and organisations – committed to the improvement of the gender balance in research policy – met in Brussels (see Declaration of Networks Active in Europe 1999). The networks recognised the rationale of the networking of women scientists in order to:

- support, enhance, and empower members in their careers;
- inform, encourage, and motivate young girls to choose scientific subjects;
- make scientific careers more attractive;
- provide a database of role models and mentors for individuals and organisations that require them;

- take part in decision-making processes to contribute to the shaping of scientific institutions and their culture;
- lobby and take part in policy processes in order to improve the gender balance in research and research policy as well as the position of women in science and science policy.

The networks recommended 'the creation of a European network of networks on women and science that should regroup existing networks of women scientists and organisations committed to the improvement of the gender balance in research policy from the European Union and from Eastern and Central Europe'.

In 2005, the European Platform of Women Scientists(EPWS) was funded. The EPWS was economically supported by the European Commission until 2009 and is now working on a voluntary basis. In 2006 BASNET, the Baltic States Network 'Women in Sciences and High Technology' was also funded by the EC in order to create monitoring and information systems on Women in Sciences and High-Technology and to concentrate interdisciplinary efforts on formulating the common Baltic States science strategy. The European Commission supported BASNET until the end of 2007.

Recently, in the field of networking, COST – the intergovernmental framework for European Cooperation in Science and Technology – launched a new initiative (genderSTE) that is intended to advance the state of the art in knowledge and policy implementation on gender, science, technology, and engineering by creating a network of policy-makers and experts on these topics. In particular, it will enhance the implementation of gender-focused policy measures for structural change in science and technology institutions and the integration of sex and gender dimensions in the content of science and technology.

Finally, in 2013 the European Commission funded the project 'GenPORT: An internet portal for sharing knowledge and inspiring collaborative action on gender and science'. The portal will become active in 2016 and aims to create an internet-based community of practice on gender equality in science, technology, and innovation.

3.1.5 Action Plan on 'Women and Science'

In 2001, an Action Plan on Women and Science was launched that set out a strategy to promote research by, for, and about women, in co-operation with Member States and other key actors. The rationale for the adoption of the Action Plan was the following: 'If society as a whole is to better understand and accept the developments in science and technology, specific measures must be taken to address both the under-representation of women in science, and the lack of attention paid to gender differences within research.'

The European Commission launched the strategy of 'research by, for, and on women' with the final goal of providing a solid basis for the promotion of gender equality within the European Research Area.

Research 'by' women means the promotion of women both as research workers and within the consultation and implementation processes of the Framework Programmes. This includes ensuring

that women are informed about the schemes and programmes intended to increase their participation, and to promote equal opportunities between women and men. Research 'for' women implies that the gender dimension needs to be taken into account when compiling and implementing work programmes to ensure that research meets the needs of all citizens, both men and women. Research 'on' women is concerned mainly with supporting gender-relevant research and contributing to enhancing the understanding of the gender question itself (European Commission 2001).

A Gender Action Plan (GAP) outlining how the gender dimension will feature in actual research content was made compulsory for all of the so-called integrated projects and networks of excellence in FP6. Each GAP should include information about how the gender dimension will be integrated in the research content. It could also include the use of gender awareness groups to encourage networking and mentoring activities. Too often, however, the quality of GAPs was not decisive in the funding decision and, in FP7, the GAP requirement was eliminated.

3.1.6 Interim Report of the FP7 Evaluation

Despite the wide range of initiatives to support women scientists, slow progress has been made towards real gender equality in science. In the Interim Report of the FP7 evaluation, the authors highlighted that 'The goal of boosting female participation has made some progress, but the glass ceiling alluded to in the final evaluation of FP6 still seems to be intact .... the goal of 40 per cent participation is some way from being met. Behind the data on participation rates, lies the fact that women comprise only some 30 per cent of the research base in the Member States. This means that the target will be very difficult to reach and highlights the need for initiatives at Member State level to increase female participation in research. Women are also under-represented in certain disciplines and at the most senior levels'.

Following the recommendations of the Interim FP7 Evaluation Expert Group, the European Commission accepted the challenge of taking a leading role in increasing the participation of women in FP7 and launching'… new analyses with the support of Member States and research institutions to identify, by the end of 2011, the cultural and situational factors which help shape female researchers' participation, as well as measures to overcome these' (European Commission 2011a).

3.1.7 A New Strategy: Shifting Towards 'Fixing the Institutions'

A new strategy was adopted for FP7. The new focus for activities is on research institutions and organisations where women scientists work. 'Fixing the administrations' (Schiebinger 2007), i.e. analysing the way that universities and research organisations are managed from a gender point of view, became the new objective. This is called 'Structural Change' and it is focussed on modernising the organisational culture of academic administration of universities, research institutions, and funding bodies, in order to let them become more gender-aware and ready to remove obstacles to women's professional careers.

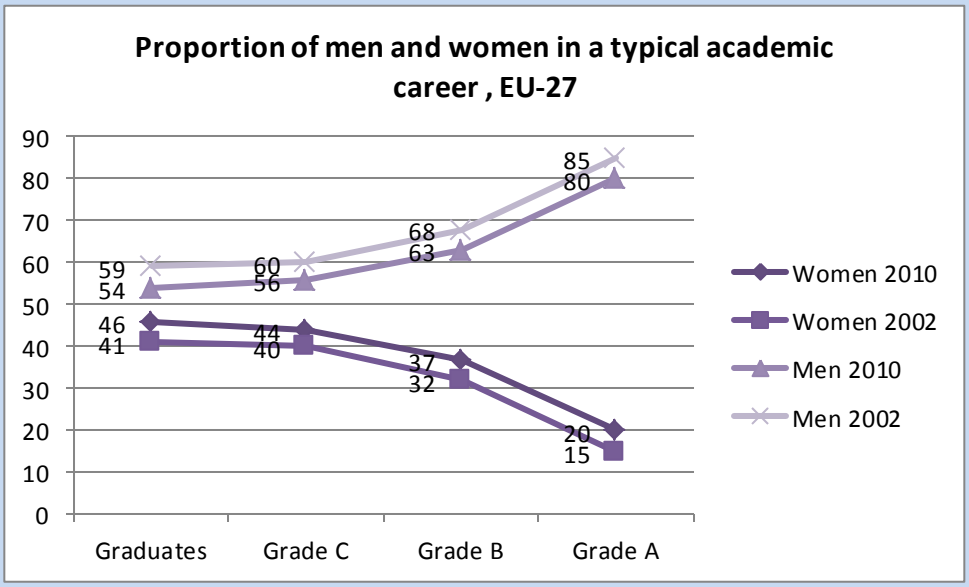
This change in strategy had a clear impact on the objectives indicated in the calls for proposals, concerning funding projects, conferences and networks, and on the organisational structure of DG Research and Innovation.

3.1.8 Gender as a Cross-Cutting Issue in H2020

In view of the new Framework Programme Horizon 2020 (H2020), the European Commission noted that, 'in spite of national and EU-level strategies on gender equality, European research still suffers from a considerable loss and inefficient use of highly skilled women. The annual increase in female researchers is less than half the annual number of female PhD graduates and too few women are in leadership positions or involved in decision-making' (European Commission 2012).

BOX 3.2 Slow progress

"In the absence of proactive policies, it will take decades to close the gender gap and bring about a higher degree of gender equality."



She Figures 2012

Therefore, the European Commission has taken the commitment to end the waste of female talents and 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.' The Commission has also renewed its commitment to ensuring that 40 per cent of the under-represented sex appears in all of its expert groups, panels, and committees, and it will apply this particularly under Horizon 2020.

In the Framework Programme Horizon 2020, gender is 'a cross-cutting issue', meaning that it is 'mainstreamed in each of the different parts of the Work Programme, ensuring a more integrated approach'. In addition, 'The gender dimension is explicitly integrated into several topics across all the sections of the Work Programme. An in-depth understanding of men and women's needs, behaviours and attitudes contributes to the scientific quality and societal relevance of produced

knowledge, technologies and innovations. It also contributes to the production of goods and services better suited to potential markets' (European Commission 2013). It is too early to evaluate the impact of this position on actual projects, funding, and the promotion of women. We hope to see real and remarkable progress in gender equality in science under H2020.

The table below displays the major steps undertaken so far (Table 3.1).

Table 3.1 - EU relevant steps in the field of women in science

1999	Commission Communication on *Women and Science* is published
1999	Council Resolution on *Women and Science* is adopted
1999	Helsinki Group is established
2000	ETAN-European Technology Assessment Network Report is published
2002	Report on *National Policies on Women and Science in Europe* by Helsinki Group is published
2003	WIR-Women in Industrial Research Report on *Women in Industrial research is published*
2003	The first issue of the report SHE FIGURES is published
2004	ENWISE-Enlarge Women in Science to East Report *Waste of talents: turning private struggle into public issue*
2004	European Commission report on *Gender and excellence in the making is published*
2005	EPWS - European Platform on Women in Science is established
2008	WIRDEM-Women in Research Decision Making Report *Mapping the Maze*
2008	European Commission report on *Benchmarking Policy Measure for Gender Equality in Science is published*
2009	Commission report on *The Gender Challenge in Research funding: assessing the European national scenes is published*
2010	*Stocktaking 10 years of "Women in Science" policy by the European Commission 1999-2009 is published*
2011	European Commission Communication on *Response to the Report of the Expert Group on the Interim Evaluation of the Seventh Framework Programme is issued*
2012	European Commission Report on *Structural Change: Enhancing Excellence, gender equality and efficiency in research and innovation is issued*
2012	The fourth issue of the report SHE FIGURES is published
2013	European Commission Report on *Gendered innovations: how gender analysis contributes to research is issued*
2014	Report Gender Equality Policies in Public Research is issued

3.2 A 'Snapshot' of Research Projects dealing with Gender in Science

3.2.1 The Activities Carried out Under FP6

In FP6-Science and Society programme, 33 research projects were funded under the 'Women and Science' programme, most of them which dealt with raising awareness about women's participation in science (i.e. through conferences and reports) and establishing concrete structures (i.e. databases, centres, platforms) that can provide the basis for long term strategies and measures to promote women's participation in research. The primary target audience were women scientists, but in order

to address the gender dimension of the whole research system, the general public, research communities, media, and the private sector were also included to a lesser extent (European Commission 2010).

The calls for proposals and the consequent funded projects disentangled the objective of awareness raising in various ways. The focus was mainly on mainstreaming gender equality in scientific institutions through in-depth analysis of the career paths of women and men. Attention was paid to the so-called 'working culture' and the existing practices in recruitment and employment of scientists in view of highlighting areas of potential gender bias.

Innovative pilot studies and surveys, designed to complement and enhance existing knowledge, and to open up new perspectives for further in-depth work in the field of women in science, were funded. These data collections included the use of new data sources, the undertaking of feasibility studies, and proposals of new methodologies.

A number of projects have developed mentoring schemes. Attention was also paid to role models in science, through a specific call concerning 'Ambassadors for Women and Science', looking at establishing policies favourable to female researchers.

Under FP6-SiS programme women scientists working in the private sector, and particularly in industrial research, were given attention by the Commission (European Commission 2003). The scarce presence of women in industrial research was studied by specific research projects, discussed in public conferences, and recommendations for improvement were posed to the relevant stakeholders.

Following the European Commission's strategy on gender equality, the calls for proposals and the funded research projects tackled the issue of women's empowerment and the promotion of the participation of women in science decision-making and science policy definition. The aim was to stimulate mechanisms for involving women scientists more actively in research management and policy definition at both the national and European levels. Practical tools for mainstreaming and monitoring gender equality were developed and discussed.

Media awareness regarding gender stereotypes and the visibility of women in science on TV were issues also considered, and in particular, pertinent ways of fighting stereotypes were discussed; for instance, presenting female role models in science, engineering, and technology could encourage young women to embark on scientific careers.

The promotion of gender equality in science was also dealt with by developing gender budgeting instruments in science. The focus of gender budgeting is to discuss the effects of public budgets with respect to equal opportunities for women and men and the transfer of gender mainstreaming to budget policies and to the process of controlling budgets. A research project was funded under FP6-SiS programme with the final aim of developing operational instruments for defining a gender sensitive budgeting process and gender equality auditing.

Altogether, the initiatives taken under the FP6-SiS programme concerning women in science covered a vast area of knowledge. The calls for proposals, the funded projects, networks, and conferences seem to be driven by the willingness to illuminate the issue of women in science, which

was a relatively little known area, and to analyse those sectors that are relevant for EU policy but scarcely investigated from a gender point of view. We found studies on women in the construction sector, agriculture, life sciences, information technologies, engineering, women as patent originators, just to make some examples. The common feature resulting from all of these studies was the scarcity of women at any level of the career ladder and the need for positive action programmes and equal opportunities policies. The best practices that were identified could not easily be transferred from one sector to another.

The evaluation report carried out at the end of the Sixth Framework Programme highlighted that only 16-17 per cent of the scientific coordinators and scientists in charge of FP6 funded projects were women, a percentage that falls well below the 40 per cent target. SiS-Science and Society was the only programme in which the target was reached for female researchers comprised 41 per cent of the coordinators and scientists in charge(European Commission 2008). In the Women in Science area, the overwhelming majority of coordinators and scientists in charge were women.

3.2.2 The Activities Carried out Under FP7

Under FP7-Science in Society programme, 25 research projects dealing with 'Gender in Science' were funded (three research projects started at the beginning of 2014). The calls for proposals showed a clear change in the attention and interest of the European Commission towards gender diversity management and structural change in research organisations because of the change in the European Commission's strategy towards women in science.

The funded projects aimed to identify and analyse the strategies and commitments taken by public research organisations in order to foster change, in particular in terms of increasing the participation of women at the highest levels of decision-making and career ladder, and the methods used for recruitment and retention of researchers. When applying for projects, universities and research bodies were expected to cooperate on common actions in order to increase the participation and career advancements of women researchers.

Some of the funded projects deal with the implementation of best practices on gender balance in research and higher education institutions. Actions were taken to involve top decision-makers (rectors' associations, ministries, networks of research associations, etc.) in order to obtain their commitment to improve the current situation on gender balance in research positions.

In the calls for proposals, special attention was given to the evaluation of research systems and to the concept of excellence, in order to reinforce the role of women in scientific research, and to enhance the gender dimension of research.

The image of researchers and the stereotypes affecting women in science were also tackled. A project dealing with science centres and museums on women and science was funded, the aim of which was to analyse how much stereotypes and outdated traditions influence the perceptions of women and men in research.

In the framework of international cooperation, the Commission launched a call for proposal enhancing research cooperation on women in science between the European Union and the

Mediterranean countries. One project was funded with the aim to better understand the situation of women in science in Algeria, Egypt, Jordan, Lebanon, Libya, Morocco, Palestinian-administered areas, Syrian Arab Republic, and Tunisia, taking into account cultural diversities and traditions.

Projects dealing with the construction of databases and the implementation of internet portals were also funded, in order to make relevant information concerning women in science accessible in a timely manner, increasing its value and enhancing the potential for its exploitation. Euraxess Portal, one of the funded projects, is a web-based information tool that supports the recruitment and mobility of women researchers across Europe. Created in 2008, the portal allows users to contact a network of more than 200 centres located in 35 European countries.

In comparison to FP6, fewer projects were funded under FP7, however each received more money, and there was a greater selection for projects that focused on the main strategic objective of the European Commission i.e. structural change. The evaluation of FP7 is not yet finalised. Following the recommendations posed by relevant influential bodies and national governments, in Horizon 2020 gender equality is a cross-cutting issue and will be implemented across and within the priorities of the programme. Horizon 2020 will also ensure the effective promotion of gender equality and the gender dimension in research and innovation content.

3.3 Best Practices

Many universities and research institutes, thanks to projects funded by the European Commission, have already started tackling gender equality issues, with the aim of redressing gender inequalities, and encouraging women to reach their full potential as scientific researchers. The majority of these initiatives may be considered best practices according to the following standard definition:a project gains the status of best practice when is*: measurable*(i.e.its goals are clear and the progress toward them can be measured), *notably successful* (i.e. it gains good results, and makes more progress towards achieving the goals than most others with similar aims), *replicable* (i.e. it is structured and documented clearly enough so that it can be reproducedelsewhere).

BOX 3.3 What is a best practice?

Best practice is a term which is widely used, especially in the realm of public policies, as it provides a link between existing initiatives and policymaking. It is particularly useful in those areas where we are looking for solutions that appear to work for solving specific problems. According to UNESCO 1994, best practices have the following characteristics: they are innovative; they make a difference; they have a sustainable effect; and they have the potential to be replicated and to serve as a model for generating initiatives elsewhere.

Three examples of best practice projects have been identified for this stocktaking publication and they are presented below, keeping in mind that: 1) a best practice is not an absolute standard of successful initiatives, 2) it does not exclude the possibility that other initiatives will be more successful in the future, 3) it does not exclude the possibility that other ongoing initiatives are yet

extremely promising in terms of achieving the status of best practice or they even may be consider best practices.
Having in mind that is not our intention to penalize areas and projects that may well be important, useful, and worth mentioning, the following three projects were selected: PRAGES, GENDERA, and GENSET. The selected projects are strongly coherent with the Commission strategy, represent an undeniable step forward on the issue of gender equality in science, were successful and replicable at some extent. We are aware that recent funded projects are working well towards undeniable successful results; identifying best practices is an ongoing process and in few years or even months wemay arrive to a completely different group of three best projects. To be noted that we consider only successfully completed projects - possibly completed by some years - in order to evaluate their impacts on science policies, stakeholders awareness of gender equality in science and potentiality for changing habits in the scientific community.

3.3.1 PRAGES- Practising Gender Equality in Science.

PRAGES was initiated in 2008 under FP7 and lasted 21 months. It was coordinated by the Department for Rights and Equal Opportunities, the Presidency of the Council of Ministries (Italy), and the Assembly of Women for Development and the Struggle Against Social Exclusion (ASDO, Italy).

Its aim was to investigate strategies, policies, and programmes designed to overcome the under-representation of women in leadership positions in science and technology. It was focussed on the fight against vertical segregation in various professional, political, and social areas and in understanding the reasons for the exclusion of women. The project also compared the various strategies implemented for promoting the presence of women in decision-making positions concerning scientific research in public institutions. PRAGES is a valuable example of a new strategy of action that integrates awareness raising, the empowerment of women, and policy-making.

3.3.2 GENDERA - Changing the Gender Balance in Research Organisations

From 2010 to 2012, GENDERA strived to change the gender balance in Europe-based research organisations. It was coordinated by TETALAP (Hungarian Science and Technology Foundation, Hungary) and funded through the SiS-Programme (FP7). Its main objective was to create 'an enabling environment' to integrate the gender dimension into science policy throughout Europe.

Using the available analyses and recommendations aimed to improve the situation of women in science, GENDERA identified and discussed good practices of gender balance at the national and European levels, both through networking and workshops.

The project aimed to identify factors limiting the participation of women in specific scientific fields as well as in decision-making positions, and introducing real-life implementation examples to top decision makers in research and higher education institutions. The project provided an online database of good practices accessible to everyone. GENDERA is a good example of an awareness raising project that sought to change the attitudes and opinions of decision-makers about the

relevance of gender equality in order to improve the efficiency of the institutions that they are heading and to 'bring to life' the aimed-for structural change.

3.3.3 GENSET - Increasing Capacity for Implementing Gender Action Plans in Science

The project GENSET was coordinated by Portia Ltd (UK) and lasted 3 years from 2009-2012. Its overall aim was to develop practical ways in which gender knowledge and gender mainstreaming expertise can be incorporated within European science institutions in order to improve individual and collective capacity for action that increases women's participation in science. This was achieved by facilitating a sustainable, collaborative dialogue between gender experts and science leaders to agree on practical guidelines for implementing gender action plans within existing institutional mechanisms. The project was very successful and well known amongst scientists and science leaders.

One of its outputs, the GENSET Consensus Report, is an innovative tool that examines gender at the knowledge level, and supports interdisciplinary dialogue between gender experts and people in gatekeeping positions such as university leadership, journal editors, and funding directors.

The project also launched the European Gender Summit, now in its IV edition, which provides a forum for stakeholders from research, industry, and policy to jointly explore how gendered methodologies can stimulate innovation and advance scientific excellence.

3.4 Lessons Learnt

Since the end of the 1990's the European Commission has adopted a formal commitment to gender mainstreaming in science, i.e. the systematic incorporation of gender issues by 'Mobilising all policies and measures specifically for the purpose of achieving equality and by actively and openly taking into account from the planning stage their possible effects on the respective situations of men and women'. In other words, gender should be integrated into the formulation and implementation of all EU policies.

Several million EUR have been invested by the European Commission in promoting gender equality in science and in modernising research institutions and universities from a gender perspective. While progress has been, and is being made, in reducing gender imbalances, changes are occurring only slowly. The actual impact of the European Commission's investment in gender equality and mainstreaming in science has not yet been evaluated.

At the end of Framework Programme FP5, a Gender Impact Assessment regarding some of the funded projects was commissioned. The assessment made clear that gender mainstreaming was missing at the level of individual research projects. The results of the study were useful in including gender issues in EU-funded FP6 projects (European Commission 2001). While the Gender Impact Assessment was continued in FP6 for some thematic fields, there is a strong need for similar studies for FP7 funded projects in order to achieve the goals of H2020 concerning gender equality and gender mainstreaming.

Gender has prominent focus in Horizon 2020, with the European Parliament and Council stating that 'Horizon 2020 shall ensure the effective promotion of gender equality and the gender dimension in research and innovation content' (European Parliament2013). To ensure that this is realised, gender balance in research teams and the integration of the gender dimension in research content will play a part in funding decisions under Horizon 2020. The two aforementioned statements 'imply a greater ambition in reaching a better gender balance in research and innovation than was the case in the 7th Framework Programme'. Ambitions should be mainstreamed into policy actions and activities.

Gendering research policy should rely on a soft-policy mode i.e. based on the goodwill of member states, stakeholders, managers of universities, and research institutions. The major lesson learnt from almost 20 years of commitment of EU towards gender equality in science is that progress is extremely slow. The gendering of innovation policies is still lacking behind; the question of re-addressing power in governing research bodies is far from being solved; some of the policies or measures implemented show no clear correlation with the presence of women in science.

Universities and research institutions play an important role in the transformation of societies as they contribute to social, economic, cultural, and political change. They should become aware that achieving gender balance in their management and funding bodies, and including gender equality in every action they implement is not only possible but also rewarding, at least in term of efficiency and performance.

Gender is a self-evident aspect of societal diversity and is as such a major source of creativity, discovery, and innovation acting as an important factor in quality. 'From a larger societal perspective, a balanced gender representation contributes to excellence in research, positively influences research outcomes and impact, and promotes the acceptance of scientific insights, thereby reaffirming the credibility of universities and strengthening their societal role' (LERU 2012).

Awareness raising is a fundamental pre-requisite for every action we want to implement in the field of gender equality. In analysing the projects funded under FP6-FP7, we noticed that there are areas of knowledge still scarcely investigated from a gender point of view and that require more attention from the EU (e.g. food, agriculture, energy, tourism, governance, and pharmaceutics).

Gender statistics and indicators, Gender Impact Assessment, gender awareness, and Gender Action Plan, were and are leading to progress towards gender equality in science and should be reinforced. Gender budgeting is still lacking on EU-funded projects, although it may have relevant effects, because it incorporates a gender equality perspective into the budgeting process and the policies that underpin it in order to promote equality between women and men.

Cultural change is complex, all encompassing, slow, and hard to measure. Ways have to be found to prioritize amongst the important elements which further structural change in higher education and research institutions and those that are rather more marginal in terms of moving towards gender equality (Müller et al. 2011). Local and small-scale initiatives seem to have a more decisive impact on women's participation in science than large-scale programmes. At the same time, uncoordinated initiatives by governments, research funders and individual universities may create confusion.

Strengthening the learning process across many specific and short-term initiatives may help to make steps forward towards gender equality in science.

3.5 Towards more gender equality in Research & Innovation: the RRI challenge

Responsible Research and Innovation (RRI) is a comprehensive approach to scientific research that aims to engage societal actors – from researchers to policy makers,citizens, entrepreneurs, etc. –in the research and innovation process, in order to ensure that the results meet the needs of the world we live in.The very objective of RRIis to better coordinate and align both the process and the outcomes of research and innovation, with the values, needs, and expectations of our society. As a result, the dialogue between science and the rest of society has never been more important, as in the Europe 2020 Strategy.

The need to adapt and tailorthe innovation process to societal needs is expected topositively affect gender equality in science, ensuring both gender equality in research careers and in the development of research content. Gender equalityis one the six pillars RRI is built on, and we are confidentthat RRI may be a way to let scientific community thoroughly understand that: 1) gender equality offers fresh competitive advantages to European research; 2)gender perspective is relevant when developing scientific products, processes and services.

Amongst other topics, the Rome SiS-RRI Conference focussed on the need for gender equality in science. There wasa dedicated session, the issue was debated during formal and informal meetings, recommendations to the EU Commission werepresented. In addition, specific attention for gender equality issue, dimension and perspective was included in the Rome Declaration.

Across all the debate and papers' presentation at the session on gender equality, a number of key messages emerged that were presented to the plenary session and forwarded to EU Commission. The key messages focussed on the following main areas: gender dimension in scientific research, gender monitoring of scientific performance and outcomes, EU more pro-active role in stimulatingmember states to implement gender equality policies and gender action plans.

The integration of gender perspective within scientific process and outcomes is recognised asa relevant tool that works to build a culture of gender sensitivity across research institutions and scientific departments. Due attention should be paid to the gender dimension of science so that projects that do not consider gender in design, content, methodology and outcomesshould not be considered for funding without adequate justifications. To undertake research on a single sex and apply the results to both is poor science. The presence of gender experts alongsideexperts in other disciplines, for example duringprojects' evaluation phase, may avoid gender bias in process and outcomes of research activities.

There is a strong need for an effective monitoring of RRI approach as well as in Horizon 2020 to makegender equality a valuable cross-cutting issue. RRI requires the capacity to change and shape existing routines of thought and behaviour; it also needs that the overarching organizational structures and systems adapt themselves in response to new insights and values. Gender equality

plays a crucial role in this process of transformation of European scientific environment and may well be consider a prerequisite for, rather than a result of, the RRI approach. Monitoring of programmes, projects, results, systems and tools concerning RRI from a gender perspective and track progress towards gender equality helps to create a gender-responsive science.

Finally, during the gender equality session, it has been stressed the need for EU to be more active and pro-active in the field of gender equality actions. Some European countries implemented gender equality plans within research institutions and universities. Gender action plans are legally required in few European countries; other countries make gender equality action plans optional. Over the time, the gap between countries active in the field of gender equality and relatively inactive countries seems to widen (Lipinsky 2014). It is therefore extremely important that the EU takes a more active role in stimulating member states to take initiatives and actions in the field of gender equality in science and monitoring progress towards gender mainstreaming objectives.

The issue of gender equality tends to stir up emotions, since it often gets to people at a personal level. This may create tensions that can be easily overcome if we researchers maintain objectivity and fairness as fundamental points of reference for our judgements and behaviour. RRI may well be of great help in this respect because 'it is strongly and inherently associated with the fundamental rights and values of Europe' (Strand 2014). The coming years will be a good field test for gender equality becoming an integral part of our societal, political and scientific behaviour and gender mainstreaming an indisputable reality.

References chapter3

Communication from the Commission. 1996. "Incorporating equal opportunities for women and men into all community policies and activities." COM/96/0067.
http://europa.eu/legislation_summaries/employment_and_social_policy/equality_between_men_and_women/c10921_en.htm

Communication from the Commission.1999. "Women and Science - Mobilising women to enrich European research." COM/99/76.
http://europa.eu/legislation_summaries/employment_and_social_policy/equality_between_men_and_women/c10930_en.htm

Commission Report. 2012. "Structural Change: Enhancing Excellence, gender equality and efficiency in research and innovation."
http://ec.europa.eu/research/science-society/document_library/pdf_06/structural-changes-final-report_en.pdf

Declaration of Networks active in Europe.1999 "Women and Science: networking the networks, Brussels, July 8-9."
ftp://ftp.cordis.europa.eu/pub/improving/docs/women_dec.pdf

European Commission. 2000. "Science Policies in the European Union: Promoting Excellence through Mainstreaming Gender Equality, Luxembourg."
ftp://ftp.cordis.europa.eu/pub/improving/docs/g_wo_etan_en_199901.pdf

European Commission. 2001. "Gender Impact Assessment of the Specific Programmes of the Fifth Framework Programme, Luxembourg": European Commission
http://ec.europa.eu/research/science-society/pdf/women_gender_impact_fp5_en.pdf

European Commission. 2003. "Women in Industrial Research – A wake-up call for European industry, Luxembourg." European Commission
http://ec.europa.eu/research/science-society/pdf/documents_women_sec2_en.pdf

European Commission. 2008. "Gender Equality Report Sixth Framework Programme, Luxembourg." European Commission
http://ec.europa.eu/research/science-society/document_library/pdf_06/gender-equality-report-fp6-final_en.pdf

European Commission. 2010. "Stocktaking 10 years of "Women in Science" policy by the European Commission 1999-2009, Luxembourg." European Commission
http://ec.europa.eu/research/science-society/document_library/pdf_06/stocktaking-10-years-of-women-in-science-book_en.pdf

European Commission. 2011a. "Communication from the Commission to the European Parliament, the Council, the European economic and social Committee and the Committee of the regions", COM/2011/ 52 final.
http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/commission_response_fp7_ie_report_2011.pdf

European Commission. 2011b. "Proposal for a Regulation of the European Parliament and the Council establishing Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020)", COM/2011/809 final.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0809:FIN:en:PDF

European Commission. 2012. "Communication from the Commission to the European Parliament, the council, the European economic and social Committee and the Committee of the regions", COM/2012/392 final.
http://ec.europa.eu/euraxess/pdf/research_policies/era-communication_en.pdf

European Commission. 2012. "She Figures." European Commission
http://ec.europa.eu/research/science-society/document_library/pdf_06/she-figures-2012_en.pdf

European Commission. 2013. "Horizon 2020, Work programme 2014-2015, Decision 8631 of 10 December."
http://ec.europa.eu/research/participants/portal/doc/call/h2020/common/1587809-18._general_annexes_wp2014-2015_en.pdf

European Parliament. 2013. "Text Adopted at the sitting of 21 November."
http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+20131121+SIT-03+DOC+WORD+V0//EN&language=EN

Helsinki Group. 2009. "Position paper on Gender and Research Beyond 2009."
http://ec.europa.eu/research/science-society/document_library/pdf_06/gender-and-research-beyond-2009_en.pdf

LERU. 2012. paper on "Women, research and universities: excellence without gender bias."
http://www.ub.edu/farmacia/recerca/LERU/LERU_Paper_Women_universities_and_research.pdf

Müller, Jorg et al.2011. "Policy towards gender equality in science and research." *Brussels economic review* , 54 (2/3): 295-316

Report of the Expert Group. 2010. "Interim Evaluation of the Seventh Framework Programme."
http://ec.europa.eu/research/evaluations/pdf/archive

Schiebinger, Londa. 2007. Keynote at the conference "Gender issues in research – Innovation through equality of opportunity", Berlin, April 18-19.
- http://ec.europa.eu/euraxess/index.cfm/general/newsletterEU4RIssue/11_02

Annex 3-Main Projects in the Gender Equality Area.

FP6 projects

Project Acronym	Project Title	Coordinator (Name of Organitation and Country)	Number of Partners Involved	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type**
ADVANCE	ADVanced TrAining for WomeN in ScientifiC REsearch	UNIVERSITÄT FÜR WEITERBILDUNG KREMS, AUSTRIA	6	01-09-2006	31-08-2008	24	456 165	456 165	SSA
BASNET	BALTIC STATES NETWORK "WOMEN IN SCIENCES AND HIGH TECHNOLOGY	UNIVERSITAS VILNENSIS, LITHUANIA	10	01/01/2006	31-12-2007	12	393 600	393 600	SSA
CECWYS	Central European Centre for Women and Youth in Science	INSTITUTE OF SOCIOLOGY OF THE ACADEMY OF SCIENCES OF THE CZECH REPUBLIC, CZECH REPUBLIC	7	01/03/2004	28-02-2007	36	699860	699860	SSA
DATAWONSCI	Study on databases of women scientists	RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAET BONN, GERMANY	6	01-04-2004	31-01-2005	9	139434	139434	SSA
DIVA	Science in a different voice	CNR- NATIONAL RESEARCH COUNCIL, ITALY	1	19-09-2005	18-09-2007	24	116139	116139	SSA
ELSA	Excellence in the Life Sciences Area	KAROLINSKA INSTITUTET, SWEDEN	1	01-04-2006	31-01-2007	12	90505	90505	SSA
ENCOUWOMSCI	Encouragement to Advance - Training Seminars for Women Scientists	GESIS - GESELLSCHAFT SOZIALWISSENSCHAFTLICHER INFRASTRUKTUREINRICHTUNGEN E.V,	1	01-10-2006	31-12-2008	24	470080	428080	SSA

		GERMANY							
ERA-GENDER	Women in Science: Mainstreaming gender equality in the European Research Area	UNIVERSITA' DEGLI STUDI ROMA TRE, ITALY	1	01-09-2003	29-02-2004	5	39855	39855	SSA
ESGI	European Study of Gender Aspects of Inventions - Statistical survey and analysis of gender impact on inventions	HOCHSCHULE FURTWANGEN UNIVERSITY, GERMANY	1	01-10-2006	31-01-2009	26	374908	374908	SSA
ENWISE ETHICS	Starting a Debate with Women scientists from Post-communist Countries on Ethical Issues	HUNGARIAN SCIENCE AND TECHNOLOGY FOUNDATION, HUNGARY	1	01-06-2003	31-08-2004	14	49296	49296	SSA
EUMENT NET	Building a European Network of Academic Mentoring Programmes for Women Scientists	UNIVERSITE DE FRIBOURG, SWITZERLAND	6	01-01-2007	30-09-2008	20	514761	514761	CA
EUROWISTDOM	European Women in Science TV Drama on Message	FEMTEC HOCHSCHUL KARRIEREZENTRUM FUER FRAUEN BERLIN GMBH, GERMANY	5	01-10-2006	30-/09-2007	12	319300	319300	SSA
FEMSTART	Fostering the public debate on university support of female scientists to start a business	STEINBEIS-EUROPA-ZENTRUM DER STEINBEIS-STIFTUNG FÜR WIRTSCHAFTSFÖRDERUNG, GERMANY	7	01-09-2006	28-02-2009	28	303740	303740	SSA
GAPP	Gender Awareness Participation Process: Differences in the choices of science careers	FONDAZIONE IDIS - CITTÀ DELLA SCIENZA, ITALY	6	01-01-2007	31-12-2008	24	808380	808380	SSA
GB-Management	Gender Budgeting as an instrument for managing scientific organisations to promote equal opportunities for women and men - with the	FRAUENAKADEMIE MUENCHEN E.V., GERMANY	4	01-09-2006	31-08-2008	12	215250	218850	SSA

	example of universities								
GENDERBASIC	Promoting the integration of the gender dimension in basic research in ERA/FP7	UNIVERSITEIT MAASTRICHT, NETHERLANDS	1	01-10-2005	31-12-2007	27	209782	209782	SSA
IFAC	Information for a choice: Empowering young women through learning for technical professions and science careers	NATIONAL ACCREDITATION CENTER FOR CONTINUING VOCATIONAL TRAINING, GREECE	10	01-10-2006	30-09-2008	24	1000000	1000000	CA
KNOWING	Knowledge, Institutions and Gender: an East-West comparative study	INSTITUTE OF SOCIOLOGY OF THE ACADEMY OF SCIENCES OF CZECH REPUBLIC, CZECH REPUBLIC	8	01-01-2006	31-12-2008	24	984107	984107	STREP
NEWS	Network on ethnicity and women scientists	UNIVERSITE LIBRE DE BRUXELLES, BELGIUM	8	01-01-2006	31-12-/2007	12	172346	172346	SSA
PALLAS ATHENE	Ambassadors for women and science - Use of best practice instruments to strengthen women in research	DEUTSCHES KREBSFORSCHUNG SZENTRUM, GERMANY	6	01-11-2005	31-10-2007	24	220000	220000	SSA
PLATWOMSCI	European Platform of Women Scientists	GESIS/GESELLSCHAFT SOZIALWISSENSCHAFTLICHER INFRASTRUKTUREINRICHTUNGEN, GERMANY	4	01-02-2005	31-10-2008	44	1988010	1988010	SSA
PROMETEA	Empowering Women Engineers Careers in Industrial and Academic Research	CONFÉRENCE DES DIRECTEURS D'ECOLES ET FORMATIONS D'INGÉNIEURS, FRANCE	19	01-11-2005	31-12-2007	26	1474471	1220000	STREP
SET-Routes	A pan-European women ambassadors programme bringing role models to schools	EUROPAISCHES LABORATORIUM FUER	3	01-11-2006	30-/04-2009	40	533200	533200	SSA

	and universities to stimulate and mobilise girls and young women for studies and careers in SET	MOLEKULARBIOLOGIE – EMBL, GERMANY							
TANDEMplusIDEA	Information for a choice: Empowering young Women Through Learning for Technical Professions and Science Careers	RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN (RWTH), GERMANY	4	01-04-2007	31-03-2010	36	466020	466020	CA
TRANSGEN	Gender Mainstreaming European Transport Research and Policies. Building the Knowledge Basis and mapping good practices	KOBENHAVNS UNIVERSITET, DENMARK	1	01-10-2006	30-09-2007	12	160211	160211	SSA
UNICAFE	Survey of the University Career of Female Scientists at Life Sciences versus Technical Universities	TUDOMANYOS ES TECHNOLOGIAI ALAPITVANY, HUNGARY	8	01-11-2006	31-10-2008	24	325000	325000	SSA
UPGEM	Understanding Puzzles in the Gendered European Map Brain Drain in Physics through the Cultural Looking Glass	AARHUS UNIVERSITET, DANMARKS PAEDAGOGISKE UNIVERSITETSSKOLE, DENMARK	7	01-09-2005	30-09-2008	37	827292	827292	STREP
WIST	Women in Innovation, Science and Technology	UNIVERSITY OF NEWCASTLE UPON TYNE, UK	5	01-09-2006	30-06-2008	22	399975	399975	CA
WOMBIT	Women on Biotechnology Scientific and feminist approaches	FONDAZIONE GIACOMO BRODOLINI, ITALY	1	01-10-2006	30-09-2007	12	288252	288252	SSA
WOMENCORE	WOMEN in COnstruction scientific REsearch	FUNDACION LABEIN, SPAIN	7	01-04-2006	31-12-2008	32	2042852	1336057	STREP
WOMENINNANO	Strengthening the role of women scientists in Nano-Science	LEIBNIZ-INSTITUT FUER FESTKOERPER-UND WERKSTOFFFORSC	11	01-10-2005	31-03-2008	30	533860	533860	SSA

		HUNG DRESDEN E.V., GERMANY							
WOSISTER	Women Scientists in Gender-Specific Technological R&D - How do Women Scientists in Technological R&D Respondto the Needs of Women End-Users?	LUNDS UNIVERSITET, SWEDEN	3	01-10-2005	30-09-2008	36	472420	472420	SSA
WSDEBATE	Stimulating Policy Debate on Women and Science Issues in Central Europe	TUDOMANYOS ES TECHNOLOGIAI ALAPITVANY, HUNGARY	5	01-10-2006	30-09-2008	24	255700	255700	SSA

Source: CORDIS Open Data - provisional list to be refined for the Stocktaking Final Report

**CA:Coordination (or networking) actions; SSA: Specific Support Action;STREP: Specific Targeted Research Project CP-FP - Small or medium-scale focused research project, CSA: Coordination and Support Action

FP7projects

Project Acronym	Project Title	Coordinator (Name of Organitation and Country)	Number of Partners	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type**
ACUMEN	Academic Careers Understood through Measurement and Norms	UNIVERSITEIT LEIDEN, NETHERLANDS	10	01-03-2011	28-02-2014	36	2025808	1495412	CP-FP
DIVERSITY	Improving the gender diversity management in materials research institutions	LEIBNIZ-INSTITUT FUER FESTKOERPER- UND WERKSTOFFFORSCHUNG DRESDEN E.V., GERMANY	14	01-01-2009	31-12-2011	36	415268	315083	CSA-SA
EGERA*	Effective Gender Equality in Research and the Academia	FONDATION NATIONALE DES SCIENCES POLITIQUES, FRANCE	8	01-01-2014	31-12-2017	36	3927352	2229155	CSA-SA
EPSW	European platform of women scientists	CEWS (CENTER OF EXCELLENCE WOMEN AND SCIENCE), GERMANY	1	01-11-2008	31-10-2009	12	839648	599122	SSA
FESTA*	Female Empowerment in Science and Technology Academia	UPPSALA UNIVERSITET, SWEDEN	7	01-02-2012	31-01-2017	48	4291096	2569180	SA
GARCIA*	Gendering the Academy and Research: combating Career Instability and Asymmetries	UNIVERSITA DEGLI STUDI DI TRENTO, ITALY	7	01-02-2014	31-01-2017	36	3572250	2297826	CSA-SA
GENDERA	Gender Debate in the European Research Area	TUDOMANYOS ES TECHNOLOGIAI, HUNGARY ALAPITVANY	9	01-11-2009	30-04-2012	29	1030585	798666	CSA-SA
GENDERNET*	Promoting gender equality in research institutions and the integration of the gender	CONSEIL NATIONAL DES INGENIEURS ET	12	15-10-2013	14-10-2016	36	1931665	1545219	CA

	dimension in research contents	DES SCIENTIFIQUES DE FRANCE, FRANCE							
GENDERTIME*	Transfering Implementing Monitoring Equality	EGALITE DES CHANCES DANS LES ETUDESET LA PROFESSION D'INGENIEUR EN EUROPE ASSOCIACION, FRANCE	10	01-01-2013	31-12-2016	36	3329404	2328077	CSA-SA
GENISLAB*	The Gender in Science and Technology LAB	FONDAZIONE GIACOMO BRODOLINI, ITALY	9	01-01-2011	31-12-2014	36	2393332	1674932	CSA-SA
GENOVATE*	Transforming organisational culture for gender equality in research and innovation	SITY OF BRADFORD, UK	7	01-01-2013	31-12-2016	36	3185139	2200332	CSA-SA
GENPORT*	An internet portal for sharing knowledge and inspiring collaborative action on gender and science	FUNDACIO PER A LA UNIVERSITAT OBERTA DE CATALUNYA, SPAIN	6	15-05-/2013	14-05-2017	48	1673376	1496372	CSA-SA
GENSET	Increasing capacity for implementing gender action plans in science	PORTIA, UK	4	01-09-2009	29-02-2012	41	1036232	1198630	CSA-SA
HELENA	Higher education leading to engineering and scientific careers	SIAULIU UNIVERSITETAS, LITHUANIA	7	01-04-2009	30-09-2011	29	930433	1212390	CSA-SA
ICWES14	14th international conference of women engineers and scientists "a changing world: new opportunities for women engineers and scientists"	CONSEIL NATIONAL DES INGENIEURS ET DES SCIENTIFIQUES DE FRANCE, FRANCE	1	01-09-2007	31-08-2008	12	593770	100000	CSA-SA
INTEGER*	INstitutional Transformation for Effecting Gender Equality in Research	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, FRANCE	5	01-03-2011	30-06-2015	39	3568019	2247705	CSA-SA
IRIS	IRIS - interests & recruitment	UNIVERSITETET I	6	01-05-2009	30-/04-2012	36	999584	1284514	CP-FP

	in science. Factors influencing recruitment, retention and gender equity in science, technology and mathematics higher education	OSLO, NORWAY							
MOTIVATION	Promoting positive images of SET in young people	BERGISCHE UNIVERSITAET WUPPERTAL, GERMANY	8	01-01-2008	31-12-2009	24	536488	499888	CA
PRAGES	Practising gender equality in science	DIPARTIMENTO PER I DIRITTI E LE PARI OPPORTUNITA, ITALY	11	01-04-2008	31-12-2009	20	1498040	998418	CSA-SA
SAPGERIC	Structural Change Promoting Gender Equality in Research Organisations	VILNIAUS UNIVERSITETAS, LITHUANIA	1	09-05-2013	08-05-2014	12	450398	299996	CSA-SA
SHEMERA	Euro-Mediterranean research cooperation on gender and science: SHE Euro-Mediterranean Research Area	UNIVERSITE LIBRE DE BRUXELLES, BELGIUM	18	01-05-2011	30-04-2014	24	2372195	1991838	CP-FP
STAGES*	Structural Transformation to Achieve Gender Equality in Science	DIPARTIMENTO PER I DIRITTI E LE PARI OPPORTUNITA, ITALY	7	01-01-2012	31-12-2015	48	4647496	2789759	CSA-SA
TRIGGER*	TRansforming Institutions by Gendering contents and Gaining Equality in Research	DIPARTIMENTO PER I DIRITTI E LE PARI OPPORTUNITA, ITALY	5	01-01-2014	31-12-2017	48	2179369	3767200	CSA-SA
TWIST	Towards Women In Science and Technology	CENTER FOR FORMIDLING AF NATURVIDENSKAB OG MODERNE TEKNOLOGI FOND, DENMARK	11	01-01-2010	31-12-2012	24	3048097	2755692	CSA-SA
WHIST	Women's careers hitting the target: gender management in	DIPARTIMENTO PER I DIRITTI E LE	6	01-05-2009	30-11-2011	31	1146582	663558	CSA-SA

	scientific and technological research	PARI OPPORTUNITA, ITALY

Source: CORDIS Open Data - provisional list to be refined for the Stocktaking Final Report

* Projects under execution
**CA:Coordination (or networking) actions; SSA: Specific Support Action;STREP: Specific Targeted Research Project CP-FP - Small or medium-scale focused research project, CSA: Coordination and Support Action

4 Science Education

What Science to Study and Why

Adriana Valente
Science Communication and Education Research Unit,
Institute for Research on Population and Social Policies,
National Research Council of Italy

Abstract

Over the last fifteen years, the European Commission (EC) has actively supported the improvement of science education, taking into account the observation that in many countries fewer young people seem to be interested in science and technology subjects. Apparently, this is an issue that has turned out to be an endless nest of Chinese boxes. A complex set of research questions surround the central point: why study science?

For several decades now, scientists have proposed answers that involve different interdisciplinary aspects, such as the insights of the scientific method, pedagogical issues, as well as the conception of the role of science in society and of citizens in society. This led to the identification of some crucial dimensions of science education that – throughout the course of the EU's sixth and seventh Framework Programmes for Research and Technological Development (FP6/FP7) – can also be recognised in the objectives pursued by the EC's 'Science and Society' (SaS) and 'Science in Society' (SiS) programmes.

4.1 Science Education – Arguments and Priorities in the Scientific Debate and Across FP6/FP7

4.1.1 Science Education Arguments

Almost 30 years ago, the Bodmer Report stressed that 'Public understanding of science has as its base the teaching of science in schools'[4](The Royal Society 1985). The Bodmer Report outlined crucial dimensions of science comprehension and learning, using the cultural argument as a starting point, according to which the extraordinary discoveries made by science 'profoundly influence the way we think about ourselves' (The Royal Society 1985).

Subsequently, scientific debates involved the core features of new and old views on science education and communication. Turner describes 'school science and its controversies' (Turner 2008), based on the five dimensions proposed by Millar: economic, utility, democratic, social, and

[4]In the summary of the Bodmer Report, it is also stated that: 'A proper science education at school must provide the ultimate basis for an adequate understanding of science'.

cultural (Millar 1996).[5] These dimensions represent the main reasons for studying science. The related arguments, which particularly address 'why' science should be studied, have had considerable influence on 'what science to teach' and 'how to teach it'.

The *cultural* argument is based on the idea that science is a major achievement of our culture and that young people benefit from being able to understand and appreciate science. It includes a decade of research on the nature of science (NoS), as well as on teachers' and students' conceptions of science (Lederman 1992). The selection of the core NoS issues to be taught in the classroom is closely related to how they should be taught (Osborne et al. 2003). By renaming the NoS elements as *Feature of Science* (FoS) (Yalaki and Çakmakcı 2010), Matthews introduces another question – why such a selection is made 'and no other of the numerous features that can be said to characterise scientific endeavour'.

The argument of *utility* is closely linked to the cultural one, since scientific understanding can help individuals to make better decisions. One main goal of science education should, therefore, be to combine the explanation of the material world that science offers with the understanding of how science actually works.

Thereafter, the *democratic* argument brings in the question of citizens' informed participation in decision making, especially in regard to policy issues that increasingly include techno-scientific components. For instance, in the discussions on curriculum reform, this argument, together with considerations of efficacy, often counter-balances the approach of science curricula being seen as strictly routes towards science careers. If one looks at the following statement, 'a more educated citizenry is trained in science and technology issues to be able to participate in policy debate' – one of the goals in the strategic view of the European Research Area (ERA) Board to be achieved by 2030 (European Research Advisory Board 2005) (European Commission 2009) – it appears that the democratic argument has been specifically considered also by the ERA.[6]

A further reason to study science, relates to the *economic* argument, which refers to the idea that economic well-being relies on bringing enough scientifically qualified personnel into the labour market. Engaging and drawing people's interest in scientific careers has persistently been connected to the economic dimension. As also underlined by the Wolfendale Report, there is a relationship between economic well-being and inclusion of young people in scientific and technological related careers (Wolfendale Report 1995).

Be that as it may, approaches that focus solely on encouraging young people towards scientific careers, have been questioned as paying rather limited attention to the relationship between demand

[5]The circumstance that Millar analysed these five arguments for Science Education, moving from the nine benefits stemming from Public Understanding of Science presented by Thomas and Durant (Thomas and Durant 1987),reveals the proximity of the two research fields: science communication and science education. Very briefly, the nine benefits presented by Thomas and Durant are related to: scienceitself, national economies, national power and influence, individuals, democratic government, society, intellectual culture, aesthetics, and ethics.

[6] 'ERA is a unified research area open to the world based on the Internal market, in which researchers, scientific knowledge and technology circulate freely. Through ERA, the Union and its Member States will strengthen their scientific and technological bases, their competitiveness and their capacity to collectively address grand challenges'.More information and documents can be found at the relevant website:
http://ec.europa.eu/research/era/index_en.htm

and supply (Osborne and Dillon 2008). Evidence exists showing that curricula developed with the sole aim of preparing young people for obtaining a science degree fail to actually engage young people with the further study of science. They equally do not stimulate curiosity and motivation of most students. Naturally, students, 'require a broad overview of the ideas that science offers, how it produces reliable knowledge and the limits to certainty' (Osborne and Dillon 2008).

Finally, the *social* argument – considering the social benefits to be obtained from integrating scientific and humanistic cultures – is particularly related to the effects that the development of science education has brought to society. This argument is also relevant within the context of Responsible Research and Innovation (RRI) of which science education is an integral part and is linked, at the same time, to a range of other 'cross-cutting' issues, including public engagement, gender, open access and ethics. By way of illustration, consideration of 'open access' leads to further considerations of 'open science', in which research processes are made accessible to public scrutiny. In turn, this links to public engagement, and so on.

Moving from the social and democratic issues included in this frame, we may further stress the *participative* argument. Science education should help citizens faced with science and technology issues to behave neither just as 'users' nor just as 'producers' of science and technology applications, for which the term 'produsage' has been created (Bruns 2008; Marinelli and Ferri 2010), but as 'knowledgeable citizens' (Jasanoff, Sheila 2011). These are well-informed and educated citizens, able to manage knowledge and to take an active part in decision-making processes related to their own personal and social spheres.

Europeans value all the aforementioned arguments for science education. The two most recent Eurobarometers on *Science and Technology* reveal general agreement with the three statements related to the democratic, cultural and career arguments (European Commission 2013a) (Figure 4.1). These results show that European citizen's opinions are aligned with academic scientific debate and with the EU agenda.

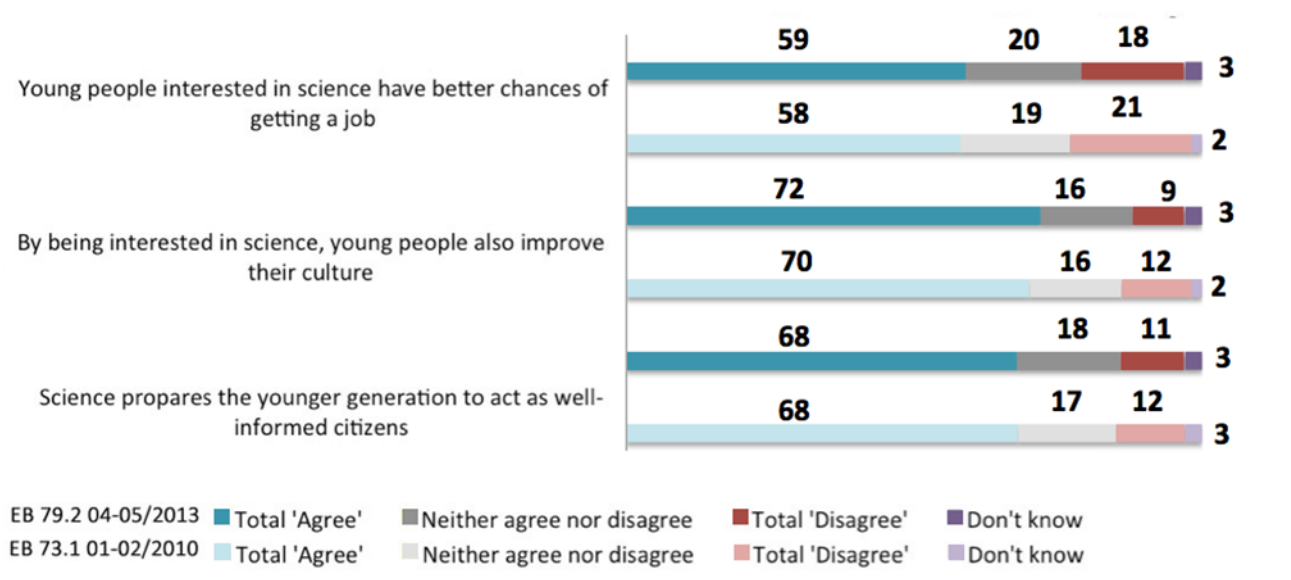


Figure 4.1 Europeans' Opinion of the Benefits of Science Education on Young People

Source: Special Eurobarometer 401 Responsible Research and Innovation (RRI), Science and Technology. Level of agreement on statements (European Commission 2013a)

4.1.2 Science Education Highlights within FP6/FP7

Alongside the scholarly arguments, beginning with the Lisbon Summit in 2000, the EU Council and the EC produced several documents setting out the way towards a European knowledge based society, the creation of the European Research Area (ERA), and pointed out policy making issues for 'science society and the citizen in Europe'(European Commission 2000). Alike, international institutions, such as the OECD, as well as other public and private organizations, equally contributed to the body of knowledge on the state of affairs, and perspectives on, science education and related issues. An overview of EU related actions, as well as documents in the field of science education is given in Table 4.1below[7].

Table 4.1 - Highlights in the field of science education	
2000	Report: Science, society and the citizen in Europe, EC
2001	EC Science and Society Action Plan
2002	Communication from the Commission of 20 November 2002 on European benchmarks in education and training: follow-up to the Lisbon European Council
2003	First Science and Society call on Science Education
2003	Communication from the Commission - "Education & Training 2010": The success of the Lisbon Strategy hinges on urgent reforms
2004	Constitution of High Level Group on Human Resource for Science and Technology
2004	Report: Europe Needs More Scientists
2004	Calls in Science and Society include career dimension

[7]Table 4.1 is an author's elaboration that includes: main documents and initiatives by the EC in Science Education and related fields; documents promoted or supported by the EC, but produced by other organizations and workgroups; documents (i.e. 2006 OECD Policy Report) that have been specifically debated at an EU level and cited in the latter. See analytical references at the back.

2005	European Research Advisory Board Report: "Science in Society": an agenda for a responsive and responsible European science in FP7
2006	OECD Policy Report: Evolution of student interest in Science and Technology Studies
2007	Mid-Term assessment of Science and Society activities
2007	Rocard Report: Science education now: a renewed pedagogy for the future of Europe
2007	Work programme Science in Society
2008	Report to the Nuffield Foundation Science Education in Europe: a critical reflection
2009	European Research Area Board Final Report: Preparing Europe for a New Renaissance
2009	Council conclusions of 12 May 2009 on a strategic framework for European cooperation on education and training ('ET 2020')
2010	Mobilization and Mutual Learning Action Plans, encompassing a series of SiS actions, including science education and public engagement
2011	Eurydice Report Science education in Europe: national policies, practices and research
2012	MASIS final synthesis Report
2012	Technopolis Report: Interim evaluation and assessment of future options for Science in Society actions
2013	Horizon 2020 work programme: 2014-2015 Science with and for Society. Making science education and careers attractive for young people

Source: Author's elaboration

Since the Lisbon Summit, heads of state and government across Europe have stressed the need to substantially boost the number of people opting for science and technology careers. The first response of the EC to this end, was through the *Science and Society Action Plan*(European Commission 2002a), a main cornerstone in the field in which room was given to issues related to young people, science education and careers, including mathematics, science, and technology. The action plan also dealt with adult education and, *in nuce*, includes socio-cultural, democratic, and economic-career arguments concerning science education. The importance of bringing together research and education partners was also envisaged.

FP6 has been the main instrument to implement ERA, which intended to overcome the problem of fragmented and overlapping research and related actions across Europe. The Science and Society Action Plan was subsequently adopted, making the 'Science and Society' theme under Structuring the ERA in the Sixth Framework Programme (FP6) 'the first ever initiative in this field at the European level scale' (European Commission 2007a). As from 2002 and up to 2006, several calls specifically addressed Science Education, one of the pillars of European strategy within FP6 'Science and Society' (SaS) Programme. During the transition from FP6 to FP7, another initiative in the field of Science Education led to the constitution of the *High Level Group on Human Resource for Science and Technology* that produced the so-called 'Europe Needs More Scientists' report (European Commission 2004). The report considers the results of the 2002 European summit in Barcelona, in which heads of state called for an increase in the European Gross Domestic Product (GDP) that is invested in research and defined strategic views on careers, including considerations regarding curricula, school system, and science education.

In 2005, the European Research Advisory Board Final Report outlined some (new) directions for the forthcoming FP7; to wit: the centrality of young people and children, the necessity to cultivate interest for science and research 'from an early age', and the importance of 'well informed and engaged teachers' (European Research Advisory Board 2005).

Starting with FP6 and throughout FP7, the EU made a great effort to promote science education. In 2012, 21 projects had already been financed within FP7 with reference to young people and science, for a total of EUR 41,253,000. Considering that by that time the total financial support to the 122 'Science in Society' (SiS) projects amounted to EUR 143,510,000, the projects supporting science education and careers received a relatively high amount of the whole funding stream, representing approximately 28.7%, both due to their pivotal role within the EC strategy and to their implementation needs.

In terms of publications the output resulting from EC funding is likely to be substantial. The publication profiles of researchers supported by the FP6/FP7 SaS/SiS programmes have been analysed for the period 2003-2010. The bibliographic analysis has been carried out by Science Metrix, calculating the profile of publications indexed in Scopus within main SaS/SiS fields and comparing the profiles with those of Framework Programme supported research (Technopolis-Fraunhofer 2012). The distribution of these publications in some main areas, among which 'Science Education', is presented in Table4.2.

Table 4.2 - Number of Papers Published in Selected Areas of SiS Research by FP Researchers 2003-2010

Country/Group	SIS		General Science & Society		Science Ethics		Science Education		Women & Minorities		Science Communication	
World	23,918	100%	9,455	40%	8,224	34%	5,364	22%	1,090	5%	697	3%
ERA	9,018	100%	3,953	44%	3,062	34%	1,772	20%	252	3%	265	3%
FP6 SaS Researchers	452	100%	100	22%	268	59%	69	15%	20	4%	27	6%
FP7 SiS Researches	515	100%	132	26%	154	30%	228	44%	8	2%	32	6%
TOTAL (SaS & SiS res.)	847	100%	209	25%	371	44%	251	30%	25	3%	47	6%

Source: Computed by Science-Metrix from Scopus (Elsevier)

Data processing: Interim evaluation & assessment of future options for Science in Society Actions (Technopolis-Fraunhofer 2012)

The 'General Science & Society' area, mainly covering general aspects of the topic, includes 40% of papers at world level. Aside from this general topic, *Science Education*, with 22% of papers, comprises the second largest area after *Science Ethics*.

In Science Education, FP6 researchers seem to have been relatively less active than ERA (15% *vs* 20%), whilst the supported research in FP7 has a proportion of papers in this area twice that of the ERA average.

Comparing FP6/FP7 publications in the field of Science Education, we can see that researchers supported by FP7 obtained higher percentage than those supported by FP6 (44% *vs* 15%). The Technopolis Interim Report also explains that FP6 publications are more than 20% less than expected in the area, based on the world distribution.

The interpretation of this data cannot be unequivocal, and is also related to the economic support given from the EC under FP7. On the one hand, it is legitimate to hypothesize that FP6 prepared the ground for scientific results that lead to publications produced within FP7. On the other hand, FP7 calls are more oriented to specific issues like careers and inquiry based science education; thus, publications may have found their way more easily into journals following mainstream issues.

It can also be argued that publication statistics are not the only relevant indicator for project impact. Many of the SiS projects, funded as 'Coordination and Support Actions' (CSA), had no mandate for performing research and instead produced effects directly related to practice. There is some debate (e.g. INSTEM, 2014) regarding the possibility of measuring these effects in the absence of long term studies running in parallel with, and beyond the duration of, such projects.

Another initiative to monitor research activities with respect to *Science in Society* in Europe was represented by the MASIS project (European Commission 2012). Although based on heterogeneous country reports, MASIS improves our knowledge about national level policies and activities. Based on MASIS, some papers further analysed issues related to the location, role, and responsibility of science across EU member states (Mejlgaard and Bloch 2012; Mejlgaard et al. 2012).

The above mentioned cornerstones and the density of activities, as well as of the discourse that they represent, are indicative of how EC support has been determinant in different directions: implementing innovative methodologies of science education, catalysing main arguments related to the theory and practice of science education, promoting actions and projects which further contributed to the production and sharing of knowledge and lesson-drawing in the field. All these considerations will be further substantiated in the next part of this paper.

4.2 Calls and Projects in Science Education

4.2.1 The Variety of Science Education Arguments in FP6

The *cultural* and *utility* arguments of science education have been considered since the first SaS calls, which focused on providing teachers, science professionals, and educational specialists with tools and opportunities to share ideas, techniques, and methods to supplement science curricula and develop educational strategies, aimed at increasing the attractiveness and relevance of science studies at school.

Many EC funded projects aimed to integrate formal and informal science education and foster collaboration between different stakeholders. Some examples of projects can give an idea of the variety of aims and strategies, as well as of certain important features that would then be deepened in the next FP7 programme. In most projects, teachers are central figures, as their competence, role and contribution are crucial for young people growing up, particularly in science.[8]

The central role of teachers is acknowledged also in the projects that specifically tackle the *social* argument of integrating scientific and humanistic culture. An example is the CISCI project on cinema and science.

Among the successful projects of the first SaS calls, SCIENCEDUC had two important features. It was based on relevant experience accumulated by partners in inquiry based learning (IBL) from an early education stage onwards, and was aimed at involving multiple stakeholders, including teachers, students and policy makers.

The next calls (2004-2006) explicitly added the *career* argument and continued to emphasise the central role of teachers. The projects that were mainly based on teaching methods equally included the need to overcome gender and inequalities in order to promote scientific careers. Innovation in science education followed the evidence, which showed that reforming science teacher education is crucial for the success of other science education reforms (Abell, Sandra K. 2000).

Practices in science teaching are considered vital for any improvement of pupil motivation, learning and attitudes towards science, and any curriculum or educational reforms need to take teachers' attitudes and capacities into account.

The POLLEN project, which was centred on the renewal of science education in primary schools, based on an inquiry approach, promoted the wide participation of teachers, educators, researchers, students and parents, whose cooperation and awareness is very important when dealing with young students.

A variety of practices characterised these science education projects, with success stories that originate from different perspectives. ECFUN, European Children's Future University Network, for example, aimed at creating a direct link between scientists and children, placing the student at the centre and emphasising the democratic argument of science at a very early stage. ECFUN brought together local activities and experiences of European Universities and Foundations to increase children's and young people's interest in science.

[8] A complete list of all PFS SaS projects can be found in EC sites and publications (European Commission 2007b).

The project GAPP was open to a variety of stakeholders, and focused on gender differences in the choice of science careers. It represented a middle path between education and science communication, aimed at developing and implementing new participative practices in these contexts.

The FORM-IT project – 'Take part in research' – created a network of experts working with new didactic concepts for science teaching, thus facilitating partnerships between universities and schools. As an intermediate outcome, FORM-IT built up a catalogue of good practices of cooperation between research and education in the member states, including, among national successful experiences, a variety of contexts and approaches to formal and informal education.

Some FP6 calls aimed at promoting science weeks and events, sharing with the calls strictly devoted to science education the *cultural* and *career* arguments, and also embracing the *social* paradigm of science. Some of these projects included schools among their target users, such as the ESCIENTIAL.IE project, which widened the implementation of European Science Festivals.

4.2.2 Science Education in FP7: Reflection on Achievements and Wide Experimentation of Inquiry Based Learning Methodologies

In 2006-2007, the years of the shift between FP6 and FP7, two international reports gathered the attention of science education researchers and practitioners. The first, the policy report *Evolution of student interest in Science and Technology Studies* (STS), stressed once again the problem of decreasing percentage of young people choosing STS at universities in most European countries. To get youth closer to scientific careers,'teaching should concentrate more on scientific concepts and methods rather than on retaining information only' (OECD, Global Science Forum 2006).

The second document *Science education now: a renewed pedagogy for the future of Europe*, also known as the Rocard Report, synthesis some major achievements of previous projects and related methodologies, centred on the 'inquiry based learning approach' (IBL), which actually formed the basis for the next calls. Thanks to this report, further attention was placed on 'bottom up' inductive pedagogical approaches. Inquiry based methodologies, already included in preceding research projects as crucial for making science more attractive to young people, were now explicitly addressed as paradigmatic models for teaching and learning, and were also considered as a way to overcome inequalities (European Commission, High Level Group on Science Education 2007).

In 2006-2008, the results of periodical international surveys, such as the OECD-PISA and TIMMS, showed that many countries were increasingly concerned with the unattractiveness of science for young people and with the insufficient diffusion of scientific culture. The 'significant overall increase in the total number of graduates' in STEM desired by 2010 was, apparently not going to be accomplished (European Commission 2002b).

The *economic-career* argument present in the second period of FP6 calls was reiterated in FP7 and becomes a catalyst for the development of other arguments on science education.

The expected benefits for all have been stressed by the Technopolis Report: 'Through this agenda, the expected outputs can be seen to be of benefit to all European citizens insofar as they improve

our prospects for future growth and competitiveness and enable solutions to the key socio-economic challenges of the present and future' (Technopolis-Fraunhofer 2012).

Within FP7, the tendency to implement most of the described arguments of science education – *economic/career*, *utility*, *democratic*, *social,cultural*, and *participative* – seems to have been accomplished. For this, particular stress is laid upon IBL, inquiry based science education (IBSE) and inquiry based science and mathematics education (IBSME)methodologies.

As IBSE is based on an inductive approach, on observation more than on a 'top down transmission', and on 'teacher-guided construction by the child of his/her own knowledge' (European Commission, High Level Group on Science Education 2007), the role ofteacher training should be adequate to this major effort. FP7 calls were further aimed at reinforcing the central role of teachers, the importance of teacher training, and including teachers in the research process, according to the principles of the 'action research' approach. Improvements in science education must include new forms of pedagogy: the introduction of inquiry-based approaches in schools, actions for teacher training in IBSE, and the development of teachers' networks, were considered the best way to actively promote and support these improvements.

In FP7 calls, IBSE was recognised as a pillar to enhance science education, allowing many relevant and valuable projects to be performed. It is worth point out the fact that more than half of the EC financed projects explicitly mentioned 'inquiry based learning' or 'inquiry based education' in their descriptive abstracts.

The downside of this wide experimentation with inquiry methodologies in Europe has been that 'very few projects have been tasked explicitly with producing formal research to evidence the effectiveness (or relative effectiveness) of the IBL approach' (Technopolis-Fraunhofer 2012).

Some examples of science education SiS projects are described below. Other successful projects, including projects that dealt with science education from a specific gender perspective, have been mentioned in the Technopolis Report(Technopolis-Fraunhofer 2012)[9]. A complete list of FP7 projects in science education organised by calls can be found in an EC RTD presentation of September 2013 (Korda and Karamitrou 2013).

Although most science education SiS projects shared similar approaches in answering very specific calls promoting IBL and IBSE, some differences can be found in the modalities of addressing the main issues, as well as in focusing specific aspects of science education.

For this reason, examples of science education SiS projects have been clustered here, in five categories, according to specific issues and strategies implemented by projects, relevant for achieving the goal of improving science education and fostering the way towards scientific careers.

[9]In addition to some of the projects presented in this document,the Technopolis Report also mentions: UPDATE, SET-Routes, HELENA, ACUMEN, SED, EUCYS, EUCUNET, MOTIVATION, and YOSCIWEB.

4.2.2.1 Adapting to National Contexts

Some projects specifically addressed the problem of 'translating' inquiry-based methods into local contexts.

KidsINNscience is a project that aimed to develop adaptive strategies to facilitate innovation of science education in formal and informal settings. Innovative curricula, as well as teaching and learning methodologies were analysed, and compared, among different countries in Europe and Latin America, considering among others also gender issues and cultural diversity. The process of reciprocal learning went side-by-side with developing plans to fit the country contexts and specificities.

In S-TEAM, particular importance was given to Teacher Professional Development (TPD). The project also disseminated research on teacher's experiences of inquiry-based methods to existing and future science teachers, involving listening to teachers, working with teacher educators and researchers, and providing support for better science education. Particular attention was paid to 'national specific contexts' as an optimum 'area for action', where TPD can be consistent with the national opportunities and constraints.

TRACES adapted actions to the needs and priorities of the consortium partners' own national and local context, touching different science and mathematics topics and different educational and sociological issues.

4.2.2.2 The Multiplier Approach

Examples of projects that have been able to pursue a 'multiplier' approach – in other words, a cascade effect of training and awareness – include Fibonacci that aimed at improving the widespread use of IBL in mathematics, and INQUIRE, in science.

Fibonacci organised a dissemination model based on a systematic approach of IBSME at grassroots level, ensured by intermediary structures with successful experience in local IBSME implementation.

INQUIRE supported teachers and science educators to develop their proficiency in inquiry based teaching and become reflective practitioners. As IBSE is not practiced in most European classrooms, INQUIRE offered a one-year practically based IBSE teacher training course, run in Botanic Gardens and Natural History Museums, to reach out to a larger number of teachers.

4.2.2.3 Networks and Portals

Many projects enhanced teacher and stakeholder networks. Scientix built an online portal to collect and disseminate European science, technology, engineering, and mathematics (STEM) education projects and their results, mainly addressed to teachers, researchers, project managers, and policy makers. The second phase of Scientix intends to expand at the national level, and among others, to reach national teacher communities through the established network of the National Contact Points (NCPs) in almost 30 European countries.

Another interesting portal is that created by PRIMAS, which developed materials for direct use in the classroom and for professional development, supporting teachers in the development of inquiry-based learning pedagogies in mathematics and science, in order to increase the number of pupils who get to experience scientific inquiry. Teachers and educational experts from different countries constituted a network for promoting these learning methods in schools of EU Member States.

4.2.2.4 Wideninig the Range of Stakeholders Involved

ESTABLISH and SIS CATALYST made big efforts to widen the network beyond strictly educational actors, aiming to include multiple actors, such as parents, business leaders and policymakers.

SIS CATALYST has also been pivotal for mobilisation and mutual learning (MML) in this area, as it is involved in reciprocal learning and supporting the variety of actors engaged with children. Within SiS CATALYST, children are fully recognised as 'change agents', able to be 'catalysts' in finding what is hardest: solutions to future challenges for European society. The project centred on the aim of Mobilisation and Mutual Learning Action Plans to foster large-scale, long-term partnerships, connecting and engaging various actors and stakeholders, and finding solutions through mutual learning and cooperation.

ESTABLISH aimed at introducing changes in classroom practice through the promotion of IBSE, as well as through the involvement of different stakeholders. In producing teaching and learning units, efforts have been made to link scientific concepts and contents to real-world scientific and industrial experiences.

4.2.2.5 Careers

Some projects explored alternative strategies to IBSE or IBL implementation, in order to enable and/or facilitate recruitment in science careers.

Among these projects, SECURE aimed to provide useful research data for policy makers to improve mathematics, science and technology (MST) curricula and their implementation. For this purpose, transnational comparative screening of MST curricula has been performed, as well as teacher and learner surveys and lesson observation.

From a different perspective, ECB/Ingeniousaimed at reinforcing the partnership between industry and education, in order to foster science and technology careers in the private sector by developing a repository of good practices.

IRIS is interesting because it is as an ideal continuation of the ROSE project, which involved researchers and practitioners from many countries to better understand the social and affective dimensions of attitudes to science education (Sjøberg and Schreiner 2010). The project was based on experimentation with education strategies, through quantitative and qualitative interviews with STM students, paying attention to gender issues. IRIS has drawn on different theoretical frameworks to address young people's educational choice processes and their relationship to STEM, showing that educational choice is not a purely rational decision.

4.2.3 Science Education from SaS/SiS to Science with and for Society

Horizon 2020 has included in the general programme some of these perspectives, in particular: promoting sustainable and crosscutting interaction between the relevant actors and strengthening their engagement with education and careers. Responsible Research and Innovation (RRI) envisages that all societal actors – researchers, citizens, policymakers, and business – shall work together during the whole research and innovation (R&I) process. Following this approach, Science with and for Society aims to 'build effective cooperation between science and society, to recruit new talent for science and to pair scientific excellence with social awareness and responsibility' (European Commission 2013b).

The first calls devoted to science education acknowledge the central role of education, considering both formal and informal science education, higher education curricula, gender equality and innovative ways to make both science education and scientific careers more attractive to young people. Moreover, the Euraxess – Researchers in Motion, promoted by the European Research Area, is devoted to enhancing the mobility of researchers and their career development.

The expected impact of the programme covers core arguments of science education: 'democratic/participative' arguments, with attention to the development of scientific citizenship and the emphasis on gender issues; 'cultural/social' arguments, in promoting innovative pedagogies in science education and developing responsible research and innovation in higher education curricula; 'economic/career' arguments, in simplifying the access to scientific careers as well as in promoting the pursuing of careers in Stem and, as explicitly specified, in the wide area of innovation.

4.3 Tentative Remarks and Lessons for the Future

The above examples of science education projects illustrate that a great deal of research in this field has been developed in recent years with EC funding. This research has proved to be highly interdisciplinary, involving different partners and stakeholders, and in many cases committed to a networking approach and fostering a participatory approach that has led both to consolidated benefits and future challenges.

Moving from these considerations, the following four issues – *Participative dimension, Widening actors, committing stakeholders, Networking, Impact knot* – are used as *keys* to draw a conclusion that also includes insights for the future.

4.3.1 Participative Dimension

Science education may and should be one of the instruments of a responsible approach to science and technology governance (Nielsen 2014). As RRI is seeking to harmonize research and innovation with societal demands and values (Sutcliffe 2011), science education should further enhance its *democratic* and *participative* arguments, including the awareness of values that are embedded in the study of science. In FP6/FP7, bridges have been built between science education and participation and engagement, as is witnessed by the inquiry based learning approach itself and by the number of projects that include both perspectives. Several FP6 and FP7 EC funded projects share this double approach, including science education and participation/engagement – from

ECFUN and ESCIENTAL, to SIS CATALYST AND YOSCIWEB – truly bringing together the two research fields. SIS CATALYST also included the ethical perspective, dealing with the ethical guidelines needed when working with children.

We can also find relevant cases in which this tendency has been followed outside SaS and SiS. For example, reference can be made here to the SSH project Biohead-Citizen, in which interests in science education and teacher professional development have been pursued, together with the analysis of implicit values embedded in science textbooks and in science teaching.

By means of consolidating the *participative* argument, engagement in Science Education has also affected the governance process. This process can be pivotal for a virtuous circle that includes relevant actors inside and outside school. According to the RRI approach, this will facilitate the process of providing future researchers and innovators with tools, skills, and qualifications that facilitate and ensure engagement with society and ethical working methods.

4.3.2 Widening Actors, Committing Stakeholders

An important achievement of the EC funded Science Education projects has been the progressive enlargement of the categories of actors involved, which should also lead to the comprehensive, responsible and passionate commitment of relevant societal stakeholders.

According to the Technopolis Report, future programmes, for the whole science-society area, should present 'more active input and "buy-in" from key actors' 'such as national Science and Education Ministries' (Technopolis-Fraunhofer 2012). Similar consideration had already been expressed by the mid-term assessment of SaS activities: 'the range of participants has not included many school authorities so far, and policy makers have not been the primary audience for most projects' (European Commission 2007c). The reasons for this are complex. Most projects have signalled their good intentions towards policymakers, and many have held national workshops or Brussels-based conferences with the express purpose of addressing/approaching policymakers. This *post-hoc* dissemination of policy recommendations suffers from the same problems as inquiry-based science education: namely, there is little opportunity to conduct research into the long-term effects of such actions.

In the field of science education, Ministries, public authorities, and industries should strengthen their partnership with schools and research organisations and become more committed to the adoption, implementation, and maintenance of at least some project achievements, including policy recommendations. Further research should improve understanding of how the growing involvement of societal actors will and can have an impact on policy making.

In order to achieve these aims, transversal project activities, strictly devoted to the relationship between researchers, policy makers and stakeholders, as well as to the implementation issues, could be required by the EC and could be equally developed by means of participatory methodologies.

4.3.3 Networking – One Way to Go Beyond Project Boundaries

In most successful FP7 projects, widening the range of actors involved and using networks have been crucial.

The creation of networks among teachers, researchers, and various stakeholders has headed in the multiple directions of sharing tools and materials, proposing methodologies, and mutual learning. The great effort that is going on among science education communities is to keep these networks active and meaningful beyond the projects' lifetime. However, this is difficult once project funding has finished.

Teachers are key players in the renewal of science education. Being part of a network allows them to improve the quality of their teaching and enhances their motivation. Networks can be an effective component of teachers' professional development that are able to stimulate learning and mutual learning, increase the production and widespread use of teaching materials, and improve teaching courses and dissemination of best practices; they have particular added value if they can bring together various stakeholders. Moreover, teacher networks may be complementary to more traditional forms of in-service teacher training and are open to gain advantage from innovative platforms for interaction, education, and participation. Further help can come from new media and social networks.

Not all teacher and professional networks have the same degree of pervasiveness, adoption, and maintenance. One indicator of the effectiveness of the networking process is, therefore, its life beyond project boundaries.

In 2011, coordinators and members of several STEM projects, most of which were financed by the Science in Society programme, but also by other initiatives, such as the Lifelong Learning Programme, created the informal network ProCoNet. INSTEM, a Comenius network, grew out of ProCoNet and they currently work together in a knowledge exchange process on inquiry-based teaching and learning, whilst interacting with stakeholders.

Another example is SUSTAIN – Supporting Science Teaching Advancement through Inquiry, in which some institutions who participated in Science in Society on IBSE methodologies, joined together once more to develop a Comenius multilateral network to further exchange their experiences and build related knowledge.

In some cases, national networks have been able to stay live after the end of projects. An example is the network created in Italy following the KidsINNscience project, in which a national community of teachers' remains involved in IBSE experimentation and in knowledge exchange on science education theory and practice.

4.3.4 Impact Knot

SaS/SiS projects have been characterized by being highly interdisciplinary, involving research in several scientific fields and having declared complex social objectives. For all these reasons, 'linear cause-and-effect relationships are difficult to make' (Technopolis-Fraunhofer 2012) and assessing impact is a hard task. This is particularly true for Science Education projects. Scientists,

practitioners, and policy-makers generally acknowledge the crucial role of education in society and, as we have seen, the economic and career arguments of science education are widely recognised.

All the same, many of the potential impacts become visible only after a rather long time-period. Only in the long run it is possible to see the effects of experimentation, as well as of the widespread use of new learning methodologies. Things are even more complex when dealing with the implementation of a new curriculum.[10] The decision to implement a new curriculum takes time, and after that a 'whole cohort of students needs to be exposed to this new curriculum' (Technopolis-Fraunhofer 2012) before it is possible to evaluate how this process impacted education and society.

Although many studies have dealt with student assessment in science, most of which are mentioned in the Eurydice Report (Eurydice 2011), there is still a lack of analysis and assessment about the implementation of science education methodologies. As already discussed in this chapter, the downside of the great effort devoted to implementing inquiry based learning is that little formal research has been produced that assess the effectiveness of this approach. The lack of robust research on the effects and results of IBL/IBSE, therefore, extends the problem of impact evaluation for science education projects.

Further considerations refer to positive and negative impact of research and to the possibility of defining 'right' outcomes and impacts of research and innovation (Von Schomberg 2013).

One more point is the complexity of managing all intervening variables, which tend to inhibit concrete measurement of the causal impact of education on economic growth. Aghion and colleagues (Aghion et al. 2009) stated that '*some* investments in education raise growth', depending on many variables such as the type and place of interventions.[11]

Regarding the impact on policy of SaS/SiS projects, the analysis carried out by Technopolis came to the conclusion that while most projects are, in a very general sense, expected to have utility to policymakers, academics or the general public, 'any detailed understanding of, or connections to, the organizations that could benefit from the results and what it is that they might do differently based on the project outputs' is lacking. 'As such, we have found that while most projects confidently expect to have an impact on policy, most also do not have a clear sense as to how this would actually take place' (Technopolis-Fraunhofer 2012).

In order to be able to effectively guarantee systematic impact assessments for future projects, some central aspects should be highlighted, including pursuing 'a comprehensive (ex-ante) impact assessment' and elaborating the understanding of 'the complex mechanisms leading to long-term impacts in complex environments' (Technopolis-Fraunhofer 2012).

---

[10] 'Countries in Europe not only have different epistemic visions of science and science teaching, they also have different approaches to curricula: in many countries the curriculum is orientative and not prescriptive, so that while teachers seem relatively free to make choices and establish their own priorities, in the reality they follow the 'accepted practices', what their colleagues do, what text book proposes, what parents expect. Changes in an apparently free situation could be as difficult as in a top-down system, because they require changes in 'public opinion and of a 'critical mass' of teachers'(Duschl and Mayer).

[11] 'Massachusets, California or New Jersey might benefit more from an investment in Mississippi's research universities than Mississippi does'(Aghion et al. 2009)

Documents preparatory to RRI, therefore, stress the importance of 'exploring impacts in advance' (Sutcliffe 2011), with reference to the variety of actors and processes involved in research and innovation.

4.4 Responsible Research and Innovation and Science Education. Further insights from the SIS-RRI Conference

The conference 'Science, Innovation and Society: achieving Responsible Research and Innovation', held in Rome on 19-21 November 2014, represented a chance to further debate science education issues, as well as the other five main key areas that have been at the core of the EU concern in the Science/Society relationship.

Six parallel sessions have been devoted to"lessons learned", particularly considering the contribution provided by the EU through the Framework Programmes 6thand 7thand the insights from the research projects, including the perspectives and expectations in the light of the Horizon 2020 Work Programme. The session 'Formal and non formal science education' was chaired by Gemma Revuelta and co-chaired by the author of this chapter, involving Rosina Malagrida, Vittorio Bo, Fiorenzo Galli and Charly Ryan as speakers. The conference also included six world café sessions. The author of this chapter chaired the world café session 'Evolution of the RRI concept in the future', in which Fern Wickson and Erich Griessler were the speakers.

The collective process of knowledge construction developed in this world café, as well as the interventions and debate that came out of the 'Formal and non formal science education' session, further contributed to the identification of trajectories and challenges of science education research and practice in the context of Responsible Research and Innovation. They constitute the basis of the considerations developed in this last part of the chapter; the author wishes to thank all the speakers and participants for their contribution.

In the course of the sessions, different scenarios have been connected to RRI and different concerns have been expressed. One major concern has been related to the meaning and scope of innovation in the contexts of RRI and with direct reference to science education. The meaning of innovation that circulated in presentations and interventions went beyond boundaries of technological innovation and economic growth, including the concept of cultural and social innovation. In the context of science education this produces various implications: social innovation should lead to strengthen the centrality of public spaces as places for learning, for meeting together, for changing ideas; social sharing of knowledge should be considered a part of economic growth; awareness should raise about the different dimensions of scientific culture and education (see paragraph 4.1).

Furthermore, it has been noticed that the concept of innovation should be included in a constant and uninterrupted process of negotiation, contextualization and updating, following an inclusive and open approach, also considering the possibility of conflict of values. The basic issue of detecting who sets the agenda and who makes choices turns out to be, in the framework of RRI, a significant challenge. The relevance of this challenge and of its inner debate has been further acknowledged in the course of the SIS-RRI Conference; a synthetic but concrete result has been the insertion of the word 'on-going' that has been added in the incipit of the Rome Declaration, whose final formulation is as follows:

'Responsible Research and Innovation (RRI) is the on-going process of aligning research and innovation to the values, needs and expectations of society'

Widening and empowering stakeholders and finding opportunities to include them in decision-making, another of the issues discussed, is part of the process. Following insights from SaS/SiS projects (see paragraphs 4.2.2; 4.3), a variety of stakeholders should be involved in educational projects, fostering the opportunity to co-create knowledge. This concept is also present in Rome Declaration, as 'all stakeholders including civil society' are invited to work together in the crucial processes like science education, as they 'are responsive to each other and take shared responsibility for the processes and outcomes of research and innovation'.

Students can and should be considered part of the educational system and of decision making processes, and their ability to be active actors from the primary school should be seriously taken into consideration. This concept has been effectively synthesised by the words 'from deficit to democracy'. In this framework, teachers are playing new roles at the boundaries between formal, informal, non formal education, so further attention should be given to teacher education and career.

In his closing addresses at the SIS-RRI Conference, Roger Strand observed that a major result of philosophy of science in the 20th century has been to let us aware of the coexistence of 'hundreds of epistemic cultures' (Strand 2014). This reminds us that science involves all areas of social life, with relevant consequences on the process of representing, communicating and learning science.

During the conference, some highlights and recommendations for the evolution of science education projects and programmes arose. Among these:

- giving centrality to the concepts of sharing, inclusion, openness, at all levels of science education;
- pursuing the goal of citizens' participation and engagement in research and innovation since the early stages of children involvement in science education;
- allowing space for the learners, their ideas, views, opinions, specific needs;
- considering that all stakeholders involved in the learning process should also be involved as learners;
- including contributes in educational projects and practice both from social and natural scientists;
- thinking about boundaries among roles, disciplines, actors, stakeholders and among formal, non formal, informal education;
- creating conditions for durable connections between schools, research, communities and social and political actors;
- including RRI in the political agenda and fostering discussion on science education and curricula development at the European, local and international levels.[12]

[12] I wish to thank Peter Gray for the fruitful discussion we had on science education

References chapter 4

Abell, Sandra K. 2000. "International Perspectives on Science Teacher Education: an introduction". In *Science Teacher Education, Abell, Sandra K. (ed)*. Vol. 10. Conpemporary Tends and Issues in Science Education. Dordrecht: The Netherlands, Springer.

Aghion, Philippe, Boustan, Leah, Hoxby,Caroline, Vandenbussche, Jerome. 2009. "The Causal Impact of Education on Economic Growth: Evidence from the United States". Washington, D.C: Brookings Institution Press. In: http://www.brookings.edu/economics/bpea/~/media/Files/Programs/ES/BPEA/2009_spring_bpea_papers/2009_spring_bpea_aghion_etal.pdf.

Bruns, Axel. 2008. *Blogs, Wikipedia, Second Life, and Beyond: From Production to Produsage*. Peter Lang, Pieterlen: Switzerland.

Duschl, Richard A., Mayer Michelina. 2012. "S-TEAM Project Science Teacher Education Advanced Methods External Evaluation Report". External Evaluation Report, 2012.

European Commission. 2000. "Science, Society and the Citizen in Europe, Commission Working Document". http://ec.europa.eu/research/area/science-society-en.pdf.

European Commission. 2002a. *Science and Society: An Action Plan*. Luxembourg: Office for the Official Publications of the EC.

European Commission. 2002b. "European Benchmarks in Education and Training: Follow-up to the Lisbon European Council". http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52002DC0629&from=EN.

European Commission. 2004. *Increasing Human Resources for Science and Technology in Europe: Conference, Brussels, 2 April 2004*. Luxembourg: EUR-OP.

European Commission. 2007a. "Work Programme Science in Society". http://ec.europa.eu/research/participants/data/ref/fp7/88164/s_wp_200701_en.pdf.

European Commission. 2007b. "Science and Society Projects Synopsis 2002-2006". ftp://ftp.cordis.europa.eu/pub/science-society/docs/sis-proj-synop-bookmarked_en.pdf.

European Commission. 2007c. "Mid-Term Assessment of Science and Society Activities 2002-2006". http://web.ceu.hu/celab/MTA%20Report%2022%20March%202007.pdf.

European Commission. 2009. "Preparing Europe for a New Renaissance - A Strategic View of European Research Area First Report of the European Research Area Board". http://ec.europa.eu/research/erab/pdf/erab-first-annual-report-06102009_en.pdf.

European Commission. 2012. *Monitoring Policy and Research Activities on Science in Society in Europe (MASIS). Final Synthesis Report*.

European Commission. 2013a. *Special Eurobarometer 401 - Responsible Research and Innovation (RRI), Science and Technilogy. Report*.

European Commission. 2013b. *Horizon 2020 Work Programme 2014-2015. Science with and for Society*.

European Commission, High Level Group on Science Education. 2007. "Sceince Education Now: a Renewed Pedagogy for thr Future of Europe". Directorate-General for Research Science, Economy and Society. http://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-on-science-education_en.pdf.

European Research Advisory Board. 2005. ""Science and Society": An agenda for a responsive and responsible European science in FP7 - ERAB Final Report". http://ec.europa.eu/research/eurab/pdf/eurab_05_035_wg6_final_report-rev_160905.pdf.

Eurydice. 2011. "Eurydice Science Education in Europe: National Policies, Practices and Research, 2011". http://www.indire.it/lucabas/lkmw_file/eurydice/sciences_EN.pdf.

Jasanoff, Sheila. 2011. "The Politics of Public Reason". In *The Politics of Knowledge, Baert et Robio Eds*. Routledge, Abingdon.

Korda, Maria, Karamitrou Maria. 2013. "Science in Society: Science Education 2013 Policy Context". http://www.czelo.cz/files/dokums_raw/DG_RTD_Czelo_16Oct2013_FINAL_VERSION.pdf.

Lederman, Norman G. 1992. "Students' and teachers' conceptions of the nature of science: A review of the research". *Journal of research in science teaching* 29 (4): 331–59.

Marinelli, Alberto, Ferri Paolo. 2010. "Introduzione: New media literacy e processi di apprendimento". In *Culture partecipative e competenze digitali. Media education per il XXI secolo, di H. JENKINS*. Milano: Guerini Studio.

Mejlgaard, Niels, Bloch, Carter. 2012. "Science in Society in Europe". *Science and Public Policy* 39 (6): 695–700. doi:10.1093/scipol/scs087.

Mejlgaard, Niels, Bloch, Carter, Degn, Lise, Nielsen Mathias W.,Ravn, Tine 2012. "Locating Science in Society across Europe: Clusters and Consequences". *Science and Public Policy* 39 (6): 741–50. doi:10.1093/scipol/scs092.

Millar, Robin. 1996. "Toward a Science Curriculum for Public Understanding". *School Science Review*. 77(280), 7-18.

Nielsen, Linda. 2014. "key message". In: Stoa Workshop, Responsible Governance of Science and Technologies. Brussels. 19 March 2014. http://www.europarl.europa.eu/stoa/webdav/site/cms/shared/Booklet_190314.pdf.

OECD, Global Science Forum. 2006. "Evolution of Student Interest in Science and Technology Studies Policy Report".

Osborne, Jonathan, Collins Sue, Ratcliffe Mary, Millar Robin, Duschl, Rick. 2003. "What "Ideas-about-Science" Should Be Taught in School Science? A Delphi Study of the Expert Community". *Journal of Research in Science Teaching* 40 (7): 692–720. doi:10.1002/tea.10105.

Osborne, Jonathan, Dillon Justin. 2008. *Science Education in Europe: Critical Reflections*. Vol. 13. London: The Nuffield Foundation. http://efepereth.wdfiles.com/local--files/science-education/Sci_Ed_in_Europe_Report_Final.pdf.

Sjøberg, Svein, Schreiner, Camilla. 2010. "The ROSE Project. Overview and Key Findings".

University of Oslo. http://roseproject.no/network/countries/norway/eng/nor-Sjoberg-Schreiner-overview-2010.pdf#page=2&zoom=auto,-106,827.

Sutcliffe, Hilary. 2011. "A Report on Responsible Research & Innovation". *European Commission, Brussels, Belgium*. http://www.matterforall.org/pdf/RRI-Report2.pdf.

Technopolis-Fraunhofer. 2012. *Interim Evaluation & Assessment of Future Options for Science in Society Actions. Final Report*.

The Royal Society. 1985. "The Public Understanding of Science (Bodmer Report)". London: The Royal Society.

Thomas, Geoffrey, Durant, John. 1987. "Why Should We Promote the Public Understanding of Science". *Scientific Literacy Papers* 1: 1–14.

Turner, Steven. 2008. "School Science and its Controversies; or, Whatever Happened to Scientific Literacy?". *Public Understanding of Science* 17 (1): 55–72.

Von Schomberg, Rene. 2013. "A Vision of Responsible Research and Innovation". *Responsible Innovation*, 51–74.

Wolfendale Report. 1995. "Report of the Committee to Review the Contribution of Scientists and Engineers to the Public Understanding of Science, Engineering and Technology".

Yalaki, Yalçın, Çakmakcı, Gültekin. 2010. "A Conversation with Michael R. Matthews: The Contribution of History and Philosophy of Science to Science Teaching and Research". *Eurasia Journal of Mathematics, Science & Technology Education* 6 (4): 287–309.

Annex 4 – Main Projects in the Science Education Area.

FP6 projects

For FP6, the projects of the following calls have been considered: *Science education in Europe*; *Science education and careers 2004*; *Science education and careers 2005*. Also projects related to the call *European science week initiative* have been considered as they include science education at school and young people and science issues.

Project Acronym	Project Title	Coordinator (Name of The Organisation And Country)	Number of Partners Involved	Start Date	End Date	Duration	Total Cost (€)	Total Funding (€)	Contract Type**
CISCI	Cinema and Science	TECHNISCHE UNIVERSITAET WIEN, AUSTRIA	11	02-02-09	01-02-11	24	494411	462962	SSA
ECFUN	European Children's Future University Network - www.universiYOU.net	UNIVERSITAET WIEN, AUSTRIA	7	02-12-09	01-06-12	30	455300	455300	SSA
EFSUPS	Exploring the ground - Fostering scientific understanding in primary schools	WISSENSCHAFTSLADEN BONN E.V., GERMANY	5	02-11-10	01-11-12	24	226986	226986	SSA
ESCALATE	Enhancing SCience Appeal in Learning through Argumentative inTEraction	THE HEBREW UNIVERSITY OF JERUSALEM, ISRAEL	6	02-01-10	01-07-11	18	499944	499944	SSA
ESCIENTIAL	European Science Festival	ASSOCIAZIONE FESTIVAL DELLA SCIENZA, ITALY	9	02-06-08	01-06-09	12	461716	225201	SSA
ESTI	EIROforum European science	EUROPEAN SPACE	6	02-11-08	01-11-12	48	3833526	2417490	SSA

	teachers initiative	AGENCY, FR							
EUROBOT	Coupe d'Europe de robotique 2003/2004'	VM GROUP SA, FRANCE	1	02-11-07	01-12-08	13	232800	147800	SSA
FORM-IT	Form - it "Take part in research"	OESTERREICHISCHES OEKOLOGIE-INSTITUT, AUSTRIA	11	02-11-10	01-11-12	24	697930	697930	SSA
GAPP	Gender awareness participation process: Differences in the choices of science careers	SCUOLA INTERNAZIONALE SUPERIORE DI STUDI AVANZATI, ITALY	6	02-01-11	01-01-13	24	808380	808380	SSA
HANDS-ON BRAINS-ON	Hands-on science teaching: combining formal and informal science learning	TIEDEKESKUSSAEATIOE, FINLAND	11	02-12-09	01-12-11	24	690000	690000	SSA
MaterialsScience	University-school partnerships for the design and implementation of research-based ICT-enhanced modules on Material properties	PANEPISTIMIO KYPROU, CYPRUS	6	02-01-11	01-01-14	36	652300	652300	SSA
PARSEL	Popularity and relevance in science education for scientific literacy	LEIBNIZ-INSTITUT FUER DIE PAEDAGOGIK DER NATURWISSENSCHAFTEN AN DER UNIVERSITAET KIEL, GERMANY	10	02-10-10	01-04-13	30	872864	872864	CA
PENCIL	Permanent European resource centre for informal learning	MINISTRY OF PRESS AND MASS MEDIA, BELGIO	18	02-10-08	01-10-11	36	4444500	4444500	SSA
PHYSFUN	Physics is Fun	POMORSKA AKADEMIA PEDAGOGICZNA, POLAND	7	02-05-09	01-09-10	16	65750	65750	SSA
PLASCIGARD	Plant Science Gardens: Plant	UNIVERSITAET	5	16-10-09	15-12-11	26	699528	699528	SSA

ENS	Science education for primary schools in European Botanic Gardens	INNSBRUCK, AUSTRIA							
POLLEN	POLLEN: Seed cities for science, a community approach for a sustainable growth of science education in Europe	ECOLE NORMALE SUPERIEURE, FRANCE	12	02-01-10	01-07-13	42	1750000	1750000	SSA
POPBL	School science teaching by project orientation - Improving the transition to University and Labour Market for boys and girls	FACHHOCHSCHULE OLDENBURG/OSTFRIESLAND/WILHELMSHAVEN, GERMANY	17	02-10-10	01-10-12	24	844962	844962	SSA
PROMISE	Promotion of Migrants in Science Education	EUROPAEISCHES TRAININGS- UND FORSCHUNGSZENTRUM FUER MENSCHENRECHTE UND DEMOKRATIE, AUSTRIA	6	02-10-09	01-10-11	24	453500	296000	SSA
ROBERTA-EU	Roberta goes EU	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, GERMANY	1	02-10-09	01-01-13	39	751275	632281	SSA
SCHOOL-FORESIGHT	Launching a Visionary Quest for the Intelligent School of Tomorrow on the basis of Relevant State-of-the-art Scientific and Technological Achievements	INTERNATIONAL ENVIRONMENT AND QUALITY SERVICES S.A, GRECE	7	02-01-08	01-11-08	10	291734	291734	SSA
SCIENCEDUC	Renovation of science teaching in European primary education	ECOLE NORMALE SUPERIEURE, FRANCE	5	02-11-08	01-11-11	36	375000	375000	CA

	with inquiry methods								
SHIELD	Launching an Educational Scientific Journey on Natural Hazards and Disasters - Exploring Today's Achievements, Future Challenges & Expectations with Respect to Forecast, Prevention and Mitigation'	INTERNATIONAL ENVIRONMENT AND QUALITY SERVICES S.A, GRECE	5	02-01-08	01-11-08	10	234340	234340	SSA
SUPERLIFE	Superconductivity in everyday life	BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM, HUNGARY	9	02-06-08	01-10-10	28	390000	390000	SSA
UPDATE	Understanding and providing a developmental approach to technology education	JYVAESKYLAEN YLIOPISTO, FINLAND	16	02-12-10	01-12-13	36	919300	873700	SSA
VENUS TRANSIT 2004	VENUS TRANSIT IN JUNE 2004: EXOPLANETS AND THE SIZE OF THE WORLD	EUROPEAN SOUTHERN OBSERVATORY - ESO EUROPEAN ORGANISATION FOR ASTRONOMICAL RESEARCH IN THE SOUTHERN HEMISPHERE, GERMANY	4	02-01-08	01-01-09	12	616000	480000	SSA
WASTEWATERRESOURCE	Play with water: Introducing ecological engineering to primary schools to increase interest and understanding of natural sciences	HOCHSCHULE WAEDENSWIL - HSW, SWITZERLAND	6	02-11-09	01-07-12	32	307160	264000	CA
WESPA	A Web portal for Energy and Semiconductors Public Awareness	ISTITUTO NAZIONALE PER LA FISICA DELLA MATERIA, ITALY	6	02-01-08	01-07-09	18	3000	3000	SSA

**SSA: Specific Support Action; CA: Coordination action

FP7 projects

For FP7, theprojects of the areas included in *Young people and science* of the action line *Strengthening potentials, broadening horizons* have been considered. Some project related tothe area *Gender dimension of science* and to the action line *Science and society communicate* have been considered as long as they include science education at school and young people and science issues.

Project Acronym	Project title	Coordinator (Name of The Organisation and Country)	Number of Partners Involved	Start Date	End Date	Duration	Total Cost	Total Funding	Contract Type***
ACCENT	Action on climate change through engagement, networks and tools	FONDAZIONE IDIS-CITTÀ DELLA SCIENZA, ITALY	15	01-04-09	31-03-11	24	1348965	1017880	CSA-CA
ARK OF INQUIRY	Ark of Inquiry: Inquiry Awards for Youth over Europe*	TARTU ULIKOOL, ESTONIA	13	01-03-14	28-02-18	48	2785392	2490519	CSA-SA
ASSIST-ME	Assess Inquiry in Science, Technology and Mathematics Education*	KOBENHAVNS UNIVERSITET, DENMARK	10	01-01-13	31-12-16	48	5350835	3971945	CP-FP
CARBOSCHOOLS+	European network of regional projects for school partnerships on climate change research	MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V., GERMANY	10	01-01-08	31-12-10	36	1426197	981553	CSA-CA
CHREACT	Chain Reaction: A Sustainable Approach to Inquiry Based	SHEFFIELD HALLAM	12	01-06-13	31-05-16	36	4040400	3601587	CSA-SA

	Science Education*	UNIVERSITY, UK							
COREFLECT	Digital support for inquiry, collaboration, and reflection on socio-scientific debates	CYPRUS UNIVERSITY OF TECHNOLOGY, CYPRUS	8	01-03-08	28-02-11	36	916260	768942	CSA-CA
CREATIVELITTLESCIENT	Creative Little Scientists: Enabling Creativity through Science and Mathematics in Preschool and First Years of Primary Education	ELLINOGERMANIKI AGOGI SCHOLI PANAGEA SAVVA AE, GREECE	12	01-10-11	31-03-14	30	1989200	1491900	CP-FP
ECB/INGENIOUS	European Coordinating Body in Maths, Science and Technology Education (ECB)	EUN PARTNERSHIP AISBL, BELGIUM	29	01-02-11	31-01-14	36	8134000	3578912	CSA-SA
ENGAGE	Equipping the Next Generation for Active Engagement in Science*	SHEFFIELD HALLAM UNIVERSITY, UK	14	01-01-14	31-12-16	36	2804226	2476238	CSA-SA
ENGINEER	brEaking New Ground IN the sciencE Education Realm	BLOOMFIELD SCIENCE MUSEUM JERUSALEM (BSMJ), ISRAEL	26	01-10-11	30-09-14	36	3151188	2795871	CSA-SA
ESCONET	ESConet trainers	UNIVERSITY COLLEGE LONDON, UK	1	01-01-09	31-07-11	31	609778	543827	CSA-SA
ESTABLISH	European Science and Technology in Action Building Links with Industry, Schools and Home	DUBLIN CITY UNIVERSITY, IRELAND	17	01-01-10	31-12-13	48	3768462	3389648	CSA-SA
EUCUNET	European children's universities network	KINDERBURO UNIVERSITAT WIEN GMBH, AUSTRIA	6	01-03-08	28-02-10	24	666086	594568	CSA-CA
FASMED	Improving progress for lower achievers through Formative Assessment in Science and Mathematics Education*	UNIVERSITY OF NEWCASTLE UPON TYNE, UK	9	01-01-14	31-12-16	36	2478828	1918076	CP-FP

FIBONACCI	The FIBONACCI Project - Large scale dissemination of inquiry based science and mathematics education	ECOLE NORMALE SUPERIEURE, FRANCE	27	01-01-10	28-02-13	38	5343519	4784597	CSA-SA
HELENA	Higher education leading to engineering and scientific careers	SIAULIU UNIVERSITETAS, LITHUANIA	7	01-04-09	30-09-11	30	1212390	930433	CP
HIPST	History and philosophy in science teaching	DEUTSCHE GESELLSCHAFT FUR INTERNATIONALE ZUSAMMENARBEIT (GIZ) GMBH, GERMANY	11	01-02-08	31-07-10	30	1099237	998211	CSA-CA
HULDA	Hulda, the European arts and sciences sailing festival	ILHAN KOMAN KULTUR VE SANAT VAKFI, TURKEY	14	01-05-08	31-12-10	32	1011619	800000	CSA-CA
INQUIRE	INQUIRE- inquiry-based teacher training for a sustainable future	UNIVERSITA ET INNSBRUCK, AUSTRIA	19	01-12-10	30-11-13	36	2622901	2234024	CSA-SA
IRIS	interests & recruitment in science. Factors influencing recruitment, retention and gender equity in science, technology and mathematics higher education	UNIVERSITETET I OSLO, NORWAY	6	01-05-09	30-04-12	36	1284514	999584	CP
IRRESISTIBLE	Including Responsible Research and innovation in cutting Edge Science and Inquiry-based Science education to improve Teacher's Ability of Bridging Learning Environments*	RIJKSUNIVERSITEIT GRONINGEN, NETHERLANDS	14	01-11-13	31-10-16	36	2795284	2498840	CSA-SA
KIDSINNSCIENCE	Innovation in Science Education - Turning Kids on to Science	ÃSTERREICHISCHES ÃKOLOGIE-INSTITUT,	10	01-11-09	31-07-13	45	1233444	999224	CP-FP-SICA

		AUSTRIA							
LIN10	60th Nobel Laureate Meeting at Lindau - Interdiscinplinarity, Internationalisation, and Excellence	STIFTUNG LINDAUER NOBELPREISTRAGER TREFFEN AM BODENSEE, GERMANY	1	01-05-10	30-04-11	12	2283000	55000	CSA-SA
MASCIL	Mathematics and science for life*	PÄDAGOGISCHE HOCHSCHULE FREIBURG, GERMANY	18	01-01-13	31-12-16	48	3776921	3298170	CSA-SA
MIND THE GAP	Mind the gap: learning, teaching, research and policy in inquiry-based science education	UNIVERSITETET I OSLO, NORWAY	9	01-04-08	31-03-10	24	875081	780276	CSA-CA
MOTIVATION	Promoting positive images of SET in young people	BERGISCHE UNIVERSITAET WUPPERTAL, GERMANY	7	01-01-08	31-12-09	24	536488	499888	CSA-CA
MY SCIENCE	My science European program for young journalists	ACCADEMIA EUROPEA PER LA RICERCA APPLICATA ED IL PERFEZIONAMENTO PROFESSIONALE BOLZANO (ACCADEMIA EUROPEA BOLZANO), ITALY	3	01-01-09	30-06-10	18	279779	252612	CSA-SA
PARRISE	Promoting attainment of Responsible Research and Innovation in Science Education*	UNIVERSITEIT UTRECHT, NETHERLANDS	18	01-01-14	31-12-17	48	2899979	2498125	CSA-SA
PATHWAY	The Pathway to Inquiry Based Science Teaching	UNIVERSITAET BAYREUTH, GERMANY	28	01-01-11	31-12-13	36	4143983	3378770	CSA-SA
PRIMAS	Promoting inquiry in mathematics and science education across Europe	PÄDAGOGISCHE HOCHSCHULE FREIBURG, GERMANY	15	01-01-10	31-12-13	48	3309697	2996236	CSA-SA

PRI-SCI-NET	Networking Primary Science Educators as a means to provide training and professional development in Inquiry Based Teaching	OFFICE OF THE PRIME MINISTER, MALTA	17	01-09-11	31-08-14	36	3182780	2836624	CSA-SA
PROFILES	Professional Reflection-Oriented Focus on Inquiry-based Learning and Education though Science*	FREIE UNIVERSITA ET BERLIN, GERMANY	24	01-12-10	30-11-14	48	3825220	3447910	CSA-SA
SAILS	Strategies for Assessment of Inquiry Learning in Science*	DUBLIN CITY UNIVERSITY, IRELAND	14	01-01-12	31-12-15	48	4248429	3748689	CSA-SA
SCICOM	European network of science centres in communicating energy-related topics	WELIOS BETRIEBS GMBH, AUSTRIA	11	01-04-08	31-07-11	40	1000927	894609	CSA-CA
SCIENTIX 2	Scientix 2* ****	EUN PARTNERSHIP AISBL, BELGIUM	1	01-01-13	31-12-15	36	6529484	6000000	CSA-SA
SECURE	Science Education CUrriculum REsearch	THOMAS MORE KEMPEN VZW, BELGIUM	11	01-11-10	31-10-13	36	1817994	1498506	CP-FP
SED	Science Education for Diversity	THE UNIVERSITY OF EXETER, UNITED KINGDOM	6	01-01-10	31-12-12	36	1409821	999982	CP-FP-SICA
SIS CATALYST	SiS Catalyst: Children as Change Agents for the future of Science in Society*	THE UNIVERSITY OF LIVERPOOL, UK	19	01-01-11	31-12-14	48	4560902	4090120	CSA-SA
S-TEAM	Science teacher education advanced methods	NTNU - NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET, NORWAY	27	01-05-09	30-04-12	36	5240157	4699928	CSA-SA
TEMI	Teaching Enquiry with	QUEEN MARY	14	01-02-13	31-07-16	42	3558127	3135919	CSA-SA

	Mysteries Incorporated*	UNIVERSITY OF LONDON, UK							
TRACES	Transformative Research Activities. Cultural diversities and Education in Science	UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II., ITALY	6	01-07-10	30-06-12	24	1198000	996700	CP-FP-SICA
YOSCIWEB	Young people and the images of science on websites	CONSEIL GENERAL DE L'ESSONNE, FRANCE	7	01-01-08	31-03-10	27	540171	489122	CSA-CA

* Project under execution

**CSA-SA: Support actions ; CSA-CA: Coordination (or networking) actions; CP: Collaborative project (generic); CP-FP: Small or medium-scale focused research project; CP-FP-SICA; Small/medium-scale focused research project for specific cooperation actions dedicated to international cooperation partner countries(SICA)

**** Scientix 2 has been preceded by Scientix 1, RTD-L4-PP-2008-1, that put the basis for the portal development.

5 Ethics

Angela Taraborrelli
Department of Social Sciences and Humanities,
National Research Council of Italy

Abstract

The EU and the EC have made significant efforts to promote fundamental rights in research through the ethical review of research protocols, the funding of research on ethical issues raised by science and technology, and the promotion of a pan-European and international dialogue on ethics. In particular, the EU and the EC have funded a number of projects on the relationship between ethics and science under SaS FP6 and SiS FP7. A number of new trends relating research to ethical issues have emerged: greater commitment among most European research funders and research performers regarding the need to actively govern science and to the centrality of ethics within this, the growth of interest in framing codes of conduct for research (research integrity, misconduct), and managing ethical issues more formally and more explicitly. Each of these trends has been taken into consideration in the SwafS programme that will be of great importance in tackling the challenges faced by Horizon 2020.

5.1 EU strategy for Ethics in Science

As Helga Nowotny, president of the European Research Advisory Board, said, science has become so pervasive, seemingly so central to the generation of wealth and well-being, that the production of knowledge has become, even more so than in the past, a social activity, simultaneously both highly distributed and radically reflexive. Science has had to come to terms with the consequences of its own success, both potentialities and limitations (Nowotny, Scott, and Gibbons 2001,1).

In the wake of the innumerable recent developments in fields such as genetics, neuroscience, and new technologies, the ethical dimension of science in terms of its impact and its cost on daily life has come under the scrutiny of both public opinion and political bodies. Being rooted in society and increasingly in the world of politics, science can no longer be considered as independent and apart and it has been at the centre of debates in the developed world for over two decades.

Under existing EU treaties, there is no reference to ethics in research. However, ethical *issues* in research are addressed and the EU's competences in the field derive from other legal sources: in several sectorial EU regulations and directives (patents, clinical trials, data protections, animal welfare, biosafety), in various decisions on framework research programmes (i.e. FP6 and FP7 Framework programmes), in a variety of international treaties and protocols that have been

incorporated into the EU legal order (Charter of Fundamental Rights, Helsinki Declaration, Oviedo Convention).[13]

The EU has assumed a number of significant initiatives to promote responsible science and research that respects fundamental, local, EU, and international ethical principles:

5.1.1 Establishment of the European Group on Ethics in Science and New Technologies (EGE, 1998).

In November 1991, the EC decided to incorporate ethics into the decision making process regarding Community research and technological development policies by setting up the Group of Advisers on the Ethical Implications of Biotechnology (GAEIB). The Commission decided, on 16 December 1997, to replace the GAEIB with the European Group on Ethics in Science and New Technologies (EGE), which acts as advisor to the president of the EC on issues of ethics and science, extending the Group's mandate to cover all areas of the application of science and technology. The Group released opinions during the period 2005-2014 that range from the ethical aspect ofsecurity and surveillance technologies to the ethical aspects of animal cloning for food supply, and from the ethical aspects of nanomedicine to the ethical aspects of ICT implants in the human body.[14]

5.1.2 Creation of an Ethical Review (ER) Institutional Platform for all Community Framework Research Proposals.[15]

The Commission has implemented a thorough ER process for all proposals that raise ethical questions and that are likely to receive Community funding. The ER mechanism aims to introduce, at the outset, the ethical perspective into the working structure of a research consortium, ensuring the compliance of EU research with ethical standards. Research proposals that have successfully passed the scientific evaluation are subject to an ethical evaluation. Through this process, the public's concerns relating to science are represented and addressed. The researchers have to

[13]The European Charter of Fundamental Rights is the cornerstone of the EU's competence on research ethics. The principles of European research ethics are four: the principle of respect for human dignity, the principle of utility, the principle of precaution, and the principle of justice (See *Concepts on Ethics*,2008).

[14]See, EGE's opinions, studies and general activity reports, http://ec.europa.eu/bepa/european-group-ethics/publications/opinions/index_en.htm (Accessed 15 August 2014).

[15]'All research activities carried out under the 7th Framework programme shall be carried out in compliance with fundamental ethical principles' (Decision 1982/2006/EC of the European Parliament and of the Council, Recital 30 and Article 6). The Ethics Review process is described in detail in the *Rules for submission of proposals, and the related evaluation, selection and award procedures*. The major change in FP7, compared to FP6, is that the ethics review is carried out on the proposal that is originally submitted with no additional information requested on ethical questions after scientific evaluation. The new *Rules* published on 22 March 2011 offer a detailed description of the new ER process, including the Ethics Screening and the Ethics Follow-up and Audit. See http://ec.europa.eu/research/participants/fp7documents/funding-guide/8_horizontal-issues/3_ethics_en.htm.

consider the impact of their research, not only in terms of scientific advancement, but also in terms of human dignity and social and cultural impact.[16]

The most common ethical issues include 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 breaches of research integrity (avoiding fabrication, falsification, plagiarism, or other research misconduct), research involving developing countries, and dual use.[17]This process is intended to ensure the protection of fundamental rights and the respect for ethical principles. Funds cannot be allocated to research that does not comply with relevant EU and national legislation and the ethical considerations specified in the Framework Programme. All research projects that raise ethical issues undergo an ethics review at the EC level. Special attention is paid to research proposing interventions on human beings (such as surgical procedures or clinical trials), on other primates, and research uses human embryonic stem cells. Some areas are excluded from EU funding. These are human cloning for reproductive purposes, altering the genetic heritage of human beings, and creating human embryos only to conduct research or obtain stem cells. TheER mechanism provides legal guarantees to both research and human subjects, safeguards the social legitimacy and market/consumer acceptance of the eventual research findings, meets the public's concerns and international requirements, and provides a predictable and well-structured regulatory research environment for researchers who apply to FP7 (Kritikos 2009).[18]

All proposals that are selected for funding and raise ethical issues undergo an Ethics Review by independent experts in research ethics coming from a variety of scientific disciplines. The review is split in two phases: the Ethics Screening and the ER.

All FP7 funded projects can request specific assistance on ethics issues from the ER Helpdesk, accessible through the 'get support' function on the CORDIS site.

Proposals that undergo an Ethics Screening and an ER can be flagged by the reviewers as requiring an Ethics Audit/Follow-Up. The objective of the Audit procedure is to assist researchers in dealing with the ethics issues that are raised by their work and if necessary to take corrective measures. During 2013, a number of audits have taken place, regarding among others Security, hESC, and Child Health Intervention Projects.

[16]In a survey recently requested by the European Commission, Directorate-General for RI, to the question: 'Do you think that science and technology should be allowed to violate fundamental rights and moral principles in order to make a new discovery?' most respondents think that fundamental rights and moral principles should not be violated in order to make a new scientific or technological discovery (61%). Almost three in ten (29%) think this should be allowed -in some cases-, while only 4% think it should be allowed -in all cases- (*Special Eurobarometer 401*, 2013).

[17]Dual-use items are goods, software, and technology normally used for civilian purposes but which may have military applications.

[18]Following the 2012 call for proposals, a *Mutual Learning and Mobilisation (MML)* action on Ethics was launched in 2013. The MML will bring together stakeholders in the ER procedure from across Europe (such as Research Ethics Committees, research associations etc.). The aim is to promote discussion and the development of approaches for the ER framework at the European level.

The ER Sector of DG RTD has organized a number of specialized workshops and focused training activities in order to facilitate the uptake of the ethics review procedures by all research related Commission and Executive agencies staff. The issues covered involve *inter alia* Research Ethics and Integrity, Innovation, Ethics Issues in Space, and Security Research.

Under the aegis of the Ethics Review Sector of DG RTD, Guidance Notes were prepared to serve as a support for those writing or reviewing research proposals on Human Security in Research, Risk-Benefit Analyses and Ethical Issues, the Roles and Functions of Ethics Advisors/Ethics Advisory Boards in EC-funded Projects, How to complete your ethics Self-Assessment, and also on Data Protection and Privacy. These toolkits are valuable guidance documents for researchers, evaluators, Commission and Executive Agencies staff, as well as anyone interested in the ethical issues in research.

5.1.3 Adoption of Action Plans and other policy initiatives for the promotion of responsible research and for linking scientific research closer to societal and ethical concerns and funding of research projects that examine the ethical standards in science and research.

The EU and the EC have funded a number of projects under SaS FP6 and SiS FP7 on the relationship between ethics and science; the rest of this chapter is devoted to their analysis.

In June 2001, the Council of Ministers delivered a resolution inviting the Member States and the EC to start a public dialogue on ethical issues in relation to science and new technologies at the European level and to integrate ethics into research practices. The EC responded to this invitation by presenting, in December 2001, the *Science and Society Action Plan*. The plan outlined the Commission's strategy for addressing the relationships between science and society and the harmonization of approaches. This was subsequently adopted in the SaS theme in the FP6 (2002-2006) and specified in 38 individual actions. Six of these actions were specifically intended to demonstrate that responsible science is being placed firmly at the core of European policy making. In relation to ethics, the main goals were specified in actions 29–34 and are as follows:

1. An information and documentation observatory will be developed to help track and analyse the development of ethical issues in science at national and international level (action 29);

2. An open dialogue will be established between NGOs, industry, the scientific community, religious and cultural groups, philosophical schools and other interested groups, stimulating an exchange of views and ideas on a range of critical issues, such as the ethical impact of new technologies on future generations, human dignity and integrity, 'info-ethics' and sustainability. A variety of mechanisms will be used (focus groups, polling exercises, debates, workshops or institutional forums etc.) (action 30);

3. Model courses and training modules will be developed in order to raise the awareness of researchers in the field of ethics (action 31);

4. Networks of ethics committees will be fostered at both national and local levels. The aim will be to achieve closer cooperation and a more effective exchange of experience and best practices (action 32);[19]

5. An international dialogue on ethical principles will be developed through a series of conferences and workshops. An important aim will be to build a capacity for ethical review in developing countries (action 33);

6. Networks of animal welfare committees will be fostered and training of young scientists on animal welfare issues will be promoted to support the implementation of European legislation on the protection of animals in research (action 34).

The mid-term evaluation of FP6 (2007, 39-40) found that progress had been made in implementing the FP6 action plan proposals, and made the following recommendations regarding ethics:

1. There is a strong need to foster cross-disciplinary dialogue in this field. Integrating ethical issues in a substantial manner in other strands of SaS as well as, more widely, in the FP needs to become a priority. There is, for instance, much to be gained from raising ethical issues in educational contexts.

2. Genetics, nanotechnology and, more generally, the cutting-edge technologies tend to dominate the ethical landscape of the SaS activities to the exclusion of other fields. There is a need to realign this focus so that it covers all areas of ethical novelty rather than concentrate on ethical issues in novel science disciplines.

3. There is little reflection demonstrated by the projects and other activities concerning the role of the private sector and commercialization. For instance, ethical implications of the commercial use of new technologies remain largely unexplored and could usefully be identified in the future priorities.

4. There is a need to map existing practices in science-related ethics and to develop indicators to monitor its development in the future.

In 2007, in order to give effect to these recommendations, the DG-Research expanded SaS into the SiS programme (2007-2013) under the Specific Programme 'Capacities' in the FP7 for Research and Technological Development. The main aim of this was to encourage public engagement and meaningful dialogue between science and civil society.

[19]The EC included in its Science and Society Action Plan the idea of a NEC Forum, which was approved in December 2001. The NEC Forum is an independent, informal platform for the exchange of information and best practices on issues of common interest in the field of ethics and science. Each meeting included a joint session with the EGE which acts as advisor to the president of the EC on issues of ethics and science. NEC Forum membership comprises the chairpersons and secretaries of National Ethics Councils. The basis of the NEC Forum is the first meeting of the NEC Forum taking place in Athens, Greece in June 2003 at the initiative of the Greek Ethics Council.

BOX 5.1 Definition of ethics

Ethics is one of the 6 keys that comprise the Responsible Research and Innovation framework.

Ethics: 'Do the right thing and do it right'.

'European society is based on shared values. In order to adequately respond to societal challenges, research and innovation must respect fundamental rights and the highest ethical standards. Beyond the mandatory legal aspects, this aims to ensure increased societal relevance and acceptability of research and innovation outcomes. Ethics should not be perceived as a constraint to research and innovation, but rather as a way of ensuring high quality results'.

Source: Responsible Research and Innovation. Europe's ability to respond to societal challenges, European Union 2012, http://ec.europa.eu/research/science-society

A number of new trends in research relating to ethical issues have emerged over the years. The report of the project Masis (Siune et al. 2009) highlighted the emergence of a new concept in the area of ethics – responsible development and innovation – that presaged the 2011 SiS high-level objectives, Responsible Research and Innovation. Moreover, it stressed the widening commitment among most European research funders and research performers regarding the need to actively govern science and the centrality of ethics within this governance. One may also add to these the growth in interest in creating codes of conduct for research (research integrity, misconduct) and managing ethical issues more formally and more explicitly(Technopolis group, 2012a, 71).

Each of these trends has been taken into consideration in the SwafS programme that will be important in tackling the challenges identified by Horizon 2020. This will require improving capacities and developing innovative ways of forming connections between science and society, adopting a new approach to research and innovation termed Responsible Research and Innovation (RRI). RRI approach sees ethical compliance as pivotal to the achievement of research excellence.

For the Horizon 2020 FP, the EC proposes to continue with the same ethical framework for deciding on the EU funding of human embryonic stem cell research as in the 7th Framework Programme. The programme of work for SwafS 2014-2015 also seeks to promote **research integrity** andto focus attentionon the issue of **ethics dumping**. Owing to increased globalisation in research activities, there is a risk that European organisations may try to conduct ethically sensitive research outside EU borders in a way that might not meet ethical standards within Europe. In order to reduce the risk of such ethics dumping, the EC promotes collaboration between European, national and international ethics bodies at all levels; additionally, it encourages the identification of good practices with a view to the development of a code of conduct for all actors.

Table 5.1 - Relevant Steps in the Field of Ethics and Science	
2000	Commission working document on Science, society and the citizen in Europe The Charter of Fundamental Rights of the European Union signed and proclaimed on 7 December 2000
2001	Council Resolution 26 June 2001 on Science and Society
2002	EC, Science and Society Action Plan
2002	Council Decision Adopting a specific programme for R&TD structuring the ERA
2006	Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006
2007	EC, Taking European Knowledge Society Seriously
2009	EC Research, The First MASIS Report.
2011	EC DG Research Workshop on RRI
2013	REGULATION (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and REGULATION (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013 lay down the rules of participation and dissemination in H2020.

5.2 A 'Snapshot' of SaS and SiS Research Projects Dealing with Ethics in Science

Aimed at ensuring that the rapid progress of science is in harmony with fundamental ethical principles, SaS and SiS activities have promoted responsible research in Europe and in the public dialogue, the monitoring and the early detection of ethical and social issues and risks arising from new technological developments for the benefit of policy makers and other interested groups.

These activities include: 1) networking between existing bodies that deal with ethics and other relevant fields in Europe; 2) promoting global dialogue concerning ethics in research with other regions; 3) awareness-raising and training activities in ethics; 4) coordination and development of codes of conduct for research activities and technological developments; 5) research on ethics in relation to science, technological developments, and their applications (nanotechnologies, human genetics, biomedical research, food technologies, etc.).

5.2.1 The Activities Carried out under FP6

Thirty-five projects were funded under SaS FP6 and these can be grouped into four types: integrated projects (1), specific support actions (17), coordination actions (8), specific targeted research projects (9). The activities of the programme are in line with the main objectives as defined by the Action Plan, and all the activities have contributed to its implementation with the exception of Action 34. The projects follow the objectives and arrangements for FP6 and are devoted to the following priorities:

1. Capacity building to develop and update codes of conduct, tools and institutional capabilities (BIOTETHED, EDCEP, EDUBIOETHICS, ETHICSCHOOL, INES, SUMMERETHICS, TWR);

2. Networking to facilitate capability building through interaction and the harmonization and sharing of good practice (BIONET, CEC-WYZ, ENWISE ETHICS, EULABOR, FASTER, HEALTHRESEARCHETHICS, MONGOLETHICS, NEBRA);

3. Research to deepen the understanding of ethical issues raised by emerging science and technology (BeSha, BITE, COB, DEPEEN, ENHANCE, ETHICSBOTS, from GMP to GBP, GENBENEFIT, IMGBCHIMERASHYBRIDIS, NANOBIO-RAISE, NANOCAP, REPROGENETICS);

4. Research to better understand new questions that may relate to the novel application of existing technologies and emerging fields (i.e. privacy and civil security) (EDIG, ETHICTRANSPLANTATION, ETHICALTRACEABILITY, EU-RECA, EUROBESE, GENEBANC, PRIVILEGED, PROPEUR).

The main achievements of the SaS programme relating to ethics were, *inter alia*(Papon et al. 2007,10; Rietschel et al. 2010, 45):

1. The programme has established a forum and a context at the European level for examining Science and Society issues in a manner that provides reflective activities on specific issues related to scientific and technological research (such as Ethics).

2. Conferences and forums have launched debates in several areas at the European level with a high level of participation from a diversity of actors. They have doubtless contributed to enhancing the visibility in Europe of important issues in areas such as ethics, women and science, and scientific communication, and have provided pilot examples of methodologies to achieve this in a broader spectrum of issues.

3. The Science and Society projects have supported a wide range of studies and participatory events in theethics area. In the governance and ethics fields, SaS actions have led the European Commission to adopt a Code of Conduct for responsible nanoscience and nanotechnology research. It is worth mentioning alsothe *25 Recommendations on ethical, legal and social implications of genetic testing* (SaS), which were intended to function partly as 'a "code of conduct" for any actor in the field of genetic testing and partly as "an action plan for genetic testing" to be implemented by policy-makers' (McNally et al. 2004, 6).

The mid-term assessment (2007, 39-40) lists the following recommendations:

1. The projects mainly focus on the most recent technologies, such as genetics, reprogenetics, and nanotechnology. They should also investigate new ethical questions involved in the new application of already routinely used technologies.[20]

[20]For example, if genetic tests are used for insurance purposes or in gatekeeping activitieslimiting access to sport or for commercial purposes, this gives rise to new and specific ethical issues which go beyond those entailed in genetic testing itself (e.g. data protection and access to genetic information, a clashbetween commercial law andbioethics, discrimination and adverse selection). For some critical reflections on the exclusive focus on genetics see the *25 Recommendations on ethical, legal andsocial implications of genetic testing* (2004).

2. As is common in Ethics research, the most crucial community to be reached are not the ethics researchers but the science researchers and science practitioners working in the corresponding fields. This needs to be taken into account in designing future activities.

3. In terms of the policy implications and potential impact of the funded activities in this area, there is also a need to involve policy-makers and institutions beyond only a commitment to participate and towards a commitment to explore policy shifts in their practices.

4. Little reflexivity is demonstrated by the projects and other activities concerning the role of the private sector and commercialization. For instance, ethical implications of the commercial use of new technologies remain largely unexplored and could usefully be identified in future priorities.

5.2.2 The Activities Carried out under FP7

The slight rebranding of 'Science and Society' to 'Science in Society' in the seventh EU Framework Programme highlighted an increasing level of appreciation for the idea that the production of scientific knowledge is a social activity. The 2010 SiS WP built on the foundations laid down in the 2009 WP, which sought to encourage more focused and structured actions that would have a greaterEuropean impact in order to promote a more effective critical mass of projects involving a wider range of key actors. The WP also encourages more focused work on ethics, namely: 1) research on the role of ethics under EU policy and law at global level and 2) investigation of ethics capacity building in research.

Approximately 31 FP7 projects fall in the area of ethics, equally divided between coordination and research activities. However, there is a greater representation of research projects in the ethics portfolio than in the overall SiS programme in which the ratio is closer to 3:1 in favour of coordination and support actions (Technopolis group, 2012a, 71).The Commission has attempted to keep abreast of current issues with calls to develop support frameworks to address the growth in the number and importance of bio-banks within the general research landscape. The calls are also directed to examine the possible implications of European research cooperation with third countries where there may be significant divergence from accepted EU good practices in terms of governance systems and ethical standards. While MML actions did not have a significant role, the 2012 WP does call for MMLs in relation to RRI for synthetic biology, human enhancement and health and active ageing; one aspect of this work will require the consideration of the ethical implications of new applications and therapies.

The individual FP7 SiS WP includes a wide range of ethics related topics under Action Line 1, 'a more dynamic governance of the science and society relationship.' The project portfolio is quite heterogeneous but can be classified in these areas:

1. Networking or capacity building (ETHICSWEB, EURECNET,SET-DEV);[21]

[21]Capacity building for ethics compliance was in FP7 a key objective for the Governance and Ethics unit.

2. Research on ethics in science and technology. Several projects are devoted to research on privacy issues related to new technologies and applications, from biometrics for security to the Internet of Things (ETHICALPATS, PRACTIS, PRESCIENT);

3. Research into the ethical implications of new applications or emerging technologies, such as synthetic biology (SYBHEL, SYNTH-ETHICS);

4. Ethical frameworks of new technologies(EFORTT, STEPE, TECHNOLIFE, VALUE ISOBARS); 4.1 Research underpinning policy support related to ethics precaution, and sustainable development (INNOVA-P2);

5. Ethics and new and emerging fields of science and technology (EGAIS, ETHENTECH);

6. Ethical issues in emerging ICT applications (ETICA, ICTethics, PHM-ETHICS);

7. Promoting trust and self-regulation in the scientific community, i.e. governance and ethics of the responsible development of nanosciences and nanotechnologies (NANOCODE);

8. Research on the relationship between science, democracy and law (EPOCH, GEST); 8.1.Regulating emerging scientific and technological developments (ROBOLAW).

9. Conditions for an informed debate on ethics and science, i.e. promotion of pan-European and international awareness of the ethical aspects of security technologies (HIDE, RISE);

10. Broader engagement of citizens to anticipate and clarify political, societal and ethical issues (NERRI, ASSET).

According to the Interim Evaluation on research ethics, the programme has been successful in forming improved networks of Research Ethics Committees. Central portals for the distribution of relevant materials and guidance have also been established. The programme has also contributed to the development and implementation of ethics frameworks and review procedures across the EU and elsewhere. The development of new insights and practices in the areas of privacy and social impact assessment has also been supported by the programme (Technopolis Group,2012a, 122-123)

5.3 Best Practices

A project gains the status of 'best' or 'promising' practice when it is: *measurable* (i.e. its goals are clear and the progress toward them can be measured), *notably successful* (i.e. the method or programme not only yields good results, but makes more progress towards achieving its goals than most other projects with similar aims), *replicable* (i.e. the method or programme is structured and documented clearly enough so that it can be reproduced elsewhere).[22]

[22]See *Community Tool Box*, http://ctb.ku.edu/en/table-of-contents, Ch. 19, sect. 6: 'Promoting the Adoption and Use of Best Practices' (Accessed: 15 August 2014)

Keeping in mind these three qualities and the objectives of the Commission concerning ethics in science, out of the projects funded under SiS in FP6 and FP7, the following best practice projects were identified:

The **ETHICSWEB** project (FP7, area 1).

Inter-connected European information and documentation system for ethics and science: European ethics documentation centre.

Start date: 01/06/2008 **End date**: 31/08/2011 **Total Funding**: 896 321 €**Contract type**: CSA-CA - Coordination (or networking) actions.

Science is fraught with ethical concerns, and scientists need access to ethical information. The ETHICSWEB project worked to make this possible. It is essentially a large database, connecting disparate information sources via a single, easy-to-search (but sophisticated) multilingual interface. It currently includes 27 respected databases and about 500,000 records in total. It has become the world's largest provider of scientific ethics information. The purpose of the undertaking was to foster democratic debate in Europe. The ETHICSWEB's portal constitutes the project's focal point, and provides more than just a searchable database. It also offers a dynamic authoritative environment, a place for partners to coordinate their work via dedicated forums, and a safe repository for public and non-public documents.[23]

1. The **PRESCIENT** project (FP7, area 2).

Privacy and emerging fields of science and technology: Towards a common framework for privacy and ethical assessment.

Start date: 01/01/2010 **End date**: 31/03/2013 **Total Funding**: 998 227 € **Contract type**: CP-FP - Small or medium-scale focused research project.

The study team revisited the notion of privacy in the context of the social network revolution, and fed the results into discussions with the European Commission about new proposals for data protection. It has also broadened the model of Privacy Impact Assessment Frameworks (PIAs) to include ethical issues (Privacy and Ethical Impact Assessment, P+EIA), beyond data protection and privacy aspects. This broadened perspective is a major contribution to the establishment of a sound and updated working approach in view of the rapid development of the new social environment.[24]

The **ETICA** project (FP7, area 6).

Ethical issues of emerging ICT applications.

Start date:01/04/2009 **End date**: 31/05/2011 **Total Funding**: 828 249 € **Contract type**: CP - Collaborative project (generic).

[23]For more details see "A database for ethics in science". http://cordis.europa.eu/result/brief/rcn/6303_en.html.

[24]For more details see *A privacy and ethical impact assessment framework for emerging sciences and technologies. Final Report. Towards a common framework for privacy and ethical assessment*, Karlsruhe: Fraunhofer, Online Access: http://publica.fraunhofer.de/documents/N-238503.html.

Researchers have identified emerging ICT applications and their potential areas of usage in order to analyse and evaluate their related ethical issues. This has been achieved particularly through wider stakeholders' engagement and consultation. By exploring technologies, ethical issues and current ways to address these, ETICA was able to develop two sets of recommendations: one for policymakers, and one for individuals and organisations involved in ICT research and development. In the future, implementing such recommendations will contribute to better and more ethically sensitive processes of ICT development across Europe. ETICA has significant impact, both academically and in terms of policy development. The project has essentially contributed to show how ethical issues of emerging technologies may be identified, and how in the process technology development is helped, especially at European level. This has been achieved in particular through wider stakeholder engagement and consultation, as seen from the collaborative ETICA/STOA Parliamentary Event in Brussels, as well as through the EU training event with personnel closely linked to ethics and ICTs. ETICA findings will support the European Group on Ethics in Science and Emerging Technologies in developing its Opinion on the Ethics of ICT.[25]

5.4 Lessons Learnt and Some Open Challenges

TheEU and the EC have done their best to promote ethics in life science and biotechnology research, to integrate it in the ERA, and toinstitutionalise it into their own decision-making processes. They have made significant efforts in promotingfundamental rights in research through the ER of research protocols,thefunding of research on ethical issues raised by science and technology, and thepromotion of pan-European and international dialogues on ethics. Due to this intense activity some common European ethics standards have been launched in areas related to research ethics, and several codes of conduct, guidelines and recommendations have been delivered, which have often inspired national governments, private foundations, and even scientific institutions outside Europe. The projects devoted to ethics and science and funded under SaS and SiS programmes had, among others, the objective to specify the ethical criteria that should be applied to the research. The SaS and SiS programmes have not only contributed to increasing the awareness of the importance of ethics in the scientific community, but have also created relevant guidelines directly applicable to the projects funded by the Commission and the whole ERA.

[25]For more details see the Final Report Summary - ETICA (Ethical Issues of Emerging ICT Applications) (http://cordis.europa.eu/result/report/rcn/56066_en.html).

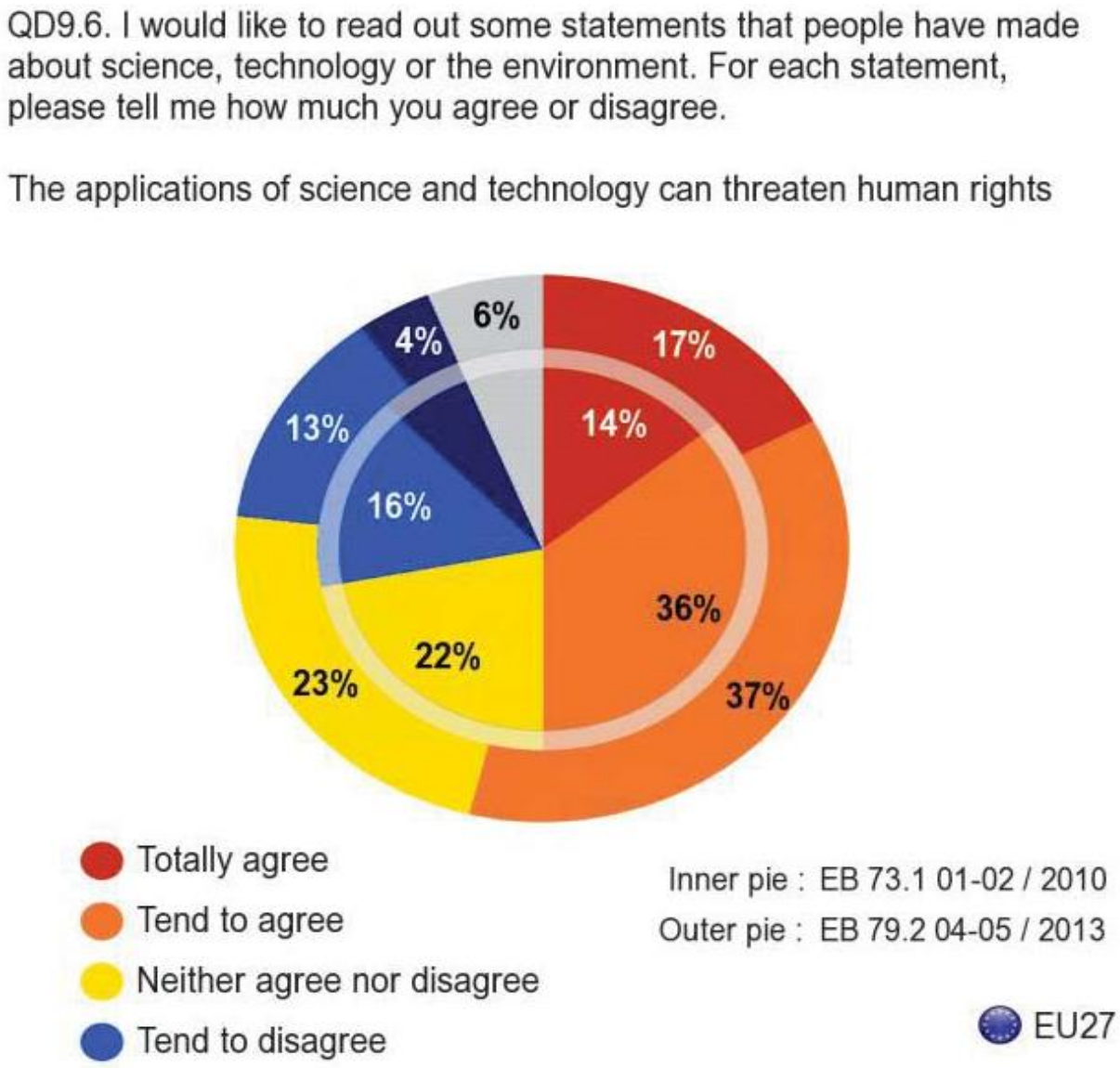


Figure 5.1 Can the application of science and technology threaten human rights?

Source: Special Eurobarometer 401. Responsible Research and Innovation (RRI), Science and Technology. Summary. November 2013, p. 22.

Some lessons can be outlined from the projects funded under theSaS and SiS programmes:[26]

1. Success depends on effective interconnections between the major stakeholders including regulators, funders, research institutions, industry and representatives of civil society.

2. The field of Ethics has become an important domain where certain European standards have already evolved. However, it remains unclear whether research should involve the imposition of any kind of 'hard' legislation (such as EU Directives or Regulations) or should relate only to voluntary codes of conduct, standards etc.

[26]See Technopolis group, 2012b, 38-39.

3. While the greatest focus tends to be on newly developed technologies or newly identified risks it is equally important that sufficient attention is given to issues that arise from the application of old technologies to new areas.

4. Clear advantages can be acquired from increased efforts to share good practices internationally and to promote the diffusion, acceptance, and widespread application of new standards, codes and practices.

5. In relation to policy implications and the potential impact of the funded activities in this area, it is clear that there is also a need for greater involvement from policy-makers and institutions that goes beyond the mere commitment to participation. An undertaking to explore policy shifts in their practices is also required.

6. Academia remains the main target of many of the funded activities. This brings with it the risk that much of the expertise being developed remains within narrow circles.

7. In relation to privacy, it must be observed that the threats posed by the collection and processing of data to members of minority and dissenting social groups have not been addressed, nor have they taken steps to protect the rights, liberty and dignity of marginalised groups, vulnerable populations, and minorities.

There is a need to extend the debate about ethics and research beyond the high profile areas of science and innovation (e.g. nanotechnologies, genetics, etc.) to include more mainstream areas such as environmental management, healthcare, social science research, etc. Additionally, our understanding of the problems raised by moral difference about the ethics of research both within and across national boundaries need to be investigated more in depth. The awareness of ethical issues among EU researchers and companies needs to be increased through embedding ELSA as compulsory requirement in research and development (e.g. product development). As Máire Geoghegan-Quinn argued:

'European society is based on sharedvalues. In order to adequately respondto societal challenges, research and innovation must respect fundamental rights and the highest ethical standards. Beyondthe mandatory legal aspects, this aims to ensure increased societal relevance and acceptability of research and innovationoutcomes. *Ethics should not be perceived as a constraint to research and innovation, but rather as a way of ensuring highquality results'*(Máire Geoghegan-Quinn, 2012).

5.5 Some Key Messages from the Rome SiS-RRI Conference

Amongst other topics, the Rome SiS-RRI Conference devoted a session to Ethics and Research Integrity (RI). The Rome Declaration issued an appeal to ensure full respect of ethical considerations in science education, in defining research agendas and conducting research, in allowing access to research results, and in applying new knowledge in society.

In the papers' presentation, much attention was given to ethical issues that deal with research integrity, such as the correct conduct of researchers, who are requested to avoid conflicts of interest (CI) and misconduct in research (as fabrication, falsification, plagiarism, or deception in proposing,

carrying out, or reporting results of research), and deliberately dangerous or negligent deviations from accepted practices in carrying out research. Suggestions were proposed about the interpretation of CI and how to tackle it and ample space was given to the issue of transparency. Moreover, an appeal was launched to reflect on the meaning of responsibility, and to overcome an ethical approach dealing exclusively with the consequences of research. The debate focussed on the role of stakeholders in implementing ethics considerations in research and on the conflict that may arise between social acceptability, research, and EU competitiveness at the global level.

A number of key messages that emerged were presented in the plenary session and forwarded to the EC:

1. *Risk-benefit analyses and ethical issues*. In RRI, full respect of ethical considerations cannot be reduced to the ELSI approach in which responsible innovation essentially boils down to an awareness of the potential consequences of the future development of a new technology. Doing so would place a serious restriction of the scope of ethics because it puts too much focus on risk issues and on technical solutions to ethical problems; this reduces responsibility to managerial prudence, encouraging an attitude among scientists to self-regulate and develop innovation for the benefit of society without intervention or involvement of the state or of the civil society (Bensaude Vincent, 2014).

2. *The role of RI in RRI*. RI is a key element enabling an effective implementation of RRI;[27] it can serve as a bridge between science and society by building trust both inside the scientific community and between the scientific community and society, enhancing the reputation of scientists and science in the public at large.

3. *Need for transparency*. The interest of the public can be promoted by facilitating a conduct of research that is safe and ethical, and includes the promotion of transparency in research. Transparency is a key issue with respect to public confidence, participant confidence in clinical trials, and clinical confidence. Transparency builds public confidence, enhances industry reputation, encourages participation in research, and protects patient's health. Transparency should be regarded as a European and global issue (Montgomery, 2014).

4. *Tensions betweenethics and RI*. An apparently still overlooked aspect is how general principles and recommendations about RI might conflict with those related to principles of ethics, bioethics, and societal interests.[28] Real and theoretical cases in which societal interests might conflict with research integrity principles are a yet unexplored subject of both research and public engagement, and the RRI framework seems to be the ideal avenue to pursue them (Fanelli, 2014).

[27]The SaS and SiS programmes had no calls specifically about RI. Research and activities about research integrity were pursued within calls with other aims, for example health or biomedicine. The Horizon 2020 agenda has included under the RRI framework a call about RI. This call intends to support research aimed at quantifying the prevalence of scientific misconduct, working on education, prevention, and related solutions.

[28]The debate around whether research on influenza A virus subtype H5N1should be published, as RI principles would recommend, or it should be censored, as concerns for public safety would impose, is a paradigmatic case.

5. *The duties of society towards science and research*. The public at large also have a duty of 'integrity', which means that they have a duty to be open to dialogue, to be more tolerant, and to deepen knowledge of scientific issues.

6. *CI, trust in science, and quality of research.*CI may generate suspicion in the public at large and may prevent RRI in being fully implemented. CI may rise not only for economic reasons, but also for personal, political, religious, ideological reasons that are just as important. CIs are often not declared, although increasingly they are, for instance in medical journals. They have a strong influence on which research is carried out, what conclusions are drawn, and how and whether research is published, and on guidelines and policies. CIs have played an important part in much poor quality experimentation. To respond to them, it is necessary to recognise their importance and pervasiveness and try to establish and enforce clear rules (Smith, 2014).

7. *The role of the media.* Scientific journalists have an important role to play and should involve society in ethics and research integrity issues by increasing the awareness of the importance of these issues.

8. *The possible tension between social acceptability and research.*To ensure long-term value and credibility to research, researchers need to exhibit an understanding of the public's concerns and convey a reassurance that ethical values are being safeguarded. Long-term sustainability of given research practices is threatened whenever some elements of a society strongly feel that a trade-off is being forced upon their values, when scientists do not appear to be listening to their concerns, or if they feel that they are not part of the dialogue.[29] Yet, complying with societal requests can risk decreasing the ability of the EU to be globally competitive (as in the case of research on animals).

9. *EU and EC more active and pro-active*. Policy, regulation, guidelines, and other governance measures are necessary, and should not be left to individual self-governance. The EU and EC should be more active and pro-active in establishing ethical Codes of Conduct, and in establishing a common and *global* framework for RRI applicable to the design of research processes.

[29] See European Commission, 2013b, 6.

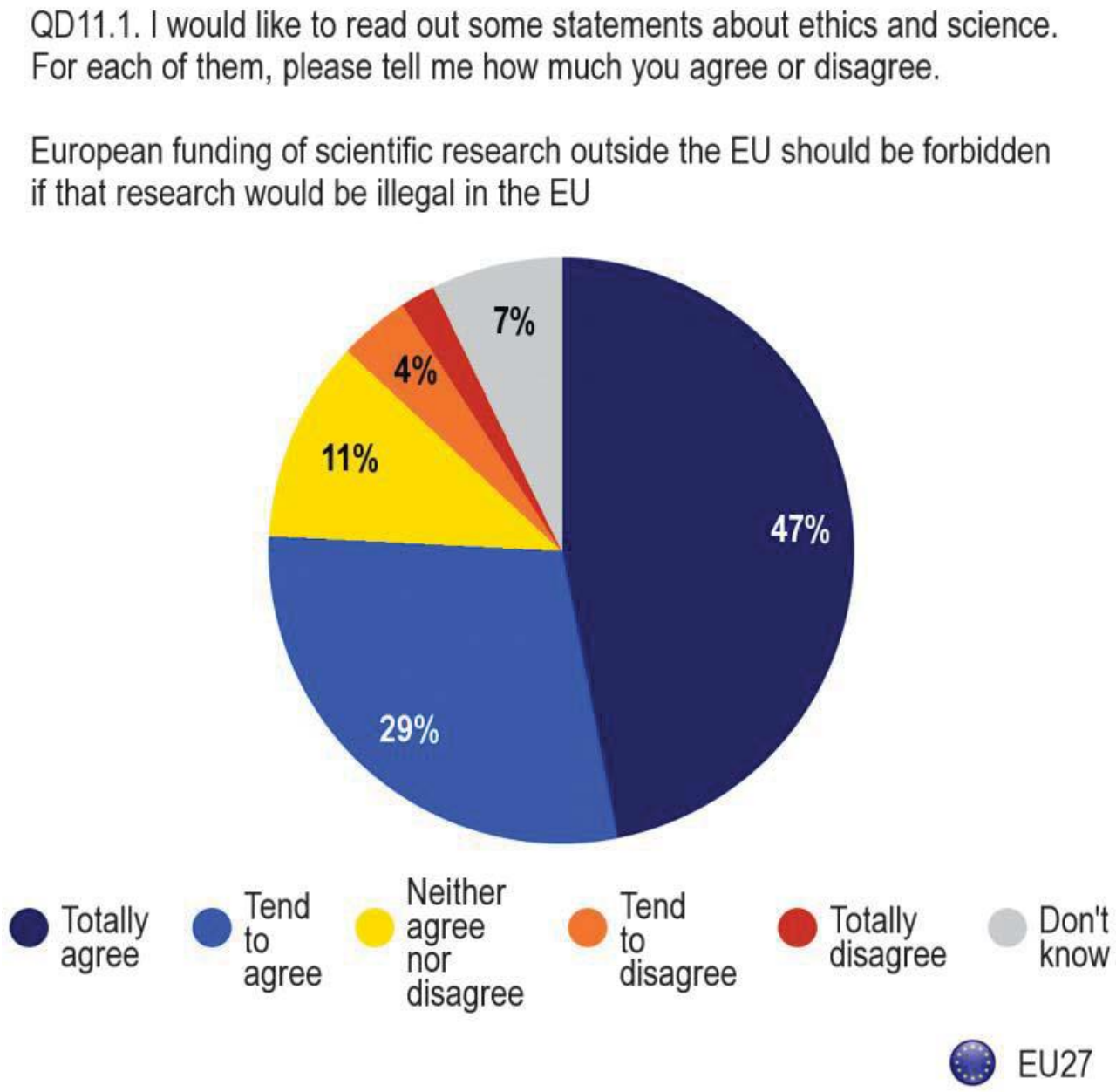


Figure 5.2 Should European funding of scientific research outside the EU be forbidden if that research would be illegal in the EU?

Source: Special Eurobarometer 401. Responsible Research and Innovation (RRI), Science and Technology. Summary. November 2013, p. 23

Referenceschapter 5

European Commission. 2008. "Concepts on Ethics"
http://ec.europa.eu/research/participants/data/ref/fp7/89878/ethics-concepts_en.pdf

Geoghegan-Quinn, Máire. 2012."Message delivered at the conference "Science in Dialogue - Towards a European Modelfor Responsible Research and Innovation -Odense, Denmark, 23-25 April 2012"
http://ec.europa.eu/research/science-society

Kritikos, M. 2009. "Ethical Review of EU-funded research projects, Unit of Governance and Ethics Directorate for Science, Economy and Society DG Research European Commission, London".
https://www.ucl.ac.uk/cpjh/recs-presentations/RECs-mihail

McNally, E. et al. 2004. "25 Recommendations on ethical, legal and social implications of genetic testing." Luxembourg: Office for Official Publications of the European Communities.

McNally, E. et al. 2004. "Ethical, legal and social aspects of genetic testing: research, development and clinical application." Luxembourg: Office for Official Publications of the European Communities.

Mejlgaard, N. et al. 2012. "Monitoring Policy and Research Activities on Science in Society in Europe (Masis), Final synthesis report." Luxembourg: Publications Office of the European Union.

Nowotny, H. et al. 2001. "Rethinking science: Knowledge and the Public in an Age of Uncertainty." Cambridge: Polity Press.

Papon, P. et al. 2007. "The Mid-Term Assessment. Science and Society Activities 2002-2006, Final Report. European Commission."
http://ec.europa.eu/research/science-society/document_library/pdf_06/1-mta-report-22032007_en.pdf

Rietschel, E. Th. et al. 2009. "Evaluation of the sixth framework programmes for research and technological development 2002-2006. Luxemburg."
http://ec.europa.eu/research/reports/2009/pdf/fp6_evaluation_final_report_en.pdf

Siune, K. et al. 2009. "Challenging Futures of Science in Society - Emerging trends and cutting-edge issues." Luxembourg: Publications Office of the European Union.

Technopolis Group, Fraunhofer-ISI. 2012. "Interim evaluation & assessment of future options for Science in Society Actions. Interim evaluation. Final Report."

http://ec.europa.eu/research/science-society/document_library/pdf_06/phase01-122012_en.pdf

Annex 5 - Main Projects in the Ethics Area.

FP6 Projects

Project Acronym	Project Title	Coordinator (Name of Organization and Country)	Number of Partners Involved	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type
BESHA	Genomics and Benefit Sharing with Developing Countries	UNIVERSITY OF CENTRAL LANCASHIRE, UK	4	01-01-2004	31-12-2004	12	80 512	79 912	SSA
BIONET	Ethical governance of biological and biomedical Research: Chinese-European Co-operation	DE MONTFORT UNIVERSITY, UK	20	01-10-2006	30-09-2009	36	739129	739129	SSA
BIOTETHED	Biotechnology Ethics: deepening by research, broadening to future applications and new EU members, permeating education to young scientists.	UNIVERSITÀ DEGLI STUDI DI GENOVA, ITALY	16	01-09-2005	31-08-2008	36	980 600	980 600	CA
BITE	Biometric identification technology ethics promoting research and public debate on bioethical implications of emerging biometric identification technologies	CENTRE FOR SCIENCE, SOCIETY AND CITIZENSHIP, ITALY	9	01-10-2004	28-02-2007	29	290 000	290 000	SSA
CEC-WYS	Central European Centre for Women and Youth in Science	INSTITUTE OF SOCIOLOGY OF THE ACADEMY OF SCIENCES OF THE CZECH REPUBLIC PUBLIC RESEARCH INSTITUTION,	7	01-03-2004	28-02-2007	36	699 860	699 860	SSA

		CZECH REPUBLIC							
COB	Challenges of biomedicine - socio-cultural contexts, European governance and bioethics	FELT, ULRIKE	9	01-04-2004	30-09-2007	36	716 438	716 438	STEP
DEEPEN	Deepening ethical engagement and participation in emerging Nanotechnologies	UNIVERSITY OF DURHAM, UK	4	01-10-2006	30-09-2009	36	1 026 325	894 226	STEP
EDCEP	European and Developing Countries Ethics Partnership	UNIVERSITETET I BERGEN, NORWAY	2	01-05-2004	30-04-2006	24	200 000	200 000	SSA
EDIG	Ethical dilemmas due to prenatal and genetic diagnostics interdisciplinary assessment of effects of prenatal and genetic diagnostics on couples in different European cultures	UNIVERSITÄT KASSEL, GERMANY	11	01-09-2005	31-10-2008	38	1 099 995	1 099 995	STEP
EDUBIOETHICS	Bioethical education on medical progress and human rights, in a multicultural, multidisciplinar and multireligious environment	UNIVERSITÉ RENÉ DESCARTES - PARIS 5, FRANCE	11	01-12-2006	31-08-2008	21	76 976	76 976	SSA
ENHANCE	Enhancing Human Capacities: Ethics, Regulation and European Policy	STICHTING VU-VUMC, NETHERLANDS	5	01-10-2005	31-03-2008	30	570 000	570 000	STEP
ENWISE ETHICS	Starting a Debate with Women scientists from Post-communist Countries on Ethical Issues	HUNGARIAN SCIENCE AND TECHNOLOGY FOUNDATION, HUNGARY	1	01-06-2003	31-08-2004	15	49 296	49 296	SSA

ETHICALTRACEABILITY	Ethical traceability and informed choice in food ethical issues	UNIVERSITY OF AARHUS, DENMARK	7	01-05-2004	30-04-2007	36	829 998	829 998	SSA
ETHICBOTS	Emerging Technoethics of Human Interaction with Communication, Bionic and Robotic Systems	UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II, ITALY	10	01-11-2005	30-04-2008	30	436 112	420 000	CA
ETHICSCHOOL	Ethics of emerging Technologies	MALSCH TECHNOVALUATION, NETHERLANDS	4	01-09-2007	28-02-2009	18	168 371	168 371	SSA
ETHICTRANSPLANTATION	Organ transplantation: Ethical Legal and Psychological aspects. Towards a common European Policy 2007 Conference	ERASMUS UNIVERSITAIR MEDISCH CENTRUM, NETHERLANDS	1	01-08-2006	31-03-2008	20	170 538	170 538	SSA
EULABOR	Latin American and European systems of ethics regulation of biomedical research: comparative analysis of their pertinence and application for human subjects protection	INSTITUT NATIONAL DE LA SANTÉ ET DE LA RECHERCHE MÉDICALE, FRANCE	7	01-09-2005	31-05-2008	33	289 270	289 270	SSA
EU-RECA	European project on delimiting the research concept and research activities	THE UNIVERSITY OF MANCHESTER, UK	9	01-03-2004	31-05-2007	39	700 000	700 000	STEP
EUROBESE	Ethics and the Obestity and Overweight Epidemic: Image, Culture, Technologies and Interventions	ERASMUS UNIVERSITAIR MEDISCH CENTRUM, NETHERLANDS	8	01-12-2005	28-02-2009	39	799 999	799 999	STEP
FASTER	Feasibility study for an advanced systematic documentation, information and communication tool in the field of ethical issues in science, research and technology	FORTH-ICS, HELLAS	10	01-01-2004	30-09-2004	9	459 996	459 996	SSA

FROM GMP TO GBP	Fostering bioethics practices (GBP) among the European biotechnology Industry	FRANCE BIOTECH, FRANCE	7	01-09-2006	28-02-2009	30	787 148	417 018	IP
GENBENEFIT	Genomics and Benefit Sharing with Developing Countries - From Biodiversity to Human Genomics	UNIVERSITY OF CENTRAL LANCASHIRE, UK	6	01-09-2006	28-02-2010	42	548 639	548 639	STEP
GENEBANC	Genetic bio and dataBanking: Confidentiality and protection of data. Towards a European harmonisation and policy	KATHOLIEKE UNIVERSITEIT LEUVEN, BELGIUM	5	01-10-2006	30-09-2009	36	1 350 000	1 350 000	STEP
HEALTHRESEARCHETHICS	Global Forum for Bioethics in Research	BIOTECHFRANCE, FRANCE	8	01-11-2006	31-12-2008	26	252 400	250 000	SSA
IMGBCHIMERASHYBRIDS	Chimeras and Hybrids in comparative European and International Research - natural scientific, ethical, philosophical and legal aspects	UNIVERSITA ET MANNHEIM, GERMANY	24	01-10-2005	30-11-2007	26	600 424	600 424	CA
INES	The Institutionalisation of Ethics in Science Policy; practices and impact	LANCASTER UNIVERSITY, UK	13	01-02-2004	31-08-2007	43	699 998	699 998	CA
MONGOLETHICS	Ethics in Mongolian and South-East Asian Science and Technology	UNIVERSITY OF CENTRAL LANCASHIRE, UK	1	01-12-2006	31-08-2007	9	53 160	53 160	SSA
NANOBIO-RAISE	Nanobiotechnology: Responsible Action on Issues in Society and Ethics	TECHNISCHE UNIVERSITEIT DELFT, NETHERLANDS	7	01-11-2005	31-10-2008	36	553 854	553 854	CA
NANOCAP	Nanotechnology Capacity Building NGOs	IVAM, NETHERLANDS	16	01-09-2006	31-08-2009	36	1 306 180	EUR 1 306 180	CA
NEBRA	Networking for ethics on biomedical research in africa	INSTITUT NATIONAL DE LA	8	03-01-2005	02-12-2006	23	380 000	380 000	SSA

		SANTE ET DE LA RECHECHE MEDICALE, FRANCE							
PRIVILEGED	Determining the ethical and legal interests in privacy and data protection for research involving the use of genetic Databases and Bio-banks	UNIVERSITY OF SHEFFIELD, UK	3	01-01-2007	31-12-2009	36	738 270	738 270	CA
PROPEUR	Property regulation in European science, ethics and law	UNIVERSITY OF BIRMINGHAM, UK	11	01-02-2004	31-01-2007	36	780 000	780 000	CA
REPROGENETICS	Reprogenetics. The ethics of men making men	INTERNATIONAL FORUM FOR BIOPHILOSOPHY, BELGIUM	6	01-04-2004	31-03-2008	48	1 071 798	979 998	STEP
SUMMERETHICS	Copenhagen summer school in research ethics 2005	THE DANISH NATIONAL COMMITTEE FOR BIOMEDICAL RESEARCH ETHICS, DENMARK	1	01-05-2005	31-03-2006	11	27 291	23 291	SSA
TWR	Comparing emerging ethical issues and legal differences impacting on European clinical trials, including a training workshop for researchers in the New Member States.	MEDICAL ECONOMICS AND RESEARCH CENTRE, UK	1	01-09-2005	30-09-2006	13	75 461	75 461	SSA

Source: Elaboration on CORDIS Open Data. Provisional list to be refined for the Stocktaking Final Report.
** CA: Coordination action; IP: Integrated Project; SSA: Specific Support Action; STEP: Specific Targeted Research Project.

FP7 projects

Project Acronym	Project Title	Coordinator (Name of The Organization and Country)	Number of Partners Involved	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type
ASSET	Action plan on sis related issues in epidemics and total pandemics	VITAMIB SAS, FRANCE		01-01-2014	31-12-2017	36	4496454	3939880	CSA-SA
EGAIS	The Ethical GovernAnce of emergIng technologieS New Governance Perspectives for Integrating Ethics into Technical Development Projects and Applications	UNIVERSITA CATTOLICA DEL SACRO CUORE, ITALY	4	01-05-2009	29-02-2012	34	998 218	837685	CP
EPOCH	Ethics in Public Policy Making: The Case of Human Enhancement	UNIVERSITY OF BRISTOL, UK	5	01-11-2010	31-10-2012	24	1477603	1150012	CP-FP
ETHENTECH	Ethics of enhancement technology	KUNGLIGA TEKNISKA HOEGSKOLAN, SWEDEN	4	01-07-2009	30-06-2012	36	667321	499889	CP
ETHICAL	Promoting international debate on ethical implications of data collection, use and retention for biometric and medical applications	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, GERMANY	4	01-01-2009	31-12-2010	24	1080930	742394	CSA-CA
ETHICSWEB	Inter-connected European information and documentation system for ethics and science: European ethics documentation centre	RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAET BONN, GERMANY	15	01-06-2008	31-08-2011	39	1004263	896321	CSA-CA
ETICA	Ethical issues of emerging ICT applications	DE MONTFORT UNIVERSITY, UK	11	01-04-2009	31-05-2011	26	1068773	828 249	CP

EURECNET	European Research Ethics Committees' Network	RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAET BONN, GERMANY	20	01-03-2011	28-02-2014	36	907 476	814 123	CSA-CA
GEST	Global Ethics in Science and Technology	UNIVERSITY OF CENTRAL LANCASHIRE, UK	4	01-02-2011	30-04-2014	39	892 295	696 820	CP-FP
HIDE	Homeland security, biometric identification and personal detection ethics	CENTRE FOR SCIENCE, SOCIETY AND CITIZENSHIP, ITALY	10	01-02-2008	31-01-2011	36	1244393	963762	CSA-CA
ICTethics	ICTethics. An interdisciplinary approach for addressing ethical, social and legal aspects of ICT	INTERNATIONAL FORUM FOR BIOPHILOSOPHY, BELGIUM	3	01-03-2009	29-02-2012	36	1228520	942540	CP
INNOVA-P2	(Pharma-innovation - patent-2)	UNIVERSITY OF CENTRAL LANCASHIRE, UK	7	01-06-2008	31-05-2011	36	930130	728640	CP-FP
NANOCODE	A multistakeholder dialogue providing inputs to implement the European Code of Conduct for Nanosciences & Nanotechnologies (N&N) research	ASSOCIAZIONE ITALIANA PER LA RICERCA INDUSTRIALE - AIRI, ITALY	9	01-01-2010	30-11-2011	23	1417801	1243777	CSA-SA
NERRI	Neuro-Enhancement: Responsible Research and Innovation	CIENCIA VIVA-AGENCIA NACIONAL PARA A CULTURA CIENTIFICA E TECNOLOGICA, PORTUGAL	17	01-03-2013	29-02-2016	35	3783868	3312430	CSA-SA
PATS	Privacy awareness through security branding	TECHNISCHE UNIVERSITAT BERLIN, GERMANY	6	01-08-2009	31/03/2012	32	1080607	964594	CSA-SA
PHM-ETHICS	Personalized health monitoring (PHM)- Interdisciplinary research to analyse the relationship between ethics, law and psychosocial as well as medical sciences	ERNST-MORITZ-ARNDT-UNIVERSITÄT GREIFSWALD, GERMANY	6	01-07-2009	30-06-2012	36	1267351	998113	CP

PRACTIS	Privacy - Appraising challenges to technologies and ethics	INTERDISCIPLINARY CENTER FOR TECHNOLOGICAL ANALYSIS AND FORECASTING, ISRAEL	7	01-01-2010	31-03-2013	39	1267956	988456	CP-FP
PRESCIENT	Privacy and emerging fields of science and technology: Towards a common framework for privacy and ethical assessment	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, GERMANY	3	01-01-2010	31-03-2013	39	1261270	998227	CP-FP
RISE	Rising pan-european and international awareness of biometrics and security ethics	CENTRE FOR SCIENCE, SOCIETY AND CITIZENSHIP, ITALY	9	01-03-2009	29-02-2012	36	1253746	919501	CSA-CA
ROBOLAW	Regulating Emerging Robotic Technologies in Europe: Robotics facing Law and Ethics	SCUOLA SUPERIORE DI STUDI UNIVERSITARI E DI PERFEZIONAMENTO SANT'ANNA, ITALY	5	01-03-2012	31-05-2014	27	1908342, 02	1497966	CP-FP
SET-DEV	Science, ethics and technological responsibility in developing and emerging countries	CONSIGLIO NAZIONALE DELLE RICERCHE, ITALY	10	01-03-2008	31-05-2011	39	1590047	1343477	CSA-CA
STEPE	Sensitive technologies and European public ethics	LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, UK	12	01-05-2008	31-12-2011	44	896216	689054	CP-FP
SYBHEL	Synthetic biology for human health: Ethical and legal issues	UNIVERSITY OF BRISTOL, UK	4	01-10-2009	30-09-2012	36	1041045	803587	CP
SYNTH-ETHICS	Ethical and regulatory challenges raised by synthetic biology	TECHNISCHE UNIVERSITEIT DELFT, NETHERLANDS	4	01-03-2009	31-08-2011	30	770608	531276	CP
TECHNOLIFE	a Transdisciplinary approach to the emerging challenges of novel technologies: Lifeworld and imaginaries in foresight and ethics	UNIVERSITETET I BERGEN, NORWAY	8	01-03-2009	30-11-2011	33	1049041	809343	CP

VALUE ISOBARS	The landscape and isobars of european values in relation to science and new technology	UNIVERSITETET I BERGEN, NORWAY	5	01-06-2009	30-11-2011	30	1085295	819971	CP

Source: Elaboration on CORDIS Open Data. Provisional list to be refined for the Stocktaking Final Report.
** CP-FP: Small or medium-scale focused research project; CP: Collaborative project (generic); CSA-SA: Support actions; CSA-CA: Coordination (or networking) actions.

6 Open Access – Open Science

Carla Basili
Research Institute on Sustainable Economic Growth (Ircres),
Italian National Research Council (Cnr)

Abstract

A novel awareness of the importance of scientific information for development has gained ground in the EC's research policies, based on the conviction that in order to optimise the impact of publicly funded scientific research, it is important to improve not only the production of knowledge, but also its dissemination and access. In this context, Open Access has gained particular relevance and attention in the European Commission's policy agenda, as a strategic means to improve the dissemination of results deriving from publicly funded scientific research.

The Science in Society Work Programme under the goal of 'Encouraging the debate on information dissemination, including access to scientific results and the future of scientific publications', has carried out a strand of actions supporting, year by year in the FP7 lifespan, the main nodal aspects of the Open Access strategy. In addition, Open Access has been adopted as a policy requirement for all research projects funded through Horizon 2020.

Corresponding to an enlarged view of Open Access that encompasses all forms of scientific results – e.g. scientific data, research infrastructures, databases, prototypes,traditional publications – the current trend in the EC's strategy towards improving knowledge circulation is shifting from Open Access to Open Science, an issue included among the intervention areas of the Horizon 2020 Work Plan 2014-2015 of the 'Science with and for Society' programme.

Keywords*: Access to scientific results, information dissemination, scholarly communication, knowledge sharing, knowledge transfer, Open Science*

6.1 EU Policy Landscape for Open Access to Improve Knowledge Circulation

Alongside the long standing conviction that the free availability of academic results is the prerequisite for effective and efficient research, a novel awareness of the importance of scientific information for development has gained ground in the EC's research policies, based on the conviction that in order to optimize the impact of publicly funded scientific research, it is important to improve not only the production of knowledge, but also access to and dissemination of the research results. This causal relationship forms the primary base of a growing amount of policy positions and regulatory initiatives issued by the European Commission in the last recent years.[30]

[30] European Commission (2007) Communication on scientific information in the digital age. - Council conclusions of 22 November 2007 on scientific information in the digital age: access dissemination and preservation - European Commission. (2012). Towards better access to scientific information: Boosting the benefits of public investments in research. - High Level Expert Group on Scientific Data. (2010). Report to the European Commission. Riding the

The goal of the Knowledge Economy, in fact, is increasingly based on reinforcing not only the production, but also the dissemination of the new knowledge generated by the scientific system. Hence, the growing importance attributed to institutions and processes of information dissemination.

> To ensure economic growth and to address the societal challenges of the 21st century, it is essential to optimise the circulation and transfer of scientific knowledge among key stakeholders in European research – universities, funding bodies, libraries, innovative enterprises, governments, policy-makers, non-governmental organisations (NGOs), and society at large. *COM(2012) 401.Towards better access to scientific information: Boosting the benefits of public investments in research*

Nevertheless, the central role of the scientific system and in general the systems of knowledge production and circulation, stand at the intersection of two conflicting phenomena. One – the availability of enabling technologies (namely the Internet and its applications) – is a positive opportunity for the dissemination of information, while the other – the unsustainable increasein journal subscription prices – constitutes an obstacle and a problem that tends to worsen over time.

This is the soil within which the Open Access movement matures as a model of scientific communication aimed at providing a viable alternative to the traditional circuit of commercial publishing. The Open Access movement can be concisely defined as the international effort to provide free online access to research literature, especially peer-reviewed journal articles. It is an evolving concept, initial formal definitions date back to the early 2000s, starting from the Budapest Open Access Initiative (2002) aimed at 'serving the interests of research, researchers, and the institutions and societies that support research (universities, laboratories, libraries, foundations, journals, publishers, learned societies, and kindred open-access initiatives).'[31]

The European voice in the Open Access arena is the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (October 2003)[32] launched 'to promote the Internet as a functional instrument for a global scientific knowledge base and human reflection and to specify measures which research policy makers, research institutions, funding agencies, libraries, archives and museums need to consider.'[33] Yet, in the Berlin Declaration the concept of Open

---

Wave: How Europe Can Gain From The Rising Tide of Scientific Data. - EESC (2013)– European Economic and Social Committee. Opinion of the European Economic and Social Committee on the 'Communication from the Commission — Towards better access to scientific information: Boosting the benefits of public investments in research' COM(2012) 401 final. (2013/C 76/09), Scientific data: Open Access to research results will boost Europe's innovation capacity (IP-12-790) just to mention a few.

[31] Budapest Open Access Initiative (BOAI, February 2002) – available at http://www.budapestopenaccessinitiative.org/

[32] The Berlin Declaration follows the Budapest Open Access Initiative (February 2002), which is an international effort to make research articles in all academic fields freely available on the Internet, and the Bethesda Statement on Open Access Publishing (June 2003), emanated by a set of 24 countries (US included). The Berlin Declaration was launched by a group of European research organizations and funding bodies, and counts to date more than 480 signatory institutions.

[33] http://openaccess.mpg.de/Berlin-Declaration.

Access is not only limited to the scientific literature but isextendedto 'include original scientific research results, raw data and metadata, source materials, digital representations of pictorial and graphical materials and scholarlymultimedia material.'[34]

The Commission endorsesthis definition, to include, in addition to publications, research data and, in general, any form of research results.

Open Access (OA) means unrestricted online access to peer-reviewed scholarly research. *ERA Progress Report 2014*

As to the EC's actions to be supported, not only *access* to publications, but also *preservation* of scientific information and access to research *data* are the recommended strands of action.[35]

From a slightly different perspective,Open Access can be considered as a form of scholarly communication that constitutes an attractive alternative to the traditional commercial publishing models of scientific literature. This explains why in 2006, the first steps of the European Commission in its commitment towards Open Access stemmed from the analysis of the economic evolution of the scientific publication markets in Europe (see the entry 'preparatory activities' in Table 6.1 below).

According to these developments, in the European context Open Access has gained particular relevance and attention in the European Commission policy agenda, as a strategic means to improve the dissemination of results obtained from publicly funded scientific research. This strategy is explicitly described in Communication COM(2012) 4890, in which two diverse EU policy strands are recalled, the 'Digital Agenda for Europe[36]' and the 'Innovation Union[37]', stating – respectively – that 'publicly funded research should be widely disseminated through open access publication of scientific data and papers' and 'open access to publications and data from publicly funded research should be promoted and access to publications made the general principle for projects funded by the EU research Framework Programmes.'

[34] *ibidem*

[35] As far as access to scientific publications is concerned, there are two publishing models:
— 'Gold' Open Access: payment of publication costs is shifted from readers (via subscriptions) to authors. These costs are usually borne by the university or research institute to which the researcher is affiliated, or by the funding agency supporting the research.
— 'Green' Open Access (self-archiving): the published article or the final peer-reviewed manuscript is archived by the researcher in an online repository before, after or alongside its publication. Access to this article is often delayed ('embargo period') at the request of the publisher so that subscribers retain an added benefit. EESC (2013)– EUROPEAN ECONOMIC AND SOCIAL COMMITTEE. Opinion of the European Economic and Social Committee on the 'Communication— Towards better access to scientific information: Boosting the benefits of public investments in research' COM(2012) 401 final. (2013/C 76/09), 14.3.2013

[36] COM (2010) 245 final

[37] COM (2010) 546 final

Open access to publications and data from publicly funded research should be promoted and access to publications made the general principle for projects funded by the EU research Framework Programmes. *Innovation Union Initiative. COM (2010) 546 final*

The institutional adherence of the European Commission to the Open Access strategy occurred in 2007, with the Council Conclusions on scientific information in the digital age, which, moving away from the premise that 'access to and dissemination of scientific information – publications and data – are crucial for the development of the European Research Area, and can help accelerate innovation' invited the Commission to experimentwith Open Access to scientific results from projects funded under the EU research framework programmes.[38]

Theinstitutional commitment of the EC is further confirmed by the Communication on Scientific information in the digital age: access, dissemination, and preservation COM(2007) 56, followed by the *COM(2012) 401. Towards better access to scientific information: Boosting the benefits of public investments in research* where a specific set of policy measures is summarised as follows:

BOX 6.1 Access to and preservation of scientific information: key measures

Policy measures
– Recommendation to the Member States regarding access to and preservation of scientific information, from 2012.
– Work with national points of reference designated by Member States to draw up common principles and standards, from 2013.
– Work with national points of reference to structure and monitor progress on access and dissemination, from 2013.

Open access to results of EU-funded research
– Establish open access to scientific publications as a general principle in the Horizon 2020 programme and set up the conditions for optimal compliance, from 2014.
– Maintain the possibility of reimbursing open access publishing fees as part of the Horizon 2020 programme, from 2014.
– Provide a framework and encourage open access to research data in Horizon 2020, taking into account restrictions that may be needed in order to protect intellectual property or legitimate commercial interests, from 2014.

Funding for infrastructures and projects
– Continue funding relevant projects in Horizon 2020, from 2014.
– Provide €45 million for infrastructures supporting open access to research articles and data, and for research on digital preservation, 2012-2013.

Coordination beyond the EU

[38]Council of the European Union, Council Conclusions on scientific information in the digital age: access, dissemination and preservation. 2832nd Competitiveness (Internal market, Industry and Research) Council meeting Brussels, 22 and 23 November 2007. <http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/intm/97236.pdf>

– Promote open access policies and the interoperability of data infrastructures with international partners.

Targets:
– By 2014, policies for open access to scientific articles and data will have been established in all Member States at all relevant levels.
– By 2016, the share of publicly-funded scientific articles available under open access EU-wide will have increased from 20% to 60%.
– 100% of the scientific publications resulting from Horizon 2020 will be available under open access.

The next sections will describe the way in which the majority of these objectives have already been achieved.

6.2 EU Policy Milestones for Open Access

New models of scholarly communication and new technological developments have been the major drivers of the Open Access strategy, interpreted as a sustainable alternative to the commercial publishing system. As soon as the Open Access strategy moved from theory to experimentation, the EC's reaction to these instances has been quite timely and strong, as it was not simply limited to providing funding for research projects on Open Access. The European Commission, in fact, in its role of research funding agency, set Open Access as a highly recommended issue (in FP7) and then as a requisite (in Horizon 2020) in the Framework Programme model Grant Agreement.

A detailed list of the European Commission policies on Open Access is given in Annex 1, while a set of selected policy milestones is highlighted in Table 6.1 below.

Table 6.1 - Selected EC policies for Open Access

Preparatory activities (2006)	Publication of EU-commissioned study on the economic and technical evolution of the scientific publication markets in Europe Press release: Commission study addresses Europe's scientific publication system Public consultation 31 March to 15 June 2006
Institutional engagement with OA (2007)	Communication on Scientific information in the digital age: access, dissemination and preservation COM(2007) 56 final *Council Conclusions on scientific information in the digital age: access, dissemination and preservation* – recommendation to the Commission to **experiment with Open Access** to scientific results from projects funded by EU research framework programmes *ERC (European Research Council) Scientific Council Guidelines for Open Access* – which provide for the **OBLIGATION to deposit in Open Access** disciplinary or institutional repositories, within a maximum period of time defined by 6 or 12 months after the

	formal publication
Launch of Open Access Pilot in FP7 (2008	Launch of Open Access Pilot in FP7 in 7 research areas constituting the 20% of the total funding amount in FP7 – This initiative follows on from the ERC (European Research Council) Scientific Council Guidelines for Open Access and is formalised by the Commission Decision (C (2008 (C(2008) 4408). on the adoption and a modification of special clauses applicable to the model Grant Agreement of FP7
July 2012	Recommendation on access to and preservation of scientific information
December 2013	Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020

6.3 European Union Strategy for Open Access in the Science and/in Society Programme Series from FP6 to FP7

According to the 2007 Council's solicitations, the European Commission set out the principle that the Open Access perspective should systematically be taken into account in all Community policies for research. The actual implementation of this strategy consists in implementing Open Access to research results from projects funded by the EU Research Framework Programmes, namely FP6, FP7 and Horizon 2020.

6.3.1 Sixth Framework Programme (2002-2006)

In FP6 there is no reference to the Open Access strategy in the Programme reference documents, however, the process of knowledge dissemination is regulated by the Regulation (EC) No 2321/2002[39] of the European Parliament and of the Council of 16 December 2002 concerning the rules for the participation of undertakings, research centres and universities in, and for the dissemination of research results for, the implementation of the European Community Sixth Framework Programme (2002-2006).

The Regulation (EC) No 2321/2002 provides some basic definitions for the terms 'knowledge', 'dissemination' and 'use' and a set of rules for dissemination and use[40] which will be adopted

[39] http://cordis.europa.eu/documents/documentlibrary/66622801EN6.pdf
[40] Article 23 - Use and dissemination of knowledge

initially also by the FP7, before the changes to the model Grant Agreement of FP7 introduced with the launch of the Open Access pilot in FP7, as illustrated in the next section.

In the *Science and Society action plan (2002)* a section is devoted to the dissemination of scientific information, where the focus is on the communication between the research community and the general public. Therefore, the support is given to actions aimed at supporting independent sources of public information, developing thematic, multilingual scientific training modules for journalists. Furthermore, the establishment of a European scientific press agency is promoted.

6.3.2 Seventh Framework Programme (2007-2013)

With respect to the dissemination, use, and access rights to scientific information, the goal in FP7 was to keep as much continuity as possible with FP6 with improvements/fine-tuning based on necessary changes that were identified during the implementation of FP6[41]. The main changes identified at the initial stage of FP7 are: a) remove most of the obligations for participants to finalise conditions prior to their accession to the EC contract and b) remove most obligations to request prior approval from the Commission for publication, transfers of ownership, and provision of access rights to third parties, where all other partners agree[42].

In August 2008, a pivotal change in FP7 with respect to Open Access happens with the launch of Open Access Pilot in FP7, applied in 7 research areas (constituting the 20% of the total funding amount in FP7). This initiative follows on from the ERC (European Research Council) Scientific Council Guidelines for Open Access and is formalised by the Commission Decision (EC, 2008a) on the adoption and a modification of special clauses applicable to the model Grant Agreement of FP7 where it has appeared necessary to adopt six additional special clauses among which the Open Access specific to 5 thematic areas[43] as well as to the activities 'Research Infrastructures' (e-infrastructures), and 'Science in Society'. The additional clause 39 states that '… beneficiaries shall deposit an electronic copy of the published version or the final manuscript accepted for publication of a scientific publication relating to foreground published before or after the final report in an institutional or subject-based repository at the moment of publication. Beneficiaries are required to *make their best efforts* to ensure that this electronic copy becomes freely and electronically available to anyone through this repository: immediately if the scientific

---

1. The participants and the Community shall use or cause to be used the knowledge which they own arising from the direct actions or indirect actions, in accordance with the interests of the participants concerned. The participants shall set out the terms of use in a detailed and verifiable manner, in accordance with this Regulation and the contract.
2. If dissemination of the knowledge does not adversely affect its protection or use, the participants shall ensure that it is disseminated within a period laid down by the Community. Should the participants fail to do so, the Commission may disseminate the knowledge. Particular account shall be taken of the following factors:
(a) the need to safeguard intellectual property rights;
(b) the benefits of swift dissemination, for example in order to avoid duplication of research efforts and to create synergies between indirect actions;
(c) confidentiality;
(d) the legitimate interests of the participants.

[41] http://ec.europa.eu/research/fp7/pdf/rules_explanatory_note_en.pdf

[42] Cit.

[43] 'Health', 'Energy', 'Environment (including Climate Change)", "Information & Communication Technologies' (Challenge 2), and 'Socio-economic Sciences and the Humanities'

publication is published "Open Access", i.e. if an electronic version is also available free of charge via the publisher, or within X[44] months of publication.[45]'

In addition, the revision of the FP7 Grant Agreement according to the Open Access Pilot implies the reimbursement of publication costs in Open Access ('paid' Open Access).

On December 2010, the official launch of the FP7 project OpenAIRE completed the implementation of the FP7 Open Access pilot.

It is worth noticing that with the OA Pilot, Open Access takes on the status of a policy measure adopted by the European Commission itself, besides being merely a research topic to be supported financially.

6.4 EU Funded Research Projects on Open Access

The theme of Open Access, in its various branches, is a cross-cutting theme in European research projects, which has become mandatory – as illustrated in the Guidelines for Open Access in Horizon2020 – for each project financed with EU funds. However, it is possible to identify projects specifically focused on the general theme of the circulation of scientific information, in terms of Open Access to publications, to research data and research infrastructures, each with specific research perspectives (Annex 2 provides a list of these projects).

No project that specifically focused on Open Access was funded under the FP6-Science and Society (SaS-FP6) programme.

The most relevant Open Access projects – OpenAire, OpenAirePlus, and DRIVER – have been funded outside the Science in Society (SiS-FP7) programme, specifically under the FP7-INFRASTRUCTURES funding scheme. This category of projects, in fact, provides the technological infrastructure enabling the deposition of peer-reviewed articles and the harvesting of their metadata (OpenAire), as well as the sharing of datasets of research data (OpenAirePlus) and the interface with the pan-European infrastructure for digital repositories(DRIVER).

In the FP7 Science in Society programme (SiS-FP7), the theme of '*Encouraging the debate on information dissemination, including access to scientific results and the future of scientific publications, taking also into account measures to improve access by the public*' – which is within the larger goal of '*Strengthening and improving the European science system*' – is one of the pillars of the Work Programme, and, during the entirety of SiS-FP7 (2007-2013) it has led to actions, different from year to year, each of which address specific nodal aspects of the Open Access strategy, as summarized in Table 6.2 below.

More specifically, the SiS-FP7 programme faces the problems of knowledge diffusion through the *Action Line*'5.1 A more dynamic governance of the science and society relationship', the *activity*'5.1.3 Strengthening and improving the European science system', including the

[44]The number X will be 6 months in the thematic areas 'Health', 'Energy', 'Environment (including Climate Change)', and 'Information & communication technologies' (Challenge 2) and the activity 'Research infrastructures' (e-infrastructures), and 12 months in the thematic area 'Socio-economic Sciences and the Humanities' and the activity 'Science in Society'.
[45] http://ec.europa.eu/research/press/2008/pdf/annex_1_new_clauses.pdf

Area'5.1.3.1 Encouraging the debate on information dissemination, including access to scientific results and the future of scientific publications'. The Commission has provided **€6,395,000**of financial support (Technopolis-Fraunhofer, 2012) in the period 2007-2011, in addition to the **€3,500,000** that has been granted up to 2013 (EC, 2012b).

Table 6.2 provides a more detailed distribution of the budget to the individual topics and projects.

Table 6.2 - SIS-FP7 financial support to Open Access topics (2007-2013)

Action line	5.1 – A more dynamic governance of the science and society relationship		
Activity	5.1.3 – Strengthening and improving the European science system		
Area	5.1.3.1. – Encouraging the debate on information dissemination, including access to scientific results and the future of scientific publications.		
Call	**Topics**	**Funded projects**	**Budget assigned**
SIS-2007-WP	No actions foreseen in 2007		
SIS-2008-WP	SiS-2008-1.3.1.1 Coordination and support actions on the scientific publishing system in connection with research excellence and dissemination and sharing of knowledge	NECOBELAC	**€** 800 000
		SOAP	**€** 809 919
SIS-2009-WP	Proposals sought under the 2008 Work Programme		
SIS-2010-WP	SIS-2010-1.3.3-1 Assessing how research outputs at individual researcher level are evaluated and measured		
SIS-2011-WP	SiS.2011.1.3.1-1 Reinforcing European strategies on access, dissemination and preservation of scientific information in the digital age	MEDOANET	**€** 746 695
SIS-2012-WP	SiS.2012.1.3.3-1: Scientific data: open access, dissemination, preservation and use		
SIS-2013-WP	SiS.2013.1.3.3-1: Upstream support to the definition, development and implementation of open access strategies and policies and to their coordination in the European Research Area	PASTEUR4OA RECODE	**€** 1 935 940 **€** 949 488

	SiS.2013.1.3.3-2: Downstream training on Open Access in the European Research Area	FOSTER	€ 1 499 860

Over the lifespan of FP7 (2007-2013), the EC's commitment towards Open Access has faced the main problematic dimensions of Open Access, and, more recently (2013) of Open Science, as Table 6.3 below summarises[46].

Table 6.3 – Nodal issues addressed by the European Commission for Open Access and Open Science in the period (2007-2013)

FP7-SIS-2008	
Topic	**SIS-2008- 1.3.1.1 Co-ordination and support actions on the scientific publishing system in connection with research excellence and dissemination and sharing of knowledge**
Description of topic	Through this topic, the Commission aims at fostering the development of joint or common research and policy agendas by building up a knowledge base through coordination (networking) and supporting actions. Subjects of particular interest include peer review, bibliometric indicators, publishing business models, and the relative impact of peer-reviewed publication on scientific careers. **Co-ordinating actions** should aim at coordinating research activities and policies. For example, they may include the organisation of events, exchange and dissemination of good practices, or the definition, organisation and management of joint or common research initiatives and/or policy activities (without funding research as such). **Supporting actions** should aim at contributing to the implementation of the Framework Programmes and the preparation of future Community research policy. Examples of support actions include the organisation of events, studies, fact finding, monitoring, and strategy development.
Expected Impact	Network-building between concerned stakeholders at the national, European and international levels with a view to supporting the development of joint or common research and policy agendas in the area of scientific publishing in connection with research excellence and integrity; support to the Commission's policy on access to scientific information.
FP7-SIS-2010	
Topic	**SIS-2010-1.3.3-1 Assessing how research outputs at individual researcher level are evaluated and measured**
Description of topic	This topic aims to support research in areas such as: - analysing the current peer review system and studying ways to improve or modify this quality and certification mechanism to allow for a more efficient, open and transparent system; - studying and proposing alternative and broader ways of measuring the

[46] Excerpts from the series of SiS-FP7 calls

	productivity and performance of individual researchers including new and improved bibliometric indicators and evaluation criteria for research careers, project evaluations, and scientific publications; - conceptualising new incentive schemes for researchers to complement and improve the traditional incentive structure of career advancement based primarily on numbers of publications, publication in journals with high impact factors, and numbers of citations; - a state of the art analysis of the gender dimension in relation to the system of career evaluation and performance measurement i.e. in what ways the current science system poses specific obstacles to women in research careers, and how such systemic weaknesses could be addressed. For this topic, the scientific and/or technological excellence evaluation criterion will include the following additional sub-criterion: 'appropriate comparative perspective in relation to the proposed research'.
Expected Impact	To provide insight into the dynamics of the European science and research system and the ways in which research outputs, at the individual researcher level, are measured and evaluated. To encourage analysis on how the European science and research system impacts on and interacts with society-at-large, with a view to building an open, effective and democratic European knowledge society. To provide policy solutions on how this system can be enhanced and improved in order to improve the governance of the European research and innovation system.
FP7-SIS-2011	
Topic	**SiS.2011.1.3.1-1 Reinforcing European strategies on access, dissemination and preservation of scientific information in the digital age**
Description of topic	This topic supports actions aimed at co-ordinating research activities and policies to reinforce the existing national strategies and structures, and contribute to the development of new ones. New initiatives can be built on a thematic and/or geographical basis. Actions may include the organisation of events, exchange and dissemination of good practices, or the definition, organisation and management of joint or common initiatives and/or policy activities (without funding research as such). Target groups are the full range of institutions and organisations in EU Member States and Associated Countries that address and/or co-ordinate policies and activities relating to access to scientific information, e.g. ministries, funding bodies, universities, libraries, associations, CSOs etc.
Expected Impact	To sustain/improve the co-ordination of existing Member State and Associated Country initiatives on access to and dissemination of scientific information; to extend current activities to other countries (both EU/Associated Countries and internationally) and/or thematic areas; to put in place new/innovative co-ordination initiatives; to create new initiatives (e.g. regional, linguistic or thematic) improving the co-ordination of existing strategies on digital repositories.
FP7-SIS-2012	
Topic	**SiS.2012.1.3.3-1: Scientific data: open access, dissemination, preservation and use**
Description of topic	This topic calls for proposals bringing together actors concerned with the broader area of 'open data'. Its aim is to enable the exploration and analysis of the relevant scientific ecosystems and legal/ethical contexts with a view to developing an international, comprehensive framework for a collaborative data infrastructure. Proposed actions should aim at co-ordinating policy, research

	and/or dissemination activities. For example, they may include the exchange and dissemination of good practices, or the definition, organisation and management of joint or common policy activities. The following actions are particularly welcome: – actions using a comparative approach (e.g. cross-national, cross-disciplinary); – actions aiming at creating networks of one type of not-for-profit actor or structure (e.g. – funding bodies, libraries, repositories, universities) from different EU Member States, Associated Countries or other third countries that are interested in exchanging good practices and exploring common policy development; – actions proposed by consortia representing different stakeholders (e.g. national research funding bodies, libraries, repositories, universities, publishers, industry users of publications). Where appropriate, financial aspects of continuation of activities or structures after expiration of the grant agreement must be addressed.
Expected Impact	Support the Commission's policies on open access to scientific data; network-building among concerned stakeholders at the European and international levels with a view to supporting the development of joint or common policy agendas and activities in the area of scientific data.
FP7-SIS-2013	
Topic	**SiS.2013.1.3.3-1: Upstream support to the definition, development and implementation of open access strategies and policies and to their coordination in the European Research Area**
Description of topic	The answers on behalf of the European Research Area Committee to the 2011 questionnaire on national open access and preservation policies in Europe15 call for the identification of common agendas and the implementation of joint initiatives. Therefore, this topic supports actions with a clear European added value that are aimed at developing, improving or consolidating co-ordination activities and policies at upstream level. The proposed actions should define or reinforce national strategies, promote their convergence in the European Research Area and facilitate their implementation at national level, in the remit of the policy developments on open access to and preservation of scientific information and Horizon 2020. In this context, the proposed action may also include the monitoring of the Member State implementation of the forthcoming soft law initiative on open access to and preservation of scientific information. Actions must be objective-driven. They may include the definition, organization and management of joint or common initiatives and/or policy activities, transnational networking activities, the exchange and dissemination of good practices etc. Initiatives may build on existing co-operative efforts and should aim to complement, improve, enlarge, or consolidate these. In addition, actions may explore the possibility of setting up a specific EU collaborative network, based on national membership, in order to better define common principles and standards, co-ordinate implementation measures and explore new ways of sharing research in the European Research Area through open access. Such a network should also ensure that the results at the national levels feed into the discussions and policy processes at Community level. Target groups are any bodies with sufficient authority and decision-making

	power in EU Member States and Associated Countries that address and/or co-ordinate policies and activities relating to open access. Where this is the case, financial aspects of continuation of activities or structures after expiration of the grant agreement should be addressed and/or planned.
Expected Impact	To improve the co-ordination of existing Member States and Associated Country initiatives on open access to scientific information and, where this is the case, to extend existing activities, as well as to set up an EU collaborative network on open access.
FP7-SIS-2013	
Topic	**SiS.2013.1.3.3-2: Downstream training on Open Access in the European Research Area**
Description of topic	While open access and open data policies and mandates have become more widely known and implemented in recent years, significant knowledge gaps in both institutional settings and among individual stakeholders still exist, in particular academics and researchers. Therefore, this topic supports actions with a clear European added value that are aimed at developing, improving or consolidating training activities at downstream level and reach the highest number of stakeholders in the European Research Area. Actions proposed must be aimed at training stakeholders with a view to permitting them and/or their organisations to fully comprehend policy and practical aspects of open access to scientific information. Stakeholders include academic staff, in particular researchers and students, but also policy-makers and staff working in funding bodies. The training should also address and train stakeholders in EU-funded research projects, in particular in those areas not covered by the Open Access Pilot in FP7, in order to prepare stakeholders for the application of open access procedures in Horizon 2020. Actions should be innovative and cross-fertilizing. Activities developed following a 'training the trainers' approach can be supported, as well as networking among already existing training initiatives. The training actions proposed must be relevant, engaging, dynamic and outcome-oriented. They must provide a range of information, advice, support, and practical help, and reach the greatest number of stakeholders. Didactic material or training tool kits must be developed and made available open access for re-use.
Expected Impact	To spread/increase knowledge of open access related issues in order to reach a wide range of communities and geographic areas; to contribute to changes in behaviour that are consistent with the ideals underlying open access; to prepare stakeholders for the application of open access in the European Research Area, in particular as regards Horizon 2020.

6.5 Lessons learned from the best practices and initiatives

Open Access, originally launched within the Scientific Community (as a reaction to the financial pressures on libraries deriving from the growing costs of scholarly journals), is a phenomenon that is becomingly increasingly associated with economic growth and innovation.

Evidence of this transformation of focus can be found in the following official documents of the Commission that relate to scientific information:Study on the economic and technical evolution of the scientific publication markets in Europe (2006) – EC Communication on 'Scientific

information in the digital age: access, dissemination and preservation' (2007) where it is worth noticing the incipit of the section about '*The importance of scientific information*' – EC Communication 'Towards better access to scientific information: boosting the benefits of public investments in research' (2012).In the first paragraph of the Opinion of the European **Economicand Social** Committee on COM(2012)401 it is stated that 'Access to scientific information is an essential requirement for successful research and boosting innovation, and therefore for Europe's competitiveness as well. (2013/C 76/09)'.

'**Access to scientific information** is an essential requirement for successful research and **boosting innovation**, and therefore for **Europe's competitiveness** as well. (2013/C 76/09)'

The transformation of the concept implies a number of consequences:

- Open Access initially involves the process of diffusion of knowledge within the scientific community (**knowledge sharing**), but the transformation of the political and economic context, gradually extends the concept to all the processes that contribute to the circulation of knowledge, namely the production and transfer (**knowledge transfer**), as well as the **long-term preservation**.
- **Greater involvement of business stakeholders** in the Scholarly Communication process: initially limited to the Publishing Industry in its role of **agent** in the Scholarly Communication process; nowadays every business organisation can be involved in the role of target recipient of the process (Knowledge Transfer), i.e. as an **information 'consumer'**.
- Strategic role of the ICT Industry for the Digital Information Management (mainly for the long term preservation needs, but also for Interoperability and Information Storage and Retrieval issues) of institutional and/or disciplinary repositories.
- Increased need for training on access to scientific information resources also outside the scientific community (Information Literacy).

Further issues to be noticed or further underlined:

- The Commission not only supports Open Access – Open Science through funding projects facing its main crucial aspects, but also conforms to Open Access in its contractual requirements for the free dissemination of results from EC funded research.
- Open problems in research data re-use: a number of real and perceived barriers still exist, including those of a legal, technical, financial, trust-related and sociocultural nature[47].
- Infrastructures to guarantee access to and uptake of knowledge by all for Open Access to publicly funded research results are not appropriately developed across Europe.[48]

[47] (EC, 2014a). ERA Progress Report 2014
[48] *Ibid.*

Infrastructures to guarantee access to and uptake of knowledge by all for Open Access to publicly funded research results are not appropriately developed across Europe. *ERA Progress Report 2014*

6.6 From Open Access to Open Science– key messages from the SIS-RRI conference

According to the Horizon 2020 work programme[49], Responsible Research and Innovation is an approach to research and innovation that 'allows all societal actors (researchers, citizens, policy makers, business, third sector organisations etc.) to work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of European society'. Improving access to scientific information is also facilitated by increasing openness and transparency, both of which are essential features of responsible research and innovation (EC, 2012a).

Improving access to scientific information is also about increasing openness and transparency, which are essential features of responsible research and innovation. *COM(2012) 401. Towards better access to scientific information: Boosting the benefits of public investments in research*.

Increasing the access to scientific results as one of the RRI policy pillars, therefore, is the background perspective of the discussion in the SIS-RRI Conference.

First, Open Access is mandatory for projects that receive funding under Horizon 2020, as extensively described in the Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020[50] and enlarged to Research Data as well[51].

Open Access must be granted to all scientific publications resulting from Horizon 2020 actions, and proposals must refer to measures envisaged. Where relevant, proposals should also provide information on how the participants will manage the research data that are generated and/or collected during the project, such as details on the types of data the project will generate, whether and how this data will be exploited or made accessible for verification and re-use, and how it will be curated and preserved. *Horizon 2020 Work Programme 2014-2015. Call H2020-GARRI-2015-1*

[49] Horizon 2020 Work Programme 2014 – 2015 - 16. Science with and for Society. Revised http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-swfs_en.pdf

[50] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf (December 2013)

[51] The launch of the Open Research Data Pilot is aimed at maximising access to and re-use of research data derived from research projects. According to the ERA Progress Report 2014, CERN continued the development and transfer of digital library technology, as well as Open Access experience, through the FP7 OpenAIREPlus project, notably with the launch of the flagship ZenodoOpen Access and Open Data repository. The Open Access pilot in FP7, supported by OpenAIRPlus is expected to be expanded in H2020,with CERN expected to continue to provide the baseline digital Open Access technology.

The final FP7 call funded projects, like FOSTER, were already oriented towards Open Science, an umbrella term enlarging the Open Access concept in favour of a more complex set of processes, agents and objects.

The Open Science concept still raises a number of problematic issues, including:

- the absence of an official *definition* of Open Science (does itinclude all research data and all kinds of research results? Does it also encompass Research Infrastructures and/or other Thematic Resources Collections? What else does it cover?);
- the need to identify the *dominant perspective* on Open Science among the following: a *technological* perspective (concerned with e-infrastructures, technological architecture etc.), a *public* perspective (concerned with the accessibility of knowledge), an *impact* perspective (concerned with alternative impact measurement), a *research* conduct perspective (concerned with collaborative and interdisciplinary research), or even the combination of all the above;
- the need for reconciling and balancing the Open Science approach with eventual restrictions that may be needed in order to protect intellectual property or legitimate commercial interests.

Looking at the Horizon 2020 Work Programme 2014-2015, the intervention area of the programme related to the dissemination of research results is the 'GARRI.4.2015 - Innovative approach to release and disseminate research results and measure their impact'.

It is worth noticing in the call that:

- the specific challenge of addressing the full range of processes included in knowledge circulation 'among researchers, innovative industries and citizens';
- the important question about new metrics for research impact: 'with open access expanding beyond scientific articles to encompass data, monographs and books, it needs to be seen whether current methods of review and measurement of impact remain practical and relevant, or whether more innovative practices are needed, and how';
- the expected impact to 'contribute not only to better science but also to a more open science system, while ensuring that the impact of scientific information on all actors of the society can be measured in a reliable way'.

In view of all the above, two important recommendations raised in the SIS-RRI debate need to be underlined:

- as an essential component in European Research Area (ERA) policy-making, a solid monitoring mechanism should be established in order to deliver data on levels of progress towards Open Access;
- the need for a cultural and institutional change in the European Research Area, since Open Science must receive merit in research assessment.

References chapter 6

"Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities," October 22, 2003, http://openaccess.mpg.de/Berlin-Declaration.

"Bethesda Statement on Open Access Publishing," June 20, 2003, http://legacy.earlham.edu/~peters/fos/bethesda.htm.

"Budapest Open Access Initiative," February 14, 2002, http://www.budapestopenaccessinitiative.org/read.

European Commission. 2006a. *Science in Society 2007: Call*, December 22, http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/fp7/calls/fp7-science-in-society-2007-1.html.

European Commission. 2006b. *Study on the economic and technical evolution of the scientific publication markets in Europe: Final report*. http://ec.europa.eu/research/science-society/pdf/scientific-publication-study_en.pdf.

European Commission. 2007a. *Communication on scientific information in the digital age. Council conclusions of 22 November 2007 on scientific information in the digital age: access dissemination and preservation*. http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52007DC0056.

European Commission. 2007b. *Science in Society 2008: Call*, November 30, http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/fp7/calls/fp7-science-in-society-2008-1.html.

Council of the European Union. 2007. *Council Conclusions on scientific information in the digital age: access, dissemination and preservation. 2832nd COMPETITIVENESS (Internal market, Industry and Research) Council meeting Brussels, 22 and 23 November 2007*.
http://ec.europa.eu/information_society/newsroom/image/council_conclusions_nov2007_6592.pdf.

European Commission. 2008a. "Annex 1." In *Commission decision on the adoption and a modification of special clauses applicable to the model grant agreement adopted on 10 April 2007 in the context of the implementation of the Seventh Framework Programmes of the European Community (2007-2013) and the European Atomic Energy Community (2007-2011), and to the model grant agreement for 'frontier' research actions and to the Marie Curie model grant agreements adopted on 16 April 2007 in the context of the implementation of the Seventh Framework Programme of the European Community (2007-2013), C(2008) 4408 final.*
http://ec.europa.eu/research/press/2008/pdf/annex_1_new_clauses.pdf.

European Commission. 2008b. *Commission decision on the adoption and a modification of special clauses applicable to the model grant agreement adopted on 10 April 2007 in the context of the implementation of the Seventh Framework Programmes of the European*

Community (2007-2013) and the European Atomic Energy Community (2007-2011), and to the model grant agreement for 'frontier' research actions and to the Marie Curie model grant agreements adopted on 16 April 2007 in the context of the implementation of the Seventh Framework Programme of the European Community (2007-2013), C(2008) 4408 final. http://ec.europa.eu/research/press/2008/pdf/decision_grant_agreement.pdf.

European Commission. 2008c. *Science in Society 2009: Call*, September 3, http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/fp7/calls/fp7-science-in-society-2009-1.html.

European Commission. 2009. *Science in Society 2010: Call*, July 30, http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/fp7/calls/fp7-science-in-society-2010-1.html.

European Commission. 2010a. *A Digital Agenda for Europe, COM(2010) 245 final*. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0245&from=IT.

European Commission. 2010b. *Europe 2020 Flagship Initiative Innovation Union, COM(2010) 546 final*.https://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf.

European Commission. 2010c. *Science in Society 2011: Call*, July 20, http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/fp7/calls/fp7-science-in-society-2011-1.html.

European Commission. 2011. *Science in Society 2012: Call*, July 20, http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/fp7/calls/fp7-science-in-society-2012-1.html.

European Commission. 2012a. *Commission Recommendation of 17.7.2012 on access to and preservation of scientific information, C(2012) 4890 final.* https://ec.europa.eu/research/science-society/document_library/pdf_06/recommendation-access-and-preservation-scientific-information_en.pdf.

European Commission. 2012b. *Science in Society 2013: Call*, July 10, http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/fp7/calls/fp7-science-in-society-2013-1.html.

European Commission. 2012c. *Scientific data: Open Access to research results will boost Europe's innovation capacity (IP-12-790)*, accessed January 12. http://europa.eu/rapid/press-release_IP-12-790_en.htm.

European Commission. 2012d. *Survey on Open Access in FP7*. Luxembourg: Publications Office of the European Union, DOI: 10.2777/81083. http://ec.europa.eu/research/science-society/document_library/pdf_06/survey-on-open-access-in-fp7_en.pdf.

European Commission. 2012e. *Towards better access to scientific information: Boosting the benefits of public investments in research, COM(2012) 401 final*.

http://ec.europa.eu/research/science-society/document_library/pdf_06/era-communication-towards-better-access-to-scientific-information_en.pdf.

European Commission. 2013. *Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020*. http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf.

European Commission. 2014a. *European Research Area: Progress Report 2014*. http://ec.europa.eu/research/era/eraprogress_en.htm.

European Commission. 2014b. *Horizon 2020 Work Programme 2014-2015: 16. Science with and for Society. Revised*. http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-swfs_en.pdf.

European Economic and Social Committee. 2013. "Opinion of the European Economic and Social Committee on the 'Communication from the Commission - Towards better access to scientific information: Boosting the benefits of public investments in research' COM(2012) 401 final (2013/C 76/09)". *Official Journal of the European Union*, Volume 56, 48-53. http://www.talentcentrebudapest.eu/sites/default/files/c_07620130314en.pdf.

European Parliament, and Council of the European Union. 2002. *Regulation (EC) n. 2321/2002 of 16 December 2002 concerning the rules for the participation of undertakings, research centres and universities in, and for the dissemination of research results for, the implementation of the European Community Sixth Framework Programme (2002-2006)*. http://cordis.europa.eu/documents/documentlibrary/66622801EN6.pdf.

European Research Council. 2007. *ERC Scientific Council Guidelines for Open Access*. http://erc.europa.eu/sites/default/files/document/file/erc_scc_guidelines_open_access.pdf.

High Level Expert Group on Scientific Data. 2010. *Riding the Wave: How Europe Can Gain From The Rising Tide of Scientific Data*. http://ec.europa.eu/information_society/newsroom/cf/newsletter-item-detail.cfm?item_id=6204.

Technopolis Group, and Fraunhofer ISI. 2012. *Interim evaluation & assessment of future options for Science in Society Actions: Final Report*. http://ec.europa.eu/research/science-society/document_library/pdf_06/phase01-122012_en.pdf.

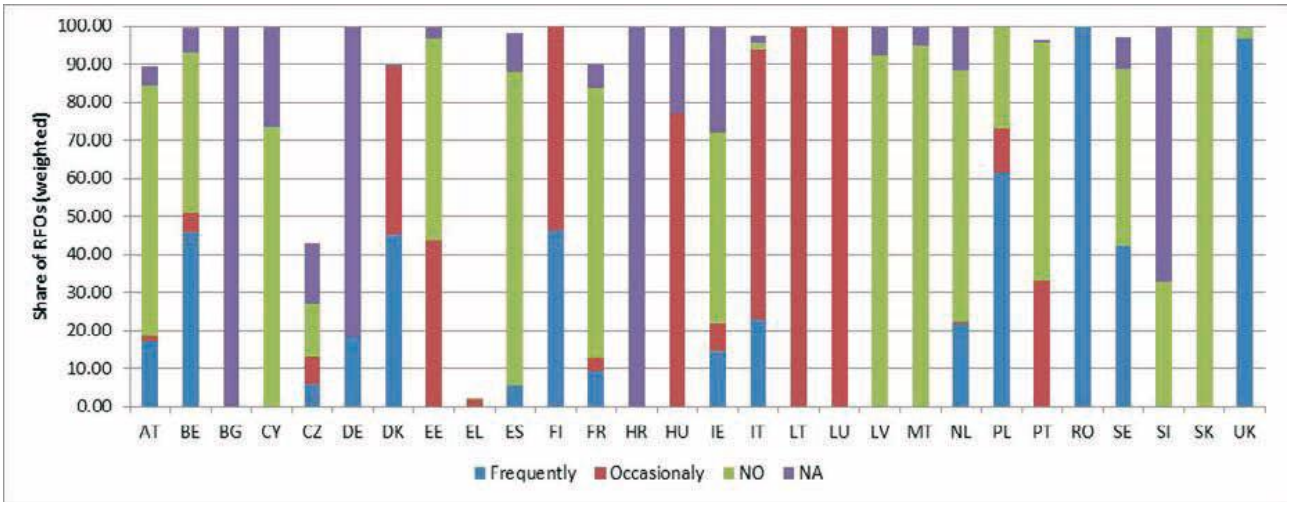


Figure 6.1 Share of funders systematically funding open access to data, 2013

Source: ERA survey 2014 (funders who answered the ERA survey in 2014, which represent 34 % of total EU GBAORD)

Annex 6.1 - EC Policy Initiatives for Open Access.

March 2006	Publication of EU-commissioned study on the economic and technical evolution of the scientific publication markets in Europe Press release: Commission study addresses Europe's scientific publication system' Public consultation 31 March to 15 June 2006
December 2006	ERC (European Research Council) Scientific Council Statement on Open Access
December 2006	European Research Advisory Board (EURAB) final report, 'Scientific Publication: Policy on Open Access'
February 2007	Communication on Scientific information in the digital age: access, dissemination and preservation COM(2007) 56 final
September 2007	Consultation on Open Access question (No. 21) of Green Paper 'The European Research Area: New Perspectives' (ERA Green Paper)
November 2007	Council Conclusions on scientific information in the digital age: access, dissemination and preservation
December 2007	ERC (European Research Council) Scientific Council Guidelines for Open Access
July 2008	Open Access Handbook – joint publication by the European Commission and the German Commission for UNESCO.
August 2008	Launch of Open Access Pilot in FP7
2007 (revised June 2009)	Reimbursement of publication costs in FP7('paid' Open Access), see page 18, article II.16.4 'other activities'
June 2009	Results of questionnaireto Member States and associated countries via the Scientific and Technical Research Committee (CREST)
October 2009	'Working Together to Strengthen Research in Europe – European Research Area Conference', Brussels. Conclusions of session 1.5'Open access and preservation: how can knowledge sharing be improved in the ERA?'
October 2010	High Level Expert Group on Scientific Data report to the European Commission 'Riding the Wave: How Europe Can Gain From The Rising Tide of Scientific Data'
November 2010	EC and National Experts Workshop Sharing knowledge: Open Access and preservation in Europe report
December 2010	Official launch of FP7 project OpenAIRE

February 2011	EC and FP7 Project Partners 'Open Access and preservation in the European Research Area: paving the way towards a sound strategy' report
May 2011	Public hearing on access to and preservation of scientific information:
July 2011	Launch of EC public consultation on scientific information (closes on 9 September 2011)
November 2011	Proposal for Open Access in Horizon 2020
December 2011	National Open Access and Preservation Policies in Europe
January 2012	Survey on Open Access in FP7
January 2012	Results of the public consultation on scientific information in the digital age
July 2012	Recommendation on access to and preservation of scientific information
July 2012	Communication Towards better access to scientific information. Boosting the benefits of public investments in research
July 2012	Communication on a reinforced European Research Area partnership for excellence and growth
October 2012	Frequently asked questions on Open Access to publications and data in Horizon 2020
2012	Survey of Open Access in FP7
January 2013	Favourable opinion of the European Economic and Social Committee on the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Towards better access to scientific information. Boosting the benefits of public investments in research - COM(2012) 401 final
February 2013	The Competitiveness Council (Internal Market, Industry, Research and Space) met on 18 and 19 February 2013 in Brussels. In the field of research, the Council held a debate on Open Access to scientific information resulting from publicly funded research projects. Member States supported the idea of developing broader and more rapid access to scientific publications in order to help researchers and businesses to build on the findings of publidy funded research. Moreover, ministers welcomed the Commission's view that Open Access to scientific publications should be a general principle of the future Horizon 2020 research framework programme. The optimal circulation, access to and transfer of scientific knowledge is one of the objectives for the establishment of a genuine European Research Area.
July 2013	Public consultation on Open Research Data - On 2nd of July 2013, the EC held a one-day public consultation on open research data in Brussels to obtain the input of all concerned stakeholders on this important and sensitive issue.

October 2013	ERC (European Research Council) Scientific Council Guidelines for Open Access - revised
October 2013	Report of the European Commission - Public Consultation on Open Research Data
December 2013	Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020

Annex 6.2 - List of projects on Knowledge Diffusion Funded under FP6 and FP7.

Project acronym	Project Title	Start year
RECODE	Policy RECommendations for Open Access to Research Data in Europe	2013
SERSCIDA	Support for Establishment of National/Regional Social Sciences Data Archives	2011
MEDOANET	Mediterranean Open Access Network	2011
OpenAIRE	Open Access Infrastructure for Research in Europe	2010
ODE	Opportunities for Data Exchange	2010
SISOB	An Observatorium for Science in Society based in Social Models	2010
APARSEN	Metadata for preservation, curation and interoperability)	2010
NECOBELAC	Network of Collaboration between Europe and LatinAmerican-Caribbean Countries)	2009
SOAP	Study of Open Access Publishing by Key Stakeholders	2009
EUROCANCERCOMS	Establishing an Efficient Network for Cancer Communication in Europe	2009
BELIEF II	To Promote the Efficient and Effective Communication of Results, Networking and Knowledge among EU e-Infrastructure Projects and their Users	2009
ACUMEN	Academic Careers Understood through Measurement and Norms	2009
DRIVER II	Digital Repository Infrastructure Vision for European Research	2008
EUROVO-AIDA	Euro-VO Astronomical Infrastructure for Data Access	2008
LiquidPub	Liquid Publications: Scientific Publications meet the Web – Changing the Way Scientific Knowledge is Produced, Disseminated, Evaluated, and Consumed	2008
PARSE.Insight	Permanent Access to the Records of Science in Europe	2008
CLARIN	Common language resources and technology infrastructure	2008
CESSDA	Council of European Social Science Data Archives	2008
DARIAH	Digital Research Infrastructure for the Arts & Humanities	2008

OAPEN	Open Access Publishing in European Networks	2008
PEER	Pilot Programme Investigating the Effect of the Deposit of Author Manuscripts on the Ecology of European Research and Publishing	2008
COMMUNIA	Thematic Network on the Public Domain in the Digital Environment	2007
ELIXIR	European life science infrastructure for biological information	2007

Annex 6.3 – Details of Open Access projects funded under SiS-FP7.

PASTEUR4OA	Open Access Policy Alignment STrategies for European Union Research
Febr- 2014 - July 2016	Total cost: EUR 2 260 335 EU contribution: EUR 1 935 940 Contract type:Coordination (or networking) actions
Programme FP7-SIS Subprogramme area: SiS.2013.1.3.3-1	Coordinator ETHNIKO IDRYMA EREVNON(Greece)
PASTEUR4OA will support the aim of encouraging the development of matching policies on open access and open data in the European Union according to the European Commission's recent Recommendation on"Access to and preservation of scientific information" (July 2012) and in view of maximizing alignment with the Horizon 2020 policy on access to the research funded by the Commission. The project will help develop and/or reinforce open access strategies and policies at the national level and facilitate their coordination among all Member States. It will build a network of centres of expertise in Member States that will develop a coordinated and collaborative programme of activities in support of policymaking at the national level under the direction of project partners. The project will build on an already existing project, Mediterranean Open Access Network (MedOANet) capitalizing on its work and an already established network within Mediterranean Europe. Further, it will take advantage of the experience and extensive networks of organizations such as EOS (Enabling Open Scholarship), JISC (Joint Information Systems Committee), SparcEUROPE, LIBER (Association of European Research Libraries), EIFL, as well as prominent funding organizations that participate in the consortium, to secure a European-wide engagement of bodies of authority of the Member States with the project's aims and extend its impact beyond Member States to neighbouring Accession States. More specifically, PASTEUR4OA will engage key national policy-makers, namely funders and research institution officials with decision-making power, in order to help them in improving and/or developing coordinated policies on open access in line with the Commission's recommendations and Horizon 2020 policies. The project will map current policies and their effectiveness to those key-policy makers and bring them together in four regional meetings, as well as the project's final meeting. It will encourage systematic exchange of model policies and best practices to achieve consistency across Member States in terms of Open Access policy and will produce briefing papers and other advocacy materials appropriate for policy-makers to be distributed in	

all countries and translated in as many languages as possible.

RECODE	Policy RECommendations for Open Access to Research Data in Europe
Febr. 2013- Jan. 2015	Total cost: EUR 1 147 484 EU contribution: EUR 949 488 Contract type: Coordination (or networking) actions
Programme FP7-SIS **Subprogramme area:** **SiS.2013.1.3.3-1**	Coordinator TRILATERAL RESEARCH & CONSULTING LLP – (UK)
The RECODE project will leverage existing networks, communities and projects to address challenges within the open access and data dissemination and preservation sector. The sector includes several different networks, initiatives, projects and communities that are fragmented by discipline, geography, stakeholder category (publishers, academics, repositories, etc.) as well as other boundaries. Many of these organisations are addressing the barriers to open access to research data, such as stakeholder fragmentation, technical and infrastructural issues, ethical and legal issues, and state and institutional policy fragmentation. However, these organizations are often working in isolation or with limited contact with one another. RECODE will provide a space for European stakeholders in the open access and data dissemination and preservation sector to work together to provide common solutions for these issues. It will provide over-arching recommendations for a policy framework to support open access to European research data. The RECODE partners will identify and connect with relevant stakeholders, building upon and strengthening existing stakeholder engagement mechanisms at the European and international levels. It will conduct studies of good practice and exchange good practice principles with relevant stakeholders and institutions during networking activities. The RECODE project will formulate recommendations for open access to research data targeted at different stakeholders and policy-makers in support of the Commissions policies. It will take account of the disciplinary and international differences in open access stakeholder ecosystems and stakeholder, institutional, funding body and governmental value chains	
FOSTER	FACILITATE OPEN SCIENCE TRAINING FOR EUROPEAN RESEARCH
Febr. 2014- Jan. 2016	Total cost: EUR 1 946 905 EU contribution: EUR 1 499 860 Contract type: Coordination (or networking) actions
Programme FP7-SIS **Subprogramme area:** **SiS.2013.1.3.3-2**	Coordinator UNIVERSIDADE DO MINHO (PORTUGAL)
FOSTER is a coordination initiative that aims to support different stakeholders,especially young researchers, in adopting open access in the context of the European Research Area (ERA) and in complying with the open access policies and rules of participation set out for Horizon 2020 (H2020). It focuses on integrating open access principles and practice in the current research workflow by targeting the young researcher training environment. In addition, FOSTER strengthens the institutional training capacity to maintain compliance with the open access policies in the ERA and H2020, and facilitates the adoption, reinforcement and implementation of open access policies from other European funders, in line with the European Commission's recommendation.	

FOSTER will establish a European-wide training programme on open access and open data, consolidating training activities at downstream level and reaching diverse disciplinary communities and countries in the ERA. Each type of stakeholder will be provided with a range of relevant training programmes, practical advice, support and help in engaging, dynamic and outcome-oriented way. Training toolkits will be developed and made openly available for re-use. The training programme will include different approaches and delivery options: elearning, blearning, self-learning, dissemination of training materials/contents, helpdesk, face-to-face training, especially training-the-trainers, summer schools, seminars, etc.

MEDOANET	Mediterranean Open Access Network
Dec. 2011 – Nov. 2013	Total cost: EUR 964 552 EU contribution: EUR 746 695
Programme FP7-SIS **Subprogramme area:** **SiS.2011.1.3.1-1**	Contract type:Support actions

MEDOANET will focus on national and regional coordination of Open Accessstrategies, policies and structures in six Mediterranean countries Greece, Italy, France, Spain, Portugal and Turkey. It will do so by means of strengthening, expanding and systematizing the activities of an already active regional network of partners from Mediterranean Europe.

MEDOANET will identify and map existing strategies, structures and policies of the six countries into an online Mediterranean Open Access Tracker, and, most significantly, it will identify and systematically engage significant policy makers and other stakeholders with the ability to affect change in policies, in a top-down approach. This will increase awareness of key issues at the policy level, fostering the conditions for coordinated policies at national and institutional levels that are currently largely lacking in these Mediterranean countries.

National Task Forces will be formed and national workshops will serve as forums to debate the course of action in each country in a coordinated fashion. A European workshop will bring together key policy makers from the six countries and other European experts and will contribute towards regional coordination across the partner countries and beyond.

The project will further produce guidelines for policy makers, namely research policy makers, public research funders, such as National Research Councils, and institution administrators, such as rectors - common for all the countries. A European conference will serve to place the project outcomes in a wider context, as well as bring together stakeholders from the six Mediterranean countries and the rest of Europe in an effort to further coordinate discourse towards policy actions that will strengthen the Open Access paradigm. To benefit from the valuable experience and expertise in Northern Europe, the consortium will also include three strategic partners from the region.

NECOBELAC	Network of collaboration between Europe and Latin American Caribbean countries to spread know-how in scientific writing and provide the best tools to exploit open access information in public health
Jan. 2009 – July 2012	Total cost: EUR 907 177 EU contribution: EUR 800 000 Contract type: Coordination (or networking) actions

Programme: FP7-SIS **Subprogramme area:** **SiS-2008-1.3.1.**	Coordinator: ISTITUTO SUPERIORE DI SANITA' (ITALIA)
The idea is to spread know-how in the production, dissemination and retrieval and use of health information in Latin American and Caribbean (LAC) countries, on the basis of the European and LAC experiences, the analysis of the different socio-cultural landscapes and the specific health information needs of the areas involved. The project will strengthen awareness about the benefits of the new publication model (open access) and create a network of institutions closely collaborating in ad hoc training programs; the first steps will regard the necessity to develop and exchange know-how in information production and diffusion (including technical and ethical issues) among all stakeholders. Specific infrastructures will be developed to promote cultural change. The project acts through a two level training approach (train-the-trainers and local training) including the use of topic maps as innovative tool based on semantic web. Traning activities will be developed both in Europe and LAC. A unifying Project such as NECOBELAC will contribute to strengthen the coordination, development and effectiveness of existing health related information infrastructures in Europe and Latin American and Caribbean countries (LAC), in order to achieve a wider scale uptake of community engagement, embedding the use of open access methods within accepted working practices. The countries involved will benefit from contacts with leaders in the field of open access development and will be able to share their experiences thus strengthening networks of collaboration with mutual advantages: - Europe will be able to benefit by increased access to the research outputs of Latin American and Caribbean countries (LAC) and by the wider adoption of open access methods. - LAC countries will be able to benefit from sharing quality programs in launching and operating open access initiatives and strengthen their existing networks and collections in the health sciences including the Virtual Health Library and Scientific Electronic Library Online both launched 10 years ago and achieving progressively sustainable operation since then. NECOBELAC will show how international bi-directional cooperation is an added value contributing to the capacity building process by embedding information dissemination practices in different geographical areas with diverse cultural and technological scenarios.	
SOAP	Study of open access publishing
Mar. 2009 – Feb. 2011	Total cost: EUR 960 945 EU contribution: EUR 809 919 Contract type:Support actions
Programme: FP7-SIS **Subprogramme area:** **SiS-2008-1.3.1.1**	Coordinator : ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCHCERN (Switzerland)
The shift from print-based to digital documents demands innovation from scientific publishers. Several radical new Open Access Publishing (OAP) business models have already emerged. The SOAP consortium represents key stakeholders such as publishers, funding agencies and a broad spectrum of research disciplines. It was formed to fuel the debate about the future of scientific publishing elaborated in COMMUNICATION (2007) 56, on scientific information in the digital age: access, dissemination and preservation. We believe that a variety of forms of OAP will ultimately co-exist, balancing attributes such	

as the cultural identities of the various stakeholders, career development paths, the perceived value of refereed publications and wider societal demand for access to information. The interests of researchers in the European Research Area (ERA) and worldwide will only be addressed by genuinely sustainable forms of publishing and commitment to change will only come about as a result of rational business decisions based on concrete evidence which does not exist today.

The wider open access debate often relies on extrapolations and assumptions. We plan to begin to deliver evidence by:

- Defining attributes that differentiate various business models for open access and identifying the drivers that motivate researchers in their desire for publication. OAP is unsustainable unless it makes sense for both publisher and researcher.
- Providing the European Commission, publishers and funding agencies with the results of a comprehensive survey of the attitudes of researchers in the ERA. These will give real insight into the demand and importance of OAP for its ultimate users.
- Applying the survey results to a range of specific publishing scenarios. We will describe and analyse new OAP solutions so that these may be emulated by other publishers, institutions and communities in an orderly transition to OAP wherever possible.

7 Governance of Science

Transforming Research and Innovation into an Inclusive Responsible Process

Emanuela Reale
Organization and sustainability of large systems in contemporary society
Institute of Research on Sustainable Economic Growth IRCRES,
National Research Council of Italy

Abstract

The Science and Society Programme (SaS) under FP6 and the Science in Society Programme (SiS) under FP7 address the issue of governance from many perspectives, such as encouraging dialogue between scientists and other members of the public, improving the use of science in policy making, promoting an adherence to ethical standards, and developing better ways for the results of research to be accessed by all. The SiS Programme also supported specific research activities such as the connection between science, democracy and law, as well as governance issues linked to participatory societies and to the ERA integration. Under the new RRI framework further efforts involving scholars, citizens, research organizations, and policy actors, are necessary to achieve democratic, participative, sustainable, and responsible governance. Moreover, research activities will be devoted to outlining the conditions under which RRI can be concretely implemented, and to examining the kind of benefits that it can bring to the functioning of research and innovation systems and to European integration.

7.1 EU Strategy for Governance

The interest for governance[52] dates back to the Commission Working document on Science, society and the citizen in Europe (EC 2000), which provided a preliminary definition and proposed that governance should be an issue for the European Union to deal with, because of the need to develop 'an open mind to innovation', acknowledge its risks and benefits, and to create rules and instruments that favour an open dialogue between policy makers, researchers, citizens, and stakeholders.

Definitions and perspectives were then refined in the White paper addressing the reform of European Governance that the Commission delivered in 2001 (EC 2001).This proposed opening up the policy-making process to involve more people and organisations in shaping and delivering EU policy: 'Reforming governance addresses the question of how the EU uses the powers given by its

[52] For analytical purposes, it is useful to recall here the distinction in EU policy between 'science for governance' and 'governance of science', which is based on the usual distinction between 'science for policy' – the application of scientific advice for policy formation and 'policy for science' – the formation of policy for the operation of government-funded science and innovation system, including funding allocation. Stocktaking refers to projects dealing with both the aspects of governance.

citizens. It is about how things could and should be done. The goal is to open up policy-making to make it more inclusive and accountable. A better use of powers should connect the EU more closely to its citizens and lead to more effective policies.'

According to the aforementioned document, governance means the 'rules, processes and behaviour that affect the way in which powers are exercised at European level, particularly as regards openness, participation, accountability, effectiveness and coherence'. Five requirements underpinning good governance were discussed together with the changes proposed: openness, participation, accountability, effectiveness and coherence, the application of which are informed by the principles of proportionality and subsidiarity, thus shaping altogether the key reference points of the EU governance, which apply also for science.

The Council Resolution of June the 26th 2001 on Science and Society (European Council 2001) recalled, among others, the Commission's Working Document, and explicitly encouraged the Member States and the Commission to improve exchanges and dialogues, best practices, and networking, developing common practices and guidelines on risk assessment and management and on the use of scientific advice for improving EU governance.

In 2002, the Science and Society Action Plan was launched (EC 2002; CREST 2002); the contents related to the issue of governance refer to:

- Risk governance (enhancing risk identification, assessment, management and communication) in order to improve consumers' health and food safety, as well as to provide interfaces for a better communication between scholars, managers, and policy makers;

- The use of expertise in policy making and in the public debate on hot topics of the agenda, such as climate change or genetically modified organisms. The Plan outlined: a) the need to deepen problems related with the uncertainty of science in that it is unable to provide unique and non-controversial answers to social problems, b) the difficulties of policy makers for integrating scientific knowledge in the decision making contents, and c) involving stakeholders in debates on science and society not only to gain trust from a larger part of society, but also to deliver more robust policies.

The Action Plan also proposed important steps:

a) The new ten-year Lisbon strategy, launched in 2000, that was aimed to make the Union 'the most competitive and dynamic knowledge-based economy in the world', leading to growth that is ecologically, economically, and socially sustainable. This development required a substantial investment in R&D and reforming processes, as well as the design of new participative modes of governance of science.

b) The Communication from the Commission on collection and use of expertise at all stages of EC policy making, by implementing principles and guidelines (EC 2002) that sought to promote good practices related to the collection and use of expertise at all stages of Commission policy-making, with a view to establishing a sound knowledge base for better policies and using expert advice in a credible way.

c) The adoption of a specific programme for R&TD for structuring the European Research Area (European Council 2002); the realization of which needs an appropriate framework of governance for science to integrate different actors across European countries.

In 2003, a conference discussed the principles of the White paper on governance (EC 2004); the new ERA domain and the policy objective of integration enabled the problem of how this area can be governed democratically and equitably to emerge. The Conference identified civil society, the research community and the European Commission as key stakeholders and highlighted the need of changing attitude toward governance, in order to create a policy framework adapted to the participatory process for the decision making of matters related to science and society.

The reactions to the White paper[53] (EC 2003) confirmed the priorities and added further issues to be considered for the promotion of wider participation in EU policy shaping and for the improvement of EU policy making. The participants in the public consultation judged the scope of the governance agenda proposed in the White Paper to be overly limited because it focused on the effectiveness and efficiency of the decision-making system. Moreover, the consultation and involvement of civil society should not undercut the representative systems; the issues of bettering the involvement of the regional and local levels in both policy shaping and policy implementation have mainly drawn constituency comments that demonstrate interest, but generally call for clarification of the Commission's ideas; a demand for 'vertical subsidiarity' emerged from regional and local players.

Finally, a precise statement on EU governance outlined that 'the principles of good governance should not be equated to democratic government, as better governance cannot be the answer to a democratic deficit problem … the White Paper's call for inclusion of more players in the policy process, while necessary, does not by itself lead to increased democratic legitimacy of policies or institutions.' (EC 2003). The set of comments collected in the Report also assessed a commitment towards global governance as extremely valuable, because of the global nature of problems affecting science and its relationships with society.

Table 7.1 - Relevant steps in the field of governance

2000	Commission working document on Science, society and the citizen in Europe
2001	EC, European Governance-A White Paper
2001	Council Resolution 26 June 2001 on Science and Society and on Women in Science
2002	EC, Science and Society Action Plan
2002	EC, Communication from the Commission on the collection and use of expertise
2002	Council Decision Adopting a specific programme for R&TD 'structuring the ERA

[53] The comments were collected by the way of a public consultation that involved stakeholders, policy makers, civil society representatives, and researchers; the comments are summarized in EC, 2003.

2003	EC, Report from the Commission on European governance (reactions to the White paper)
2006	EC, From science and society to science in society: Towards a framework for 'co-operative research
2007	EC, Taking European Knowledge Society Seriously
2008	Final Report on the Helsinki process on globalization and democracy
2009	EC, Global Governance of Science. Report of the Expert Group
2009	EC Research, The First MASIS Report.
2011	EC DG Research Workshop on RRI
2013	Horizon 2020 – Work Programme 2014-2015, 16 Science with and for Society

Source: author's elaboration

Based on the mentioned developments, in 2006 the FP7 introduced a conceptual change (from Science And Society to Science In Society). The aim was to embed scientific research in society and to break down the barriers between science and society and between scientists and citizens. The rationale behind the change was that the sustainable development of European societies depends on their capacity to create and to exploit knowledge and to innovate. This implied the concentration of research on governance under the SiS Action Line, 'A more dynamic governance of the science and society relationship', and a consistent growth in the amount of funding allocated (see Section 2).

The same year, a Report from a European Commission Workshop (EC 2006) outlined the trade-off between public participation/public engagement rhetoric and the concrete attitude of high-level policy making. 'Despite the high profile afforded to the language of "involving stakeholders", "public participation" and "social inclusion", such perspectives serve to impede progress in achieving genuine public engagement as a pervasive feature of science governance. .... A constant pressure is exerted on those exercises that are undertaken, such that they are forestalled, or become diluted, diverted, constrained, or eventually neglected in the subsequent policy process' (EC 2006). To face this challenge, the seminar delineated the need to promote public participation and engagement at the earliest stages of policy making, when the 'policy developments remain relatively flexible and open to influence'.

It is worth citing two other initiatives that are relevant for understanding the evolution of the EU's strategy on governance: the Report of the Expert Group on Science and Governance (EC 2007c), and the Final Report of the Helsinki process on globalization and democracy (Finnish Ministry of Foreign Affair 2007). The former recommended, among others, a shift from expert-dominated to more open deliberative science-informed institutions on ethics, risk and innovation, and 'the adoption, both in the governance of science and the use of science for governance, of new institutions and procedures for more inclusive and pluralistic discussion, learning, and challenge'.[54]The latter, focusing on new requirements emerging from the process of globalization,

[54] The European Commission promoted since 2005, SINAPSE-Scientific Information and Expertise for Policy support in Europe, a web communication platform to promote better use of expertise in EU policymaking and governance. SINAPSE supports networking, expert groups, and facilitates ad-hoc public consultations and e-debates:

highlighted global governance as a multi-actor and multi-level view of politics in which local, national, regional, and global political processes are inseparably linked and in which different forms of governance co-exist side by side rather than in a hierarchical order. Cooperation between stakeholders is the sole way of addressing the emerging challenges (identifying public needs, facilitate negotiations, disseminate knowledge, broadening public participation).

In 2009, the debate on science in society and on the governance issue and its global dimension was further enriched. The Report of the Expert Group on Global Governance of Science to the Science, Economy and Society Directorate of the EC (EC 2009a) discussed science as a social institution producing knowledge oriented towards action that needs global governance instruments in order to comprehensively cover all of the sciences and cross national boundaries. Efforts should be devoted to raising public participation, and to move toward models more adapt at governing the tensions between universal scientific knowledge, general ethic principles, and local knowledge and traditional values. At the same time, the MASIS (Monitoring Policy and Research Activities on Science and Society) Expert Group set up by the European Commission produced the first Report (EC 2009b), which investigated the role of science and the relationships with society at the level of individual European countries. The evidences collected showed that self-regulation of science must go with instruments that can support the participation of other stakeholders. More social actors to be involved also means the need to broaden the coverage of policy for science, including more questions, not necessarily limited to traditional items such as funding and knowledge transfer. Concepts of accountability for performance, reflexivity through the assessment of results and impact, responsible development, responsible innovation, and 'ethicisation' gained a new prominence.

In 2011, a Workshop promoted by the DG Research to build, by the way of a participatory process, the notion of Responsible Research and Innovation in Europe (EC 2011), ended up with: a) the concepts of science for society, targeted to Europe's societal challenges and to the production of a right impact; b) the concept of science with society, thus on responsiveness of research and innovation to society in the face of the uncertain effects that can be produced; and finally c) linking R&I to a general responsibility toward society, challenging scientists as well as other policy and economic actors about their role and responsibilities. The mentioned thoughts, concerns, discussions, and evidences collected and the results produced by the MASIS project (EC 2012), formed the basis for the construction of the new Horizon 2020 strategy and the related work programme.[55] Figure 7.1 presents three dimensions explored in the Eurobarometer on Public Perceptions of Science, Research and Innovation (EC 2014). These are the positive impact that respondents think should come from science, technology and innovation (STI) in 13 different areas; the level of positive impact that respondents think people's behaviour is likely to have in each area; the level of priority that respondents think should be given by science and technological innovation to this area (size of the bubbles of Figure 7.1).

---

http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=1299&lang=1

[55] European Commission Decision C(2013)8631 of 10 December 2013, Annex 16 to the Decision, Horizon 2020 – Work Programme 2014-2015, 16 Science with and for Society.

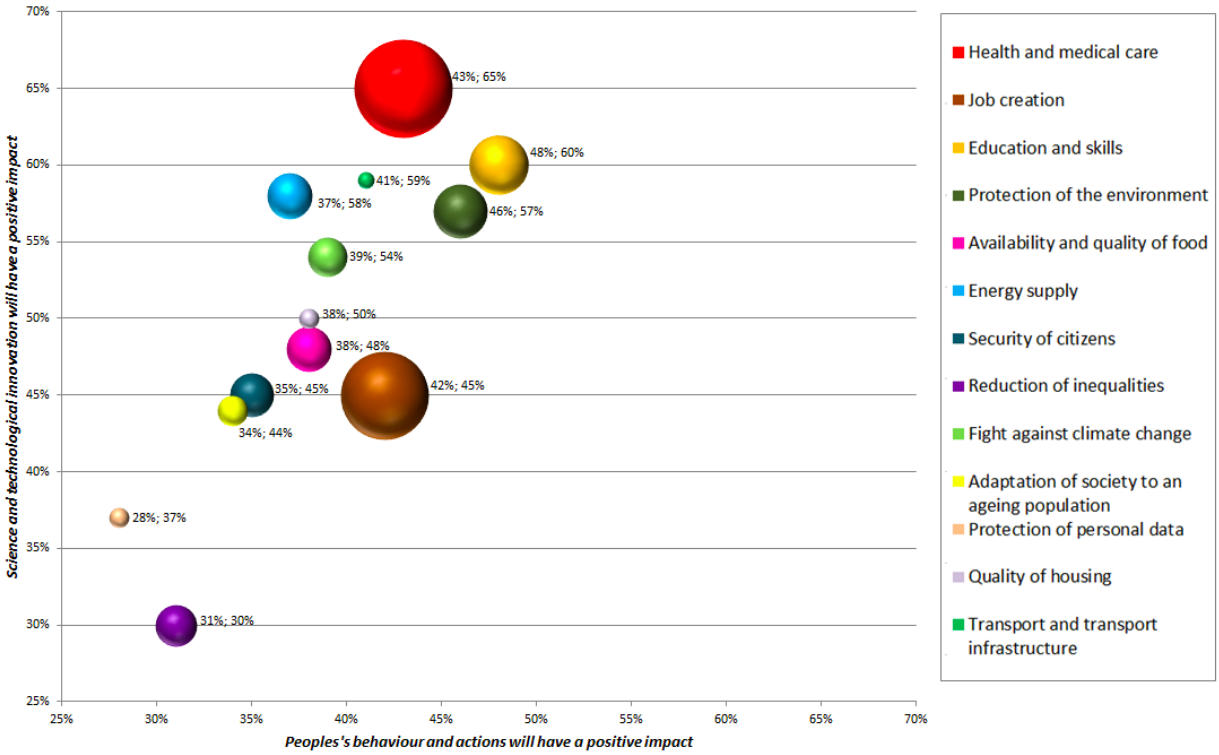


Figure 7.1 Level of priority,level of positive impact of Science Technology and Innovation-STI and level of positive impact of people behaviour in 13 areas (EU28, 27.910 respondents)

Source: Special Eurobarometer 419, 2014

It is evident that positive outcomes are more expected from the STI innovative outcomes than from people' actions. Thus, there is a diffuse perception of distance between STI endeavour and actions from society, which can be overcome only under special circumstances (people involved in STI activities and people with the highest level of education).

7.2 Snapshot of Science and Society and Science in Society

Providing stocktaking of how governance issues have been developed within the Science and Society action under FP6, how they evolved under FP7, and what lessons can be derived from the past experiences for the new phase of Horizon 2020, is not an easy task. Governance has several interconnected perspectives, which are suitable to be included, or excluded, from the field. Thus, the first issue for the stocktaking is to circumscribe the perimeter of the Governance issues under the Science and/in Society Programmes, which covers the following items:

- Governance of policy, organizations and research activities: monitoring, design, implementation;
- Use of scientific advice and expertise in policy making;
- Responsible governance of science, thus governance model and tools improving the possibilities of a successful engagement of citizens and society in a co-creative research and innovation process(practices, expert groups, structured debates supporting reform processes).

Governance mechanisms aimed at improving and consolidating the European Research Area, under institutional logics of collaboration, coordination and integration are included; issues related to research integrity and privacy are not included. The governance issue has some overlapping areas with other pillars, namely, public participation/awareness and ethic. This implies that the appreciation of the governance issue must be integrated with the evidences of other thematic areas.

7.2.1 The Activities under FP6

Under FP6, 17 projects dealing with governance issues were supported (9 Coordination Actions and 8 Specific support Actions). The amount of funding was about 7,5 Million Euros. Almost all the partners involved came from western European countries (Figure7.2).

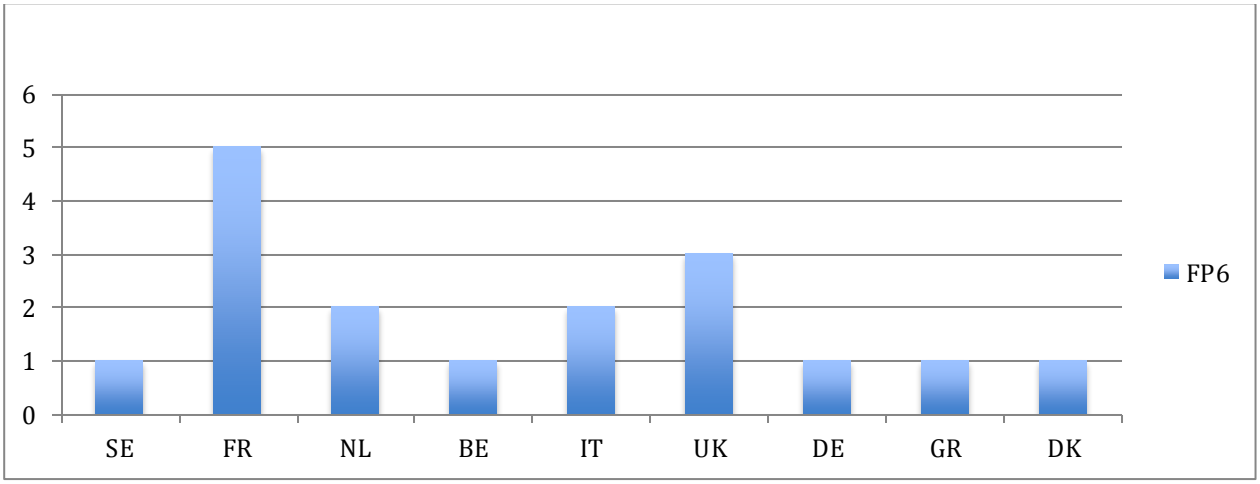


Figure 7.2 Coordinators of Science and Society (SaS) Projects by Country
Source: author's elaboration on CORDIS Open Data

7.2.1.1 Deliberative democracy methods

One stream was the understanding of deliberative democracy methods on topics with a direct link to current policy discussions, to facilitate structured debates on controversial issues (stem cells, cloning, Genetic Modified Organisms, genetic property rights etc.). The objectives were to raise awareness and understanding of deliberative democracy methods, by producing tools to facilitate structured debates on controversial issues and monitor the change of attitudes among the European public.[56] For instance, citizens have been charged with assessing both research developments and ethical and socio-political aspects of issues at stake in the field of brain science and with delivering a set of recommendations relevant to policy-makers and the wider scientific and research communities. The initiative is supposed to help the agenda setting, by linking specific issues of concern or interest to the public to a larger debate on brain science.[57]

[56] Project DECIDE - DEliberative CItizens' DEbates in European science centres and museums; http://cordis.europa.eu/project/rcn/73944_en.html
[57] Project ECD-Meeting of Minds. European Citizens' Deliberation on Brain Science; http://cordis.europa.eu/project/rcn/74471_en.html

7.2.1.2 Risk communication and interpretation

An important issue was the extent to which the European countries have risk communications plans at the national level (e.g., natural risks and/or man-made, accidental risks and/or deliberate) and within specific risk domains (natural disasters, food safety, critical infrastructures, etc.). The main goal was to promote co-ordination of national approaches on risk communication and to propose initiatives for involving all stakeholders and civil society in a more dynamic risk governance culture, both within and across countries[58]. On the same issue, another objective was to shape a resilience and risk governance concept, based on existing research, and an accompanying management tool. For example, issues of science development and societal uncertainty, risk assessment and the precautionary principle can be faced through open dialogue and interactive communication within a wide network, including scientists, science communicators and media[59].

Other perspectives put trust as fundamental, for risk interpretation of the public, between 'real' and 'perceived' risks, and focused on how risk governance can be made transparent to decision makers and the general public. Limitations of risk science, the importance and difficulty of maintaining trust and the socio-political nature of risk suggested a participative approach in order to make the decision process more democratic, to improve the relevance/quality of technical analysis and to increase the legitimacy and public acceptance of political decisions. In this context, an interdisciplinary and procedural approach to risk governance can define a reasonable path towards the creation of more resilient communities[60]. In this area, also projects on the significance to reach a comprehensive risk governance strategy, to be more transparent to decision makers and to the general public, were developed. The comparison among different approaches to risk governance represents one key step. Risk informed decision-making, precaution principle to risk reduction could be integrated through a more inclusive deliberative method that takes people's concerns and values into account[61]. A further perspective aims at developing an accepted governance model by connecting risk assessment, risk management, and risk communication. Based on a policy learning approach, the exchange, comparison and analysis of insights, lessons and inputs on risk governance practices from both scientists and policy makers, can be integrated within a unique governance framework across different risk fields.

SaS projects produced different outputs and tools to conduct and facilitate deliberative consultations and monitor the change of attitudes among the European public (e.g. on contemporary Life Sciences)and a range of dissemination activities were performed. In some cases, the projects' evaluation reports provide a sound appreciation of the diffusion of results and of their impact.[62] The Mid-Term Evaluation Assessment of SaS (EC, 2007b) pointed out that the scope of several projects in the area of Scientific Advice and Governance activities seems to be narrower than the objectives

[58] Project STARC - STakeholders in Risk Communications; http://cordis.europa.eu/project/rcn/74473_en.html
[59] Project RISK NETWORK - Risk communication network; http://cordis.europa.eu/project/rcn/74476_en.html
[60] Project MIDIR - Multidimensional integrated risk governance; http://cordis.europa.eu/project/rcn/80073_en.html
[61] Project CARGO - Comparison of approaches to risk governance; http://cordis.europa.eu/project/rcn/80075_en.html
[62] For instance, DECIDE (Developing and Evaluating Communication Strategies to Support Informed Decisions and Practice Based on Evidence) materials have been translated in the languages of the countries where the meetings took place. A highly diverse audience of more than 2000 adult and young citizens in several countries were engaged via the European network of science museums and other institutions.

set by the Action Plan and related Work Programmes. The same document outlined the excessive importance given to the topic of expanding public participation and the low consideration to the key questions on the democratic governance of technological change under conditions of globalisation, as well as the governmental scientific advisory process within the EC and its Member States.[63] The strong focus on public participation mechanisms in the Programme may have distracted attention from the examination of the role of scientific advice in the EC and its Member States and have shown some difficulties in engaging policy-makers in the proposed activities. Further, the programme focused on risk communication and public participation, while ignoring structural political and economic issues that underlie public concerns about both the governance of science and technology and the role of science and technology in governance.[64]Consequently, the policy relevance and impact of activities have been too limited. Recommendations for the FP7 programme underlined the need of scaling up the scope of the projects and dedicating more attention to the coordination efforts.

7.2.2 The Activities under FP7

The new structure of FP7 produced a substantial increase in the number of projects developed under the governance theme and expanded the topics: 33 projects were supported (4 Coordination Actions, 14 Specific support Actions, 15 Research projects, either Collaborative or small-medium scale). The amount of funding was about 17,4 Million Euros. 16 projects have been completed and 9 projects are still under execution (expected to be completed in 2016).[65] A broad range of countries was involved, from both Western and Eastern Europe, and in some cases non-European countries. Different fields of activities can be identified (Figure 7.3).

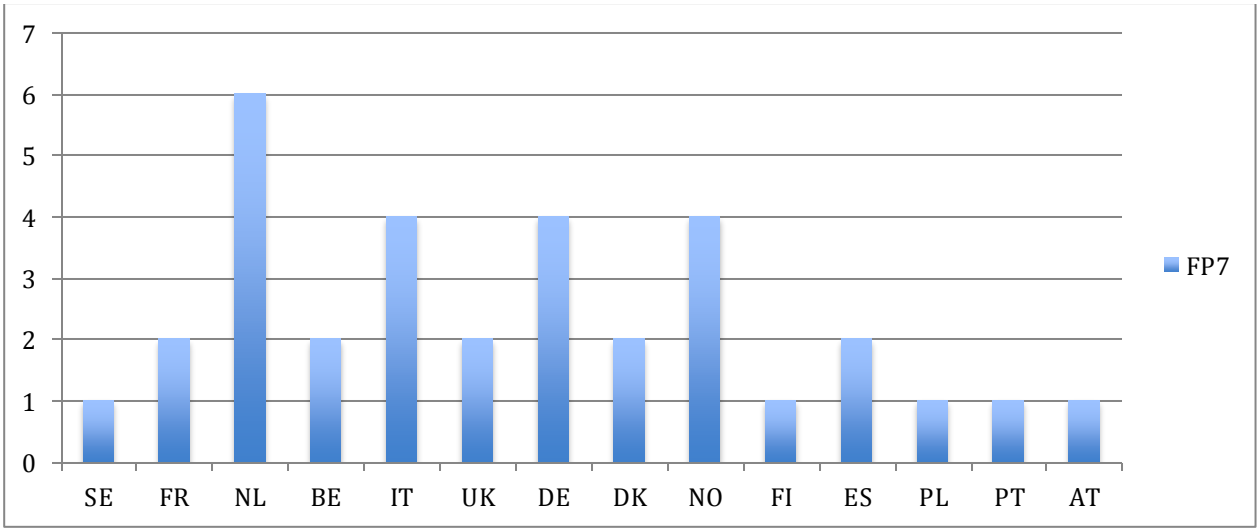


Figure 7.3 Coordinators of Science in Society (SiS) Projects by Country

Source: author's elaboration on CORDIS Open Data

[63]It is important to remember that under FP6 a large part of projects on governance were funded under the 'Citizen and governance in a knowledge-based society' Priority Thematic Area.

[64]It is important to remind that in FP6 a large part of projects on governance were funded under the 'Citizen and governance in a knowledge-based society' Priority Thematic Area.

[65] This analysis does not include SINAPSE (Scientific Information and Expertise for Policy support in Europe), a project funded under both FP6 and FP7 that is devoted to strengthening and improving the European Science system, promoting exchanges and dissemination of results produced by other projects (e.g. MASIS, EUIMA -Sharing innovative practices in University modernization, and ULAB –European Laboratory for modelling the Technical Research University of Tomorrow). MASIS is also not included since it came from an EC initiative.

7.2.2.1 Deliberative processes

One stream concentrated on human and environmental safety, ethical and moral dilemmas and perceptions of risks and responsibilities, as revealed through a focus on the market interfaces across the value chain of consumer goods. Consumers, citizens, and their organisations could be the most important stakeholders in the diffusion process of products in Europe and beyond. The main goal is to evaluate and stimulate the deliberate dialogue, and give scientific support to the stakeholders responsible for this dialogue[66]. Within the same line, the importance of participation of civil society organizations, together with business and research actors, has been considered a crucial aspect. Deliberative processes are needed to involve stakeholders from civil society through information exchange, open discussions, and continuous feedback on decision-making, on research agendas and political actions in the area of sustainable consumption and production[67].

New instruments and methods for societal engagement are seen as fundamental, to boost the quality, capacity, and legitimacy of European research governance and to solve the looming problems related to the grand challenges. Through a systemic and contextual perspective, new public engagement tools for dynamic governance in the field of Science in Society can then emerge from an intensive co-operation between researchers and science policy actors[68]. Debates on science, to strengthen public engagement in research, and complementary impact assessment instruments, to evaluate engagement activities, have been developed, by involving researchers and Civil Society Organisations in the formulation of research agendas and in research processes[69].

7.2.2.2 Science Advice

Improving the quality, effectiveness and efficiency of recommendation for policy action based on scientific knowledge – considering also expert judgment, ethical and societal values, and experience from relevant stakeholders for health across Europe – was a central issue in the SiS initiatives. Many EU Member States have national science advisory bodies, but they differ regarding their structures, practices and given relevance, all of which are difficult to manage at the national level. Moreover, many health issues have transnational dimensions. The rapid increase of scientific knowledge and health issues to be addressed exceed what national bodies can deal with. To overcome this issue, international collaboration between national bodies, for the establishment of common best practices methodologies, should be based on open governance, as more evidence-based policy making in Europe can be more transparent to the public[70]. Activities aimed at bringing together different researchers in science, technology, and society, in order to devise a collaborative tool to map out scientific and technical controversies, were also developed. The creation of a digital

---

66 Project NANOPLAT - Development of a platform for deliberative processes on nanotechnology in the European consumer market; http://cordis.europa.eu/project/rcn/88433_en.html

67 Project DELIBPROCESSCP - Identifying research needs and designing elements of deliberative processes on sustainable consumption and production in the demand areas food, housing and mobility; http://cordis.europa.eu/project/rcn/89924_en.html

68 Project PE2020 - Public Engagement Innovations for Horizon 2020; http://cordis.europa.eu/project/rcn/110581_en.html

69 Project PERARES - Public Engagement with Research and Research Engagement with Society; http://cordis.europa.eu/project/rcn/94941_en.html

70 Project EUSANH-ISA - Improving science advice for health in Europe, EuSANH; http://cordis.europa.eu/project/rcn/90985_en.html

platform allowed the connection of the best research in Europe and maximizes the exchange of methods and expertise[71].

7.2.2.3 Dialogue between government, science and society

Different theoretical and empirical models of the way in which science interacts with society in their respective national realities, on assessment frameworks and on the correlation between national and international research policies, were developed. Dialogue among multiple stakeholders on regulation and governance (scientific, institutional, industrial communities, the broad public) has been supported to articulate both consensus and absence of consensus, to sustain a European debate, and to foster the development of a shared frame of knowledge, objectives, actions, to arrive defining constructive and practicable regulatory solutions.[72] Mechanisms, for effectively tackling the scientific and technology related challenges faced by society, bring together different actors with complementary knowledge and experiences. This line included forms of dialogue and cooperation between science and society at different stages of the research process. Through partnerships, between research organisations and different societal actors, each pool of experiences and knowledge can better focus respective efforts to develop a common approach in facing societal challenges[73].

Enabling effective two-way communication between scientists and other stakeholders is another object, which is supposed to enhance democratic debate with a more engaged and informed public, by providing better conditions for collective choices on scientific issues[74]. Other approaches, aimed at elaborating a model of Civil Society Organizations, representing relationships and causal effects of factors that influence participation in research, are on-going. In fact, broader stakeholder engagement in technical and scientific research needs to be stimulated, implemented, and evaluated through appropriate tools, in order to realize the promise of participative research governance[75].

7.2.2.4 Governance tools

One relevant issue was the deepening of the concept description of the social impact of research, as the outcome of an iterative practice in which researchers and stakeholders each play a role. Productive interactions are exchanges between researchers and societal actors in collaborative settings (networks), where the knowledge is produced and valued to be, at the same time, scientifically and socially robust and relevant[76]. On a similar topic, a project is developing novel

---

71 Project MACOSPOL - Mapping controversies on science for politics; http://cordis.europa.eu/project/rcn/87595_en.html

72 Project FRAMIGNANO - International multi-stakeholder dialogue platform framing the responsible development of nanosciences and nanotechnologies (NS&T); http://cordis.europa.eu/project/rcn/89673_en.html

73 Project R&DIALOGUE - Research and Civil Society Dialogue towards a low-carbon society; http://cordis.europa.eu/project/rcn/103605_en.html

74 Project GAP2 - Bridging the gap between science, stakeholders and policy makers Phase 2:Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment; http://cordis.europa.eu/project/rcn/99712_en.html

75 Project CONSIDER - Civil Society Organizations in Designing Research Governance; http://cordis.europa.eu/project/rcn/101821_en.html

76 Project SIAMPI - Social impact assessment methods for research and funding instruments through the study of productive interactions between science and society; http://cordis.europa.eu/project/rcn/90987_en.html

tools that make it possible to measure and predict the social appropriation of research knowledge, modelled as the product of complex interactions within and between multiple, intersecting communities of scientists, journalists, industrial actors, decision makers, and consumers.[77]

In this context, conditions for the development of more integrated technology assessment methods are investigated, to get socially robust and efficient practices in closer relation with the world of policy makers and innovators. Through the concept of epistemic networks, different technological assessment techniques have been explored in a concerted and holistic manner and integrated within a unique soft framework.[78] Further methodological development of appropriate tools for social impact assessment and technology evaluation have been studied, for emerging science and technology with the objectives of mapping their strengths and weaknesses, future trends and needs and determining their appropriate application domains. A flexible integrated framework of analysis facilitates holistic societal dialogue, reflection, and policy advice on emerging science and technologies and can be applied for conducting analyses and coordinating policy deliberations[79].
The discrepancy between the criteria used in performance assessment and the broader social and economic function of scientific and scholarly research, as well as a lack of recognition for new types of work that researchers need to perform, was the object of the Academic Careers Understood through Measurement and Norms project[80], which adopted criteria and guidelines for Good Evaluation Practices.

A two-stage interactive scenario process, which uses stocktaking of forward-looking activities, and analyses of academic literature[81] pointed towards key critical junctures in ways of doing and organising research in universities, research organizations, companies and civil society, and their dynamics. This analysis was the basis for generating long-term transformative scenarios towards 2030 that incorporated significant structural and institutional changes in STI systems and practices.

7.2.2.5 The universities' modernization agenda

Universities are key actors for promoting science in society; they were analysed as to: i) the sustainability of university funding, financial management and development of full-costing, ii) the transparency and appropriateness of measurement tools for the assessment of university-based research reflecting the diversity of university missions, iii) the human resources development (careers)[82]. Moreover, mutual learning and best practices exchanges were at the core of a think-tank of five leading Technical and Research-intensive European Universities, committed to working together, towards renewing University policies in research, valorisation, entrepreneurship, and

[77] Project SISOB - An Observatorium for Science in Society based in Social Models; http://cordis.europa.eu/project/rcn/97180_en.html
[78] Project EPINET - Integrated Assessment of Societal Impacts of Emerging Science and Technology from within Epistemic Networks; http://cordis.europa.eu/project/rcn/103532_en.html
[79] Project EST-FRAMES - Integrated EST Framework; http://cordis.europa.eu/project/rcn/100425_en.html
[80] Project ACUMEN - Academic Careers Understood through Measurement and Norms; http://cordis.europa.eu/project/rcn/97240_en.html
[81] Project RIF - Research and Innovation Futures 2030: from explorative to transformative scenarios; http://cordis.europa.eu/project/rcn/100447_en.html
[82] Project EUIMA - Take-up activities by universities of specific guidelines and recommendations to implement their modernisation agenda; http://cordis.europa.eu/project/rcn/93207_en.html

outreach.[83]. A further trend in this context is that European universities generally need to reorganize their three main functions, education, research, and innovation, in recognition of the value of further interaction and interplay between these tasks[84]. A think-tank composed of five leading Research-intensive European Universities, already mentioned above, is an interesting initiative in this field. The proposal is to systematically compare, benchmark and refine their strategies to contribute towards better choices, by carrying out experimental best practices in order to demonstrate how networking and open innovation between universities can increase the quality of research and innovation in the quest for excellence[85].

7.2.2.6 Responsible Research and Innovation (RRI)

Under this topic, projects explored the dynamics of participation in research and innovation, the characteristics of responsible practices, (nature of new partnerships among various stakeholders, researchers and policymakers that are developing within innovation networks), and the influence that these developments have on knowledge production and policy. By determining the characteristics of research and innovation, involving diverse groupings, and by defining the social processes involved in responsible research and innovation practices, a governance model can be successfully developed[86]. Specific applications of Responsible Research and Innovation have been proposed; for instance, in the field of neuro-enhancement with the aim of shaping a normative framework underpinning the governance of these technologies. Analytic Classification of technologies, mobilization, and mutual learning activities engaging scientists, policy-makers, industry, civil society groups, and the wider public, are proposed to stimulate and organize a broad societal dialogue tailored to specific issues and stakeholders.[87]

A normative and comprehensive framework for RRI governance practices across and beyond Europe is under development. The framework is supposed to deliver cognitive and normative guidance that can be applied flexibly in different contexts[88].

The SiS activities covered different fields, generally emerging interdisciplinary ones, such as GMOs, and Nanotechnologies, as well as key actors of the national and global research systems (funding organizations, universities and research organizations). The main objectives of the Programme in the area of Governance were to strengthen and improve European science systems, foster the uptake of scientific advice in policymaking and improve the understanding of the place of science and technology in society, ensure broader engagement to anticipate and clarify political, societal and ethical issues, and promote better framework conditions, knowledge exchange and partnerships for higher education institutes in line with the evolving role of universities.

---

84 Project K-TRIANGLE - The Knowledge Triangle Shaping the Future of Europe; http://cordis.europa.eu/projects/result_it?q=contenttype=%27project%27%20AND%20%27K-TRIANGLE%27

85 Project ULAB - European Laboratory for modelling the Technical Research University of Tomorrow; http://cordis.europa.eu/project/rcn/97669_en.html

86 Project GREAT - Governance of REsponsible innovation; http://cordis.europa.eu/project/rcn/106794_en.html

87 Project NERRI - Neuro-Enhancement: Responsible Research and Innovation; http://cordis.europa.eu/project/rcn/108652_en.html

88 Project RES-AGORA - Responsible Research and Innovation in a Distributed Anticipatory Governance Frame. A Constructive Socio-normative Approach; http://cordis.europa.eu/project/rcn/108668_en.html

All in all, a large set of outcomes has been produced and others are foreseen; the academic outputs went with other results, such as a broad dissemination of the project results: guidelines and policy recommendations for relevant stakeholders, tools, models and platforms for sharing data and information, disseminating them among stakeholders, including policy makers. A strong commitment in all the projects toward producing an impact in terms of stakeholders' use of the results is visible.

According to the final report of the 'Interim evaluation & assessment of future options for Science in Society Actions' (Technopolis Group, Fraunhofer-ISI 2012)the FP7 SiS programme has piloted new mechanisms for linking policymakers to sources of scientific advice, with considerable success, and has generated new tools to strengthen engagement of policymakers in scientific research. Further, the programme has had a material impact in promoting and supporting modernisation agendas within universities and has developed and promoted improved technology assessment practices.

A significant proportion of the projects supported by the SiS programme have involved innovative approaches to the engagement of different types of actors both within the project teams and through new methods of dissemination. The programme has been successful in involving non-researchers within consortia, with a full role across all stages of research, from formulation of project ideas, through research design and implementation, to dissemination and exploitation of results. In particular, experiences of involving Civil Society Organisations (CSOs) indicates that they can play an important role in helping to achieve a stronger integration of societal aspects into EC funded research.

In sum, the evaluation outlined that the FP7 SiS programme has succeeded in its ambitions to develop larger, more strategic projects with more pronounced policy links than under FP6: in fact, the number of public bodies participating in the FP7 SiS is significantly higher than in FP6 SaS. However, the impacts that can be expected, especially regarding policymaking, are rather limited. The projects results have produced advancements across a number of areas, even though these achievements might seem fragmented, because they are spread across a number of thematic areas and activity fields. Policymakers and other stakeholder groups seem to find it difficult to relate to the large volume of work that has been carried out across a wide number of themes and general awareness of the key achievements of the programme remains low, even among key audiences.

Recommendations for future activities under the H2020-Science With and For Society (SWAFS), suggested capitalising on the accomplishments achieved so far by concentrating efforts on areas in whichthe potential impact can be higher, , more carefully choosing the topics to be addressed. Finally, the advice is to place greater emphasis on closer engagement of stakeholders, understanding the needs of the different target audiences, generating clear and targeted messages, and increasingthe dissemination of results.

7.3 Best Practices

The term best practices generally refer to those particular ways of doing things that comparatively perform better than others, for solving a specific problem or treating a specific condition. A practice may encompass a whole program, or a project, or it may simply refer to a single method; best practice can promote certain behaviours, attitudes, or causes. When science and society are concerned, the possibility of getting such comparative assessment of practices is often neither

robust nor reliable. The definition of best practices as techniques for achieving operational excellence (cost and time reduction, better quality and better outcomes), the value of which rests on their success over time, the possibility to replicate them, and their capability to generate positive and measurable results, does not fit with the uncertainties and complexities that characterise both scientific efforts and the structure of societies.

We then refer to 'best' practice as methodologies that have proven or promise to reliably lead to a desired result. As a consequence, considering projects that can be labelled as best practices in any field, implies looking at the knowledge and technology at one's disposal to improve the possibilities of being successful. Best practices are examples of robust research design, implementation, and outcomes, not formal standards that one is obliged to comply with.

Looking at projects funded under FP6 and FP7 Science and/in Society in the field of governance, we consider best practices those projects that have: a) a clear focus and a broad coverage of the governance issues, which emerged in the policy debate as more relevant in the move toward the ERA; b) actual or foreseen achievements and results, which may be likely to be adapted to different contexts; c) dissemination activities and stakeholders involvement. Taking into account the wide range of activities carried out under FP6-SaS and FP7-SiS programmes, particular attention has been given to projects that proposed comprehensive methods and flexible tools that can be used in different contexts and application domains. Both practical instruments, experimented and tested in pilot cases, and holistic methodological frameworks, able to include different aspects, are practices likely to be further exploited and transferred, thus conditions that create the right circumstances that allow the projects to produce successful outputs. Furthermore, the projects that faced more widely and deeply the different aspects of governance issues have been specially regarded; for example, crosscutting themes within an integrated perspective, a broad coverage of governance topics, such as risks, engagement, dialogue, and science advise. Finally, concerning the specific context of the relationships between science and society, particular attention has been devoted to the projects that focused on a more inclusive and horizontal governance, where the large involvement of diverse relevant stakeholders has been seen not as a complement, but as a necessary condition for an acceptable and socially relevant production of knowledge.

Box 7.1 and Box 7.2 respectively outlines examples of FP6 and FP7 projects with the mentioned characteristics.

BOX 7.1 An FP6 example

RISK BRIDGE - Building Robust, Integrative Inter-Disciplinary, Governance Models for Emerging and Existing risks

Start date: 01/07/2006 **End date**: 30/06/2009

Total Funding: 776.105 € **Contract type**: SSA - CA - Coordination action

This project (coordinator: TNO, The Netherlands) developed an integrative risk governance model connecting risk assessment - management and communication based on a resilience and discursive approach. For six risk field (Biotechnology/stem cells, Radioactive waste, Nanotechnology, Climate change,

Sediments and Electromagnetic), a learning trajectory was organized, in which 3 workshops form the focal points (learning about best practices across disciplines and participants within each risk field; 'designs' a best science-policy interface for each risk field; compares, analyses and learns across risk fields resulting in an accepted governance model including trans-disciplinary lessons and input from scientists and policy makers). All the analyses are integrated in a report (book) recommending how to handle complex and emerging risks in the form of a process scheme approach. RISK BRIDGE is a good example of tool development for the risk governance that can be applied in several different contexts.

PATH FP6

Participatory approaches in science and technology

Start date: 01/04/2004 **End date**: 31/12/2006

Total Funding: 200.000€ **Contract type**: CA - Coordination action

The project, coordinated by the Macaulay Institute – UK, aims to build a path for new participatory structures involving a wide range of actors in order to build robust, transparent and effective ways for deliberation of science-based issues and formulation of related policies. As participatory processes have largely been used at a local scale, the project focuses specifically on two persistent challenges: scale and representation. The first challenge faced is how these processes can be scaled-up at a wide level. A second key concern is how best to represent a diverse and diffuse public as well as 'silent voices' (e.g. children, future generations). These two crosscutting themes are explored at a generic level, and via three case study areas, namely: genetically modified organisms (GMOs) in agriculture, biodiversity conservation, and nanotechnology.

BOX 7.2 An FP7 example

HEALTHGOVMATTERS - Health Matters: A social science and ethnographic study of patient and professional involvement in the governance of converging technologies in Medicine

Start date: 01/06/2009 **End date**: 31/07/2012 **Total Funding**: 860.478 € **Contract type**: CP Collaborative Project (generic)

The project, coordinated by the Zeppelin University GmbH, Germany, explored patients' and professionals' formal and informal involvement in governing the production and mediation of health and medical knowledge. The interest was in exploring interactions between constellations of actors (patients, care-givers, health professionals, citizens, and patient and professional organisations) who become involved in mediating and articulating the definitions and lived meanings of health, illness and disease in the context of encounters with new health technologies. Often referred to as "converging technologies", the integration of different actors in the area of medicine hold the potential to vastly improve ICT – Information and Communication Technologies capacity for medical data management and information generation and to provide the foundation for the translation of research knowledge into clinical trials and clinical practice.

NANOCODE - A multi-stakeholder dialogue providing inputs to implement the European Code of Conduct for Nano-sciences & Nanotechnologies (NS&N) research

Start date: 01/01/2010 **End date**: 30/11/2011

Total Funding: 1.243.777 € **Contract type**: CSA-SA Support Action

The project objective was the definition and development of a framework enabling the successful integration and implementation at European level and beyond, of the Code of Conduct (CoC) for responsible NS&N research defined by the EC. AIRI-National Association for Industrial Research (Italy) was the coordinator; the project was devoted to identifying and consulting stakeholders, to explore knowledge, attitudes, reactions and proposals in relation to the CoC assessing the most relevant codes of conducts, voluntary measures and practices for a responsible technology development. The project is one example of outcomes used to support the EC, EU policy makers and stakeholders in the implementation of the European CoC. The engagement of stakeholders in the debate improved the awareness on the CoC and in shaping its content to the stakeholders' needs and expectations, making it a more accepted, concrete and practical instrument for decision-making in NS&N R&D.

7.4 Lessons learnt

Several lessons arose from the debates developed during the SiS-RRI Conference held in Rome on September 19-21 2014. Hereafter the main issues raised during the session devoted to the Governance key are outlined. In Box 7.3, the key items that emerged during the World Café session and strongly related to the implementation of the RRI governance are also presented.

Policy-making and, more generally, the possibility of considering the public interests were questioned. How is it possible to realize effective public involvement? How can the different patterns of public opinion, based on various actors, concerns, and feelings on political decisions be properly taken care of? Can knowledge inform policy-making? How can disagreements and controversies regarding the interpretation of scientific evidences be managed? The answers that were provided pointed out that attempts to eliminate controversies often generate new ones. Moreover, science can only inform not decide. So, scientists must be 'honest brokers' and the political decision is something involving different actors to scholars.

Transparency in science communication and advice are important objectives to guarantee RRI governance: the selection process of scientific experts, as mediators in the interpretation of scientific results, should be extremely open and a balanced participation of stakeholders should be assured in order to avoid conflicts of interests.

Risks and science contribution: doubts among the public about scientific evidence could undermine the positive social impact of science and technology. A need for early involvement of citizens, continuous dialogue and balanced participation, to promote confidence of people to science applications, was suggested. Nonetheless, when policies have to be designed and put into action, risks cannot be ruled out, rather evidence–based policies have to recognize uncertainties and possibilities of failures. The risk consideration led to a discussion about the need to pursue good enough science, instead of excellent science.

As to RRI implementation, it has, in the long run, to be considered as a way to simplify and disintegrate certain aspects: in other words, avoid building a new bureaucracy. On the one hand, technology development might help to address the existing challenges; on the other hand, it is

difficult to establish a direct connection between scientific and technological development and contribution to society.

RRI shall be used as a benchmark to scrutinize the relationships between research programmes and grand challenges, in order to make research programmes truly'public', by empowering people and convincing politicians. Thus, RRI shall find room also in funding schemes, evaluation exercises, and performing environments.

BOX 7.3 The world café: key items on RRI governance

Consider RRI issues when research-funding programs are designed and put into actions (e.g. from dissemination of results to societal interaction plan for stimulating the participation of the users)

Rethink the purposes, rules and internal organizations of research performers, including the concept of 'responsibility'

Integrate RRI in research evaluation finding adequate criteria and indicators

Involving different actors, especially firms, toward the RRI implementation in science and technology

Consider that RRI implies a systematic change at different level (political commitments, social institutional changes, mentality changes)

How RRI impacts freedom of research: does it enhance or constrain?

7.5 Challenges moving toward RRI

Governance is a key issue in the field of science in society. This clearly emerged from the number of projects funded under SaS and SiS actions, the results of the MASIS Report, and the Interim evaluation and assessment of future options for SiS Actions (Technopolis et al. 2012). The movement from good governance to more elaborated concepts of democratic, participative, sustainable and responsible governance, is reflected in the aims, objectives, activities and outcomes of the projects funded under FP6 and FP7. Some open points can be outlined.

Priority setting and decision-making. Two aspects emerged. The first is the importance of mechanisms for public involvement in science decision-making, opening up the process to different stakeholders and the use of the outcomes in the actual policy decisions. Differences exist across countries between formalized procedures of participation and non-formalized ones, the former having kind of, but low degree of public involvement, the latter no involvement. This is indeed a challenge to be considered, either when refer to top-down opportunities or bottom up ones (e.g. Civil Society Organizations).

The second aspect is the use of scientific advice in policy making, which is gaining a momentum in European countries either through formalized or non-formalized procedures. Here, a clear challenge is to develop ways of governing controversies, especially in some research areas (e.g. GMOs, Climate change, Environment), where the scientific evidences are not definitive, different

suggestions for policy action might come from diverse approaches and perspectives of scholars themselves, and realize the precautionary principle in policy making might be extremely difficult.

Actor constellation. One important lesson coming from SiS is the acknowledgement and recognition of the broad range of actors, including research institutes, universities, funding agencies and firms, to be involved in the governance of science, and the different role they are likely to play in shaping the relationship between science in society in a multi-level and multi-layered policy space, such as R&I policy. It means that we are moving towards a sort of institutionalization of the actions in the field, which is likely to impact reform and restructuring processes, as well as the missions of the mentioned organizations. In this respect, one key topic on the governance issue to be further explored is the changing positioning and involvement of the different actors in science and society.

Risk-based regulation became a core item within the governance issue. Awareness of 'innovation not as an end but as a mean' of economic wealth and social benefits went with the rise of the awareness of its transformative impact, which can be either for the good or for the bad. Both the linear model of science and innovation policy and the social contract for science are under discussion, and the public value of science is no longer taken for granted. How far can this different perspective of innovation go with the traditional policy approach of innovation, as way for economic growth to be achieved in the short term?

The RRI concept has to be deepened and explored, understanding what it means in concrete terms for governance. RRI involves the need to make the motivations and the intentions for actions more democratic (science for society), considering what kind of transformation the decisions on science might produce on society, and whether these transformations are desirable. RRI also involves the institutionalization of mechanisms able to explore the type of impact a decision of science might produce (science with society), with assessment and forward looking processes, anticipatory governance, accountability tools. Can these results be achieved without the support of an important research effort, based on collaborative projects?

The way forward brings strong challenges for the governance issue: the documents analysed and the evidences collected converge, considering the capability to deal with new and uncertain topics must be sustained with a continuous and dedicated EU funding. This commitment fits with the principles of proportionality and subsidiarity of the EU funding, since no progress can be done without financial support nor this kind of financing can be actually find in the budgets of the EU Member States.

Referenceschapter 7

EC. 2000. Commission working document on Science, society and the citizen in Europe. Brussels: 14.11.2000 SEC(2000)1973.
http://ec.europa.eu/research/area/science-society-en.pdf

EC. 2001. European Governance-A White Paper. COM(2001) 428 Final (2001/C 287/01).
http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:C:2001:287:TOC

European Council. 2001. Council Resolution 26 June 2001 on Science and Society and on Women in Science. (2001/C199/01).
http://ec.europa.eu/research/science-society/document_library/pdf_06/council-resolution-june-2001_en.pdf

EC. 2002. Science and Society Action Plan. Brussels: European Commission.
http://ec.europa.eu/research/science-society/pdf/ss_ap_en.pdf

CREST. 2002. CREST Report: Implementation of the Science and Society Action Plan. 11 October 2002. Brussels: 08 Oct 2002. Full text of Document 1206/02.
http://www.timeshighereducation.co.uk/news/crest-report-implementation-of-the-science-and-society-action-plan/172096.article

EC. 2002. Communication from the Commission on the collection and use of expertise by the Commission: Principles and Guidelines. 11.12.2002 COM(2002)713 final.
http://ec.europa.eu/governance/docs/comm_expertise_en.pdf

European Council. 2002. Council Decision of 30 September 2002 Adopting a specific programme for research, technological development and demonstration: 'structuring the European Research Area' (2002-2006). EC/835/EC.
http://ec.europa.eu/research/fp6/index_en.cfm?p=0_docs

EC. 2003. Report from the Commission on European Governance. Brussels: European Commission.
http://ec.europa.eu/governance/docs/comm_rapport_en.pdf

EC. 2004. Governance of the European Research Area: Giving society a key to the lab. Luxembourg: Office for Official Publications of the European Communities.
http://bookshop.europa.eu/en/governance-of-the-european-research-area-pbKI5804021/

EC. 2006. From science and society to science in society: Towards a framework for 'co-operative research, Report of a European Commission Workshop, Governance and Scientific Advice. 24-25 November 2005.
http://ec.europa.eu/research/science-society/pdf/goverscience_final_report_en.pdf

EC. 2007a. Final Report of the Study on the Integration of Science and Society Issues in the Sixth Framework Programme. Brussels: DG Research, European Commission.
http://ec.europa.eu/research/science-society/document_library/pdf_06/integrating-sis-issues-in-research-full-report_en.pdf

EC. 2007b. Mid-Term Assessment. Science and Society Activities 2002-2006. Final Report. Brussels: DG Research, European Commission
http://ec.europa.eu/research/science-society/document_library/pdf_06/mta-final-report_en.pdf

EC. 2007c. Taking European Knowledge Society Seriously. Report of the Expert Group on Science and Governance. Brussels: European Commission, EUR 22700.
https://www.bmbf.de/pub/EuropeanKnowledge(6).pdf

Finnish Minister of Foreign Affair. 2008. Final Report on the Helsinki process on globalization and democracy. A case for multi-stakeholder cooperation. Finnish Minister of Foreign Affair.
http://formin.finland.fi/public/default.aspx?contentid=137740&contentlan=2&culture=en-US

EC. 2009a. Global Governance of Science. Report of the Expert Group on Global Governance of Science. Brussels: European Commission.
http://ec.europa.eu/research/science-society/document_library/pdf_06/global-governance-020609_en.pdf

EC. 2009b. The MASIS Report. Challenging Futures of Science in Society. Emerging Trends and Cutting-edge Issues. Brussels: EC, Directorate-General for Research.
http://ec.europa.eu/research/science-society/document_library/pdf_06/the-masis-report_en.pdf

EC. 2011. DG Research Workshop on Responsible Research and Innovation in Europe. Access August 14.
http://ec.europa.eu/research/science-society/document_library/pdf_06/responsible-research-and-innovation-workshop-newsletter_en.pdf

EC. 2012. Monitoring Policy and Research Activities on Science in Society in Europe (MASIS). Brussels: DG Research and Innovation, European Commission.
http://ec.europa.eu/research/science-society/document_library/pdf_06/monitoring-policy-research-activities-on-sis_en.pdf

EC. 2014. Public Perceptions of Science, Research and Innovation. Special Eurobarometer 419. Brussels: DG Research and Innovation, European Commission
http://ec.europa.eu/public_opinion/index_en.htm

Technopolis Group, Fraunhofer-ISI. 2012. "Interim evaluation & assessment of future options for Science in Society Actions. Final Report."
http://ec.europa.eu/research/science-society/document_library/pdf_06/phase02-122012_en.pdf

Annex 7 - Governance: list of projects under FP6 SaS.

Governance: list of projects under FP6 SaS

Project Acronym	Project Title	Coordinator (name of the organizatin and country)	Number of partners involved	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type*2	Link
CARGO	Comparison of approaches to risk governance	KARITA RESEARCH AB (SE)	4 (BE; GB; SE; SE)	01/06/2006	31/05/2008	24	356333	356333	CA	http://cordis.europa.eu/project/rcn/80075_en.html
CIPAST	Citizen Participation in Science and Technology	CITÉ DES SCIENCES ET DE L'INDUSTRIE (FR)	11 (CH; DE; DE; DK; FR; FR; FR; FR; GB; IT; NL)	01/04/2005	31/03/2008	36	750000	750000	CA	http://cordis.europa.eu/project/rcn/74467_en.html
RISKBRIDGE	Risk-BRidge (Building Robust, Integrative interDisciplinary, Governance Models for Emerging and Existing risks)	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK - TNO (NL)	5 (BE; DE; FR; GB; IT)	01/07/2006	30/06/2009	36	776105	776105	CA	http://cordis.europa.eu/project/rcn/80067_en.html
STARC	STakeholders in Risk Communications	ELECTRICITÉ DE FRANCE (FR)	5 (BE; CH; DE; FR; GB)	01/06/2005	30/11/2006	18	337491	337491	CA	http://cordis.europa.eu/project/rcn/74473_en.html
TRUSTNET-IN-ACTION	The making of inclusive risk governance: trustnet-in-action	MUTADIS CONSULTANTS SARL (FR)	14 (AT; BE; BE; DE; DE; FR; FR; FR; FR; FR; GB; GB; IT; NL)	01/01/2004	31/12/2006	36	799623	799623	CA	http://cordis.europa.eu/project/rcn/84588_en.html

ECD	Meeting of Minds. European Citizens' Deliberation on Brain Science'	KING BAUDOUIN FOUNDATION (BE)	11 (BE; BE; DE; DK; FR; GB; GB; GR; HU; IT; NL)	01/11/2004	31/10/2006	24	1360352	800000	CA	http://cordis.europa.eu/project/rcn/74471_en.html
MIDIR	Multidimensional integrated risk governance	CONSIGLIO NAZIONALE DELLE RICERCHE (IT)	5 (DE; DE; DE; GB; IT)	01/06/2006	29/02/2008	21	393857	367562	CA	http://cordis.europa.eu/project/rcn/80073_en.html
PATH	Participatory approaches in science and technology	MACAULAY INSTITUTE (UK)	7 (DE; DE; DK; ES; GB; IT; NO)	01/04/2004	31/12/2006	33	254609	200000	CA	http://cordis.europa.eu/project/rcn/73943_en.html
PSX2	Participatory science and scientific participation: The role of civil society organisations in decision making about novel developments in biotechnologies	CONSIGLIO DEI DIRITTI GENETICI (IT)	8 (FR; ES; UK; CH; DE; IT; FR; EE)	01/02/2007	30/11/2008	20	434332	434332	CA	http://cordis.europa.eu/project/rcn/84152_en.html
CAPOIRA	Capacity-building for patient organisations to participate in Research Activities	EUROPEAN ORGANISATION FOR RARE DISEASES (FR)	4 (FR; IT; ES; DK)	01/01/2007	30/06/2008	18	154581	154581	SSA	http://cordis.europa.eu/project/rcn/84160_en.html
DECIDE	DEliberative CItizens' DEbates in European science centres and museums	AT-BRISTOL LIMITED (UK)	4 (BE; FI; FR; IT)	01/11/2004	30/04/2006	18	330000	330000	SSA	http://cordis.europa.eu/project/rcn/73944_en.html
MESSENGER	Media, Science and Society: Governance and Engagement in Europe	SOCIAL ISSUES RESEARCH CENTRE (UK)	1 (NL)	15/02/2005	14/02/2006	12	267480	267480	SSA	http://cordis.europa.eu/project/rcn/74468_en.html

RISK NETWORK	Risk communication network	LUDWIG MAXIMILIANS UNIVERSITA ET MUENCHEN (DE)	7 (NL; DE; UK; UK; DE; DE; FR)	01/06/2005	30/11/2007	30	500000	500000	SSA	http://cordis.europa.eu/project/rcn/74476_en.html
WINDFARMPERCEPTION	Visual and acoustical impact of wind farms on residents	THE UNIVERSITY OF GRONINGEN (NL)	2 (SE; NL)	01/01/2007	31/08/2008	20	170900	170900	SSA	http://cordis.europa.eu/project/rcn/84155_en.html
CONFERENCE SACRIMM	European Conference on Scientific Advice, Crisis management and media	HELLENIC CENTER FOR INFECTIOUS DISEASES CONTROLL (GR)	1 (GR)	27/03/2003	26/11/2003	8	140000	140000	SSA	http://cordis.europa.eu/project/rcn/73945_en.html
SAFMAMS	Scientific Advice for Fisheries Management at Multiple Scales	AALBORG UNIVERSITY (DK)	7 (DK; DK; DK; EE; GB; SE; SE)	15/04/2005	14/04/2008	36	690120	690120	SSA	http://cordis.europa.eu/project/rcn/75360_en.html
STACS	Science, technology and civil society - Civil society organisations, actors in the European systemof research and innovation	ASSOCIATION POUR LA CRÉATION D'UNE FONDATION SCIENCES CITOYENNES (FR)	6 (UK, BE, DE, DE, FR, UK)	01/03/2007	30/04/2009	26	415847	389177	SSA	http://cordis.europa.eu/project/rcn/84153_en.html

Governance: list of projects under FP7 SiS

Project Acronym	Project Title	Coordinator (name of the organizatin and country)	Number of partners involved	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type*	Link
EPOKS	European patient organizations in knowledge society	ASSOCIATION POUR LA RECHERCHE ET LE DEVELOPPEMENT DES METHODES ET PROCESSUS INDUSTRIELS - ARMINES (FR)	4 (PT; IE; UK; UK)	01/02/2009	30/04/2012	39	1129012	905242	CP	http://cordis.europa.eu/project/rcn/90953_en.html
SYNTH-ETHICS	Ethical and regulatory challenges raised by synthetic biology	TECHNISCHE UNIVERSITEIT DELFT (NL)	4 (NL, IT, DE, ANU)	01/03/2009	31/08/2011	30	770608	531276	CP	http://cordis.europa.eu/project/rcn/90989_en.html
TECHNOLIFE	A Transdisciplinary approach to the emerging challenges of novel technologies: Lifeworld and imaginaries in foresight and ethics	UNIVERSITY OF BERGEN (NO)	8 (NO, LV, ES, UK, FR, DK, IT)	01/03/2009	30/11/2011	33	1049041	809343	CP	http://cordis.europa.eu/project/rcn/90988_en.html

EGAIS	The Ethical GovernAnce of emergIng technologieS New Governance Perspectives for Integrating Ethics into Technical Development Projects and Applications	UNIVERSITA CATTOLICA DEL SACRO CUORE (IT)	4 (SI, UK, FR, BE)	01/05/2009	29/02/2012	34	998218	837685	CP	http://cordis.europa.eu/project/rcn/91156_en.html
HEALTHGOV MATTERS	Health Matters: A social science and ethnographic study of patient and professional involvement in the governance of converging technologies in Medicine	ZEPPELIN UNIVERSITAET GEMEINNUETZIGE GMBH (DE)	3 (AT,AT, UK)	01/06/2009	31/07/2012	38	1049301	860478	CP	http://cordis.europa.eu/project/rcn/91215_en.html
SIAMPI	Social impact assessment methods for research and funding instruments through the study of productive interactions	KONINKLIJKE NEDERLANDSE AKADEMIE VAN WETENSCHAPPEN - KNAW (NL)	4 (ES, FR, NL, UK)	01/03/2009	28/02/2011	24	989744	793302	CP	http://cordis.europa.eu/project/rcn/90987_en.html

	between science and society									
ACUMEN	Academic Careers Understood through Measurement and Norms	UNIVERSITEIT LEIDEN (NL)	9 (ES, UK, DE, DE, DK, EE, NL, EE, IL)	01/03/2011	28/02/2014	36	2025828	1495412	CP-FP	http://cordis.europa.eu/project/rcn/97240_en.html
CONSIDER	Civil Society Organizations in Designing Research Governance	DE MONTFORT UNIVERSITY (UK)	7 (BE, BE, FR, UK, UK, DE, DE)	01/02/2012	31/01/2015	36	1849467	1499381	CP-FP	http://cordis.europa.eu/project/rcn/101821_en.html
ENGAGE2020	Engaging Society in Horizon 2020	FONDEN TEKNOLOGIRÅDET (DK)	5 (DE; UK; NL; BG; DE)	01/09/2013	30/11/2015	27	1224310, 19	998123	CP-FP	http://cordis.europa.eu/project/rcn/110502_en.html
EPINET	Integrated Assessment of Societal Impacts of Emerging Science and Technology from within Epistemic Networks	UNIVERSITETET I BERGEN (NO)	6 (BE; UK; ES; NL; UK; BE)	01/05/2012	30/04/2015	36	1927263	1488746	CP-FP	http://cordis.europa.eu/project/rcn/103532_en.html
EST-FRAME	Integrated EST Framework	HOGSKOLEN I OSLO OG AKERSHUS (NO)	6 (DK; NO; NL; UK; DE; DK)	01/01/2012	31/12/2014	36	2087027	1499273	CP-FP	http://cordis.europa.eu/project/rcn/100425_en.html

PE2020	Public Engagement Innovations for Horizon 2020	KULUTTAJATUTKIMUSKESKUS (FI)	4 (FI; DK; IT; LT)	01/02/2014	31/01/2017	36	1229660	999341	CP-FP	http://cordis.europa.eu/project/rcn/110581_en.html
RES-AGORA	Responsible Research and Innovation in a Distributed Anticipatory Governance Frame. A Constructive Socio-normative Approach°	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V (DE)	7 (AT, IT, NL, UK, FR, DK, DK)	01/02/2013	31/01/2016	36	3708885	3003406	CP-FP	http://cordis.europa.eu/project/rcn/108668_en.html
SISOB	An Observatorium for Science in Society based in Social Models°	UNIVERSIDAD DE MALAGA (ES)	7 (ES, IT, DE, HU, CH, HU, RA)	01/01/2011	31/12/2013	36	1810212	1411858	CP-FP	http://cordis.europa.eu/project/rcn/97180_en.html
GREAT	Governance of REsponsible innovATion°	UNIVERSITE DE NAMUR ASBL (BE)	9 (BE, UK, DE, UK, FI, FR, UK, DE, IE)	01/02/2013	31/01/2016	36	2256080	1780571	CP-FP t	http://cordis.europa.eu/project/rcn/106794_en.html
MACOSPOL	Mapping controversies on science for politics	FONDATION NATIONALE DES SCIENCES POLITIQUES (FR)	7 (DE, IT, UK, CH, NL, BE, NO)	01/01/2008	31/12/2009	24	1034315	924514	CSA-CA	http://cordis.europa.eu/project/rcn/87595_en.html
EUSANH-ISA	Improving science advice for health in Europe, EuSANH	HEALTH COUNCIL OF THE NETHERLANDS (NL)	5 (ES, SE, RO, PL, BE)	01/02/2009	31/01/2012	36	1046940	943271	CSA-CA	http://cordis.europa.eu/project/rcn/90985_en.html

PERARES	Public Engagement with Research and Research Engagement with Society	RIJKSUNIVERSITEIT GRONINGEN (NL)	27 (NL; BE; DE; UK; UK; IE; IE; ES; FR; FR; SE; GR; RO; NO; FR; IT; IE; CY; DK; NL; UK; DK; HU; EE; UK; DE; IL)	01/05/2010	31/10/2014	54	3085511	2728041	CSA-CA	http://cordis.europa.eu/project/rcn/94941_en.html
RESPONSIBILITY	Global Model and Observatory for International Responsible Research and Innovation Coordination°	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E V (DE)	12 (BE, UK, BE, DE, UK, CY, IT, GR, AT, MAL, RCH, JA)	01/02/2013	31/01/2016	36	1779733	1484427	CSA-CA	http://cordis.europa.eu/project/rcn/108670_en.html
EUIMA	Take-up activities by universities of specific guidelines and recommendations to implement their modernisation agenda	ASSOCIATION EUROPEENNE DE L'UNIVERSITE (BE)	-	01/01/2010	30/06/2012	30	1355235	1200000	CSA-SA	http://cordis.europa.eu/project/rcn/93207_en.html

FRAMINGNANO	International multi-stakeholder dialogue platform framing the responsible development of nanosciences and nanotechnologies (NS&T)	ASSOCIAZIONE ITALIANA PER LA RICERCA INDUSTRIALE (IT)	5 (BE, UK, NL, CZ, CH)	01/05/2008	31/03/2010	23	742934	675044	CSA-SA	http://cordis.europa.eu/project/rcn/89673_en.html
NANOPLAT	Development of a platform for deliberative processes on nanotechnology in the European consumer market	STATENS INSTITUTT FOR FORBRUKSFORSKNING (NO)	6 (DE, HU, BE, UK, NO, TR)	01/03/2008	31/08/2009	18	792810	599855	CSA-SA	http://cordis.europa.eu/project/rcn/88433_en.html
ULAB	European Laboratory for modelling the Technical Research University of Tomorrow	UNIVERSIDAD POLITECNICA DE MADRID (ES)	4 (IT, DE, UK, FR)	01/01/2011	31/12/2012	24	699445	598063	CSA-SA	http://cordis.europa.eu/project/rcn/97669_en.html
DELIBPROCESSSCP	Identifying research needs and designing elements of deliberative processes on sustainable	UNEP/WUPPERTAL INSTITUTE COLLABORATING CENTRE ON SUSTAINABLE CONSUMPTION	2 (HU, UK)	01/02/2008	OOO	24	399224	399224	CSA-SA	http://cordis.europa.eu/project/rcn/89924_en.html

	consumption and production in the demand areas food, housing and mobility	AND PRODUCTION GGMBH-CSCP (DE)								
GAP2	Bridging the gap between science, stakeholders and policy makers Phase 2:Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment°	THE SECRETARY OF STATE FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS (UK)	38 (ES, DK, DE, DK, NO, SE, FR, ES, IT, MT, ES, EE, UK, UK, NL, NL, UK, NO, IT, UK, UK, ES, NO, FR, ES, ES, SE, EE, MT, DK, UK, NL, DE, NL, BE, ES, SE, UK)	01/04/2011	31/03/2015	48	7555445	5913773	CSA-SA	http://cordis.europa.eu/project/rcn/99712_en.html
K-TRIANGLE	The Knowledge Triangle Shaping the Future of Europe	UTBILDNINGSDEPARTEMENTET (SE)	-	01/04/2009	31/01/2010	10	285813	150000	CSA-SA	http://cordis.europa.eu/projects/result_it?q=contenttype=%27project%27%20AND%20%27K-TRIANGLE%27

MIRRORS	Monitoring ideas regarding research organizations and reasons in science	UNIVERSITA DEGLI STUDI DI CATANIA (IT)	-	01/01/2008	31/12/2009	24	312000	278000	CSA-SA	http://cordis.europa.eu/project/rcn/88290_en.html
NANOCODE	A multistakeholder dialogue providing inputs to implement the European Code of Conduct for Nanosciences & Nanotechnologies (N&N) research	ASSOCIAZIONE ITALIANA PER LA RICERCA INDUSTRIALE - AIRI (IT)	9 (CH, UK, DE, FR, ES, CZ, NL, RA, ZA)	01/01/2010	30/11/2011	23	1417801	1243777	CSA-SA	http://cordis.europa.eu/project/rcn/92804_en.html
NANOETHICS 2011	Governance and ethics of nanosciences and nanotechnologies	POLISH ACADEMY OF SCIENCES (PL)	-	01/01/2011	29/02/2012	14	154900	107814	CSA-SA	http://cordis.europa.eu/project/rcn/98076_en.html
NERRI	Neuro-Enhancement: Responsible Research and Innovation	CIENCIA VIVA-AGENCIA NACIONAL PARA A CULTURA CIENTIFICA E TECNOLOGICA (PT)	17 (UK; NL; AT; IT; PT; DK; NL; HU; DE; DE; AT; ES; IT; UK; BE; UK; IS)	01/03/2013	29/02/2016	36	3783867,55	3312430,35	CSA-SA	http://cordis.europa.eu/project/rcn/108652_en.html

PACITA	Parliaments and Civil Society in Technology Assessment°	FONDEN TEKNOLOGIRÅDET (DK)	15 (DK, DE, NL, NO, AT, BG, PT, BE, ES, CH, LT, CZ, BE, IE, HU)	01/04/2011	31/03/2015	48	5431938	4437730	CSA-SA	http://cordis.europa.eu/project/rcn/98487_en.html
R&DIALOGUE	Research and Civil Society Dialogue towards a low-carbon society	TRIARII BV (NL)	14 (CZ; NO; FR; DE; GR; IT; NO; NO; UK; FR; PT; DE; ES; PT)	01/06/2012	30/11/2015	42	4482268	4131441	CSA-SA	http://cordis.europa.eu/project/rcn/103605_en.html
RIF	Research and Innovation Futures 2030: From explorative to transformative scenarios°	AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH (AT)	4 (UK, DE, NL, FI)	01/10/2011	30/11/2013	26	1226201	860256	CSA-SA	http://cordis.europa.eu/project/rcn/100447_en.html

Source: CORDIS Open Data.

8 Global Trends in Science in Society

Massimiano Bucchi and Brian Trench, with Ilaria Ampollini
Observa,
Science in Society

Abstract

This chapter reviews global trends in 'science in society' practices and policies outside the EU.
Science in society has become over the past few decades a global concern and a global enterprise with important common denominators as well as distinctive regional characteristics.
Relevant international collaborations in the area of Science and Society (SaS)/Science in Society (SiS) within and beyond the EU have been put in place during the past few years through the European Commission's Framework Programmes; however, more substantial collaboration remains to be developed. The chapter reviews key international trends by looking at main topics at global conferences, the role of international and non-governmental organisations, national policy strategies, and university programmes. In the last section, a series of brief country reports outlines recent developments in selected countries, such as Argentina, Malaysia, Mexico, New Zealand, Nigeria and Turkey.

8.1 Introduction

This report reviews global trends in 'science in society' practices and policies outside the EU. Relationships between science and society are receiving steadily increasing attention across the world, in academic, professional, policy-making and non-governmental sectors. This increased attention reflects the impacts scientific discoveries and science-related issues are having on society. Global health challenges, pandemics, climate change, energy choices, misuse of drugs in sport and environmental management are just some of the contexts in which science and scientists are thrust into the centre of public affairs. Further, the increasing weight of knowledge production and knowledge workers in both developing and developed economies makes the resourcing and governance of science central public policy questions. The scientific and technical skills capacity of countries and the associated issues of recruitment of young people into science are matters of concern across the globe.

'Science in society' as an area of professional practice, of research and of policy-making addresses these and other dimensions of the complex relationships between science and society. The European Union has had dedicated programmes of action and research on science in society for two decades. These have focused on questions of communication, public engagement and public understanding, but also on young people's career and study choices, gender equality and ethics in research. The broader agenda is captured in the current key phrase, responsible research and innovation.

The brief for this report was to examine trends in countries and regions outside the EU. Indeed, many of the countries and regions surveyed translate the broader topic of science in society largely in terms of science communication and public understanding of science.

Also, in several countries, government programmes and policies on science (sometimes expressed as 'science and technology', or 'science, technology and innovation') refer with varying degrees of emphasis and explicitness to the public's views of science and technology as a potential constraint on, or support for, economic and social development. Typically, this leads to government programmes for raising public awareness about science; these can incorporate direct or indirect support for establishment of science centres and museums, for national 'science weeks' or similar concentrated efforts in public science, for media attention to science, and for innovations in science education.

These dimensions of science in society, as they are represented in non-EU countries and regions, are our main concern in this report. In the relatively short time that 'science communication' has been a recognised term for a cluster of professional and educational practices, it has become a global phenomenon. When the first large-scale international conferences of science communication practitioners, educators and researchers took place in the early 1990s, their attention and attendance were largely restricted to western Europe and north America. But the PCST (Public Communication of Science and Technology) series of conferences now attracts 500-600 participants from 50-60 countries in all continents, alternating its venues between Europe and elsewhere. The 2014 PCST conference took place in Brazil, with very strong representation from that country and from Latin America. Previous conferences since 2000 have been held in India, South Korea, South Africa, again with strong local and regional flavours.

The World Conference of Science Journalists had 700-plus participants from 73 countries at its conference in Helsinki in 2013. The biennial conference is the principal activity of the World Federation of Science Journalists, though it also has programmes aimed at supporting science journalism in developing countries. The federation has affiliated associations in several countries of East and West Africa, as well as across the developed world.

The professional conferences of science museums and centres attract similar numbers and distributions of participants. The 2014 Science Centre World Summit in Belgium had 464 participants from 58 countries. That meeting followed conferences in 2008 and 2011, under slightly different names, that took place in Toronto and Cape Town, respectively. The meeting in 2014 attracted representatives from several international and inter-governmental bodies, including the International Council of Science (ICSU), UNESCO and CERN. Even an explicitly European-centred event, the annual meeting of ECSITE (European Network of Science Centres and Museums) assembled just short of 1,000 participants from 48 countries, many of them outside Europe, at its May 2014 event in the Netherlands.

The proliferation of science communication activities and institutions across the globe, but also the differences and similarities between countries and regions in the organisation of these activities and institutions have become an object of specific interest in the worldwide science communication communities. A collection of country profiles and essays, *Science Communication in the World* (Schiele et al 2012), that grew out of the PCST conferences featured 31 contributors from six continents, presenting national overviews side-by-side. Another edited volume (Bauer et al 2011)

sketched a global view of patterns of scientific culture, drawing on national and international surveys of public attitudes to science and technology. Indeed, the spread of public opinion surveys focused on science and technology and the changing forms and content of those surveys are another aspect of the global spread of science communication and of its research.

In considering science communication comparatively across countries, we are helped by a large-scale assessment of science-in-society practices in Europe, the MASIS (Monitoring Policy and Research Activities on Science in Society) project which surveyed 37 countries. The project's final report categorised national science communication cultures as 'consolidated', 'developing or 'fragile', according to six parameters that appear valid beyond Europe (Mejlgaard et al 2012: 67). These refer to the science communication infrastructure; the political attention to science communication; the actors involved in science communication; the academic tradition of research dissemination; public attitudes towards science; the number and qualifications of science journalists.

Generally based on these criteria we review current and recent trends in science communication outside Europe in terms principally of the roles of various institutions in supporting science communication or, in other words, promoting the presence of science in society. The ways in which this is done varies between countries and within countries over time, as seen in the relative emphasis on public understanding (favouring promotional and/or didactic approaches) and on public engagement (favouring dialogical and interactive approaches). First, however, we offer: a brief overview of EU funded projects (mostly funded within the context of FP7- Science in Society) with a relevant international focus and involvement of participants outside the EU; a summary view of the interests of science communication practitioners and researchers from outside Europe through an analysis of their contributions to international science communication conferences.

8.2 Science in Society: International Collaboration Through EU Projects

International collaboration in the area of Science and Society (SaS)/Science in Society (SiS) has been strongly promoted within and beyond the EU through the European Commission's framework programmes of research, as well as by other means. From FP6 to FP7 the number of projects in this area with non-EU participants increased from 17 to 60, and the geographical coverage and themes broadened (see Figure8.1)[89]

Themes covered in international collaborations beyond the EU member states within FP6 have included: scientific research; social aspects, coordination and cooperation; research ethics; education and training; policies; legislation and regulations; information and media. Themes covered in the context of international collaborations beyond the EU member states within FP7 have included: scientific research; social aspects, coordination and cooperation; innovation, technology and transfer; research ethics; education and training; regional development; policies; legislation and regulations; nanotechnology and nanoscience; security; standards; sustainability; employment. The changes in themes from FP6 to FP7 may also reflect the content of the programmes and of the specific calls within those programmes.

[89]See also the document of December 2012, Interim evaluation & assessment of future options for Science in Society Actions.

As shown in Figure8.1, external collaboration has expanded to new themes such as innovation, regional development, sustainability, standards, security. Other thematic areas display a relevant increase of international focus (coordination, education/training, research ethics). However, other themes have remained substantially excluded from such collaboration patterns. In particular, the absence of the theme of evaluation should be noted, particularly since the lack of attention and emphasis of evaluation has been repeatedly underlined by experts as one of the critical points for science in communication and science in society during the past years. It will be seen in the following section of this report that evaluation is a well-represented topic in international conferences of science communication practitioners and researchers. Several initiatives in this area (festivals, exhibitions, contexts, researchers' nights, conferences) lack thorough impact and evaluation analyses, mostly limiting themselves to (sometimes doubtful) counting the number of participants[90].

General objectives pursued by SaS/SiS FP6/FP7 projects involving external collaboration have included:

- Networking platforms and International databases
- Promotion of a global debate
- Reaching of multiple targets
- Sharing of knowledge
- Development of innovative practices
- Exploration of the ethical dimension of research
- Establishment of platforms for International dialogue
- Workshops
- Dialogue with policy-makers

Specific objectives have included:

- Environmental control (compilation of Atlas of Environmental Justice)
- Network on responsible research and innovation
- Exploration of ethics in S&T and the related policies
- Analysis of the gap between science education research and actual teaching practice
- Analysis of technology used for teaching
- Promotion of gender equality
- Promotion of sustainability sciences and sustainability policies
- Exploration of benefits and risks of Synthetic biology
- Evaluation of ethics in biomedical research
- Sharing genomics research with developing countries

Summing up, it seems that international collaboration as reflected in EU funded Science in Society projects has increased, particularly regarding certain thematic areas. However, more substantial collaboration remains to be developed, particularly with regard to methodology and impact evaluation in Science in Society. However, this has to take into account the fact that "Science in

[90]See Bucchi and Trench (2014); Jensen and Buckley (2014).

Society" meanings and related policy strategies are interpreted and articulated in rather different ways in different areas of the world (see below, in particular chapter 8).

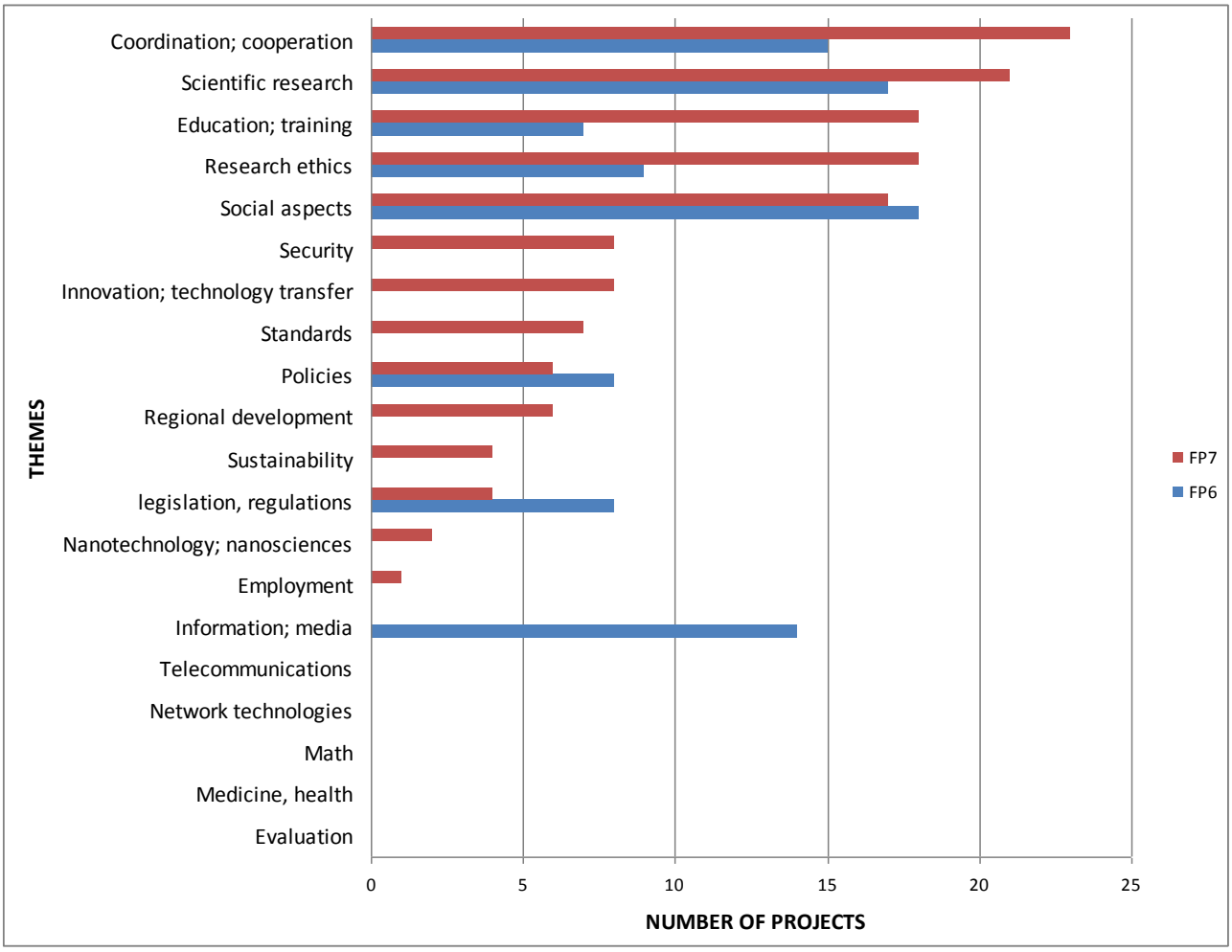


Figure 8.1 International Collaboration Beyond EU in FP6/FP7 SaS/SiS Projects – Main Themes and Number of Projects

Source: FP6/SaS and FP7/SiS websites/documents

8.3 Topics at Global Science Communication Conferences

One of the possibilities to detect international trends in science in society reflection and practice is to look at presentations and discussion topics at global conferences. Public Communication of Science and Technology (PCST) conferences have been since the early 1990s one of the main international occasions for discussing such topics. The conferences have gradually expanded their content to public engagement and science in society more broadly. They also offer a unique combination of scholars and practitioners' contributions and perspectives that many academic conferences miss.

A detailed analysis the topics of abstracts presented by non-EU contributors at PCST international conferences in 2010 (New Delhi, India), 2012 (Firenze, Italy) and 2014 (Salvador, Brazil) was conducted specifically for this report (*Tab. 1*). This analysis, as with other aspects of the present report, supports the view of science in society as a global concern, indicates some broadly shared trends, but also points to significant national and regional variations. The analysis shows, for

example, that science communicators and scholars from India tend to focus on communication and engagement with science in rural areas and nutrition/health issues, whereas in China, priority attention has been given to science museum activities and impact evaluation issues, a relevant focus also for Australian contributions.

Climate change emerged as a key science communication topic in 2010, particularly in Australia, China, India and Korea. Latin America and Brazil in particular feature a specific interest for activities aimed at students and children as well as for the theme of scientific citizenship and social inclusion through science engagement, while North America and USA in particular saw a relevant proportion of contributions on the role of scientists and their training in science communication.

Engagement and citizenship are a relevant focus also for South Africa, which is also one of the areas explicitly thematising 'developing countries' as a context of science communication. Risk-related communication emerged as a key focus of contributions from Japan, mainly related to the Fukushima disaster.

In general terms, global trends show an increasing focus on government policies (see next section) and on the role of scientists in communicating research to the public, including training of researchers for communication, which is also referred to later. Compared to Europe, less attention seems to be given issues such as democratization, citizenship and communication in relation to scientific debates and controversies.

Overall, the key difference lies in the fact that contributions from Europe reflect an agenda of science in society and science communication that is internally consistent, professionally autonomous (to the point of being, to some extent, self referential) and relative independent from government setting[91]. Onthe other hand, non-European contributions tend to be more influenced – and in some cases directly influenced - by policy agendas through funding/shaping of organisational resources.

[91] The salience of climate change issues in several contributions from Europe is only apparently an exception. In many European countries, the relevance of the issue seems to have been substantially shaped by intergovernmental agendas and throughout media agenda and discourse, rather than by governmental policies. See for example Beltrame, Bucchi and Mattè (2013).

Table 8.1 - Main Keywords of Contributions Presented to PCST (Public Communication of Science and Technology) World Conferences, 2010-2014, from non-EU sources

Keywords	PCST2010	PCST2012	PCST2014	TOTAL
Media coverage of science	52	7	24	83
New tools for science communication; new actors	33	15	22	70
Strategies and practices for science communication	20	17	33	70
Evaluation of science communication	40	12	13	65
Body, medical issues, health	20	10	22	52
Climate change; environment	23	3	23	49
Children; school; students	19	3	24	46
Engagement; scientific citizenship	11	3	20	34
Training of scientists, how scientists communicate	9	10	13	32
Museums	22	2	12	36
Visual	3	7	17	27
Science journalism	4	3	15	22
Government; policies	6	4	14	24
TV	5	3	5	13
Risk	3	6	4	13
Training	5	1	4	10
Developing countries	8	0	1	9
Astronomy	2	3	3	8
Controversy; debates	4	3	0	7
Responsibility	2	1	0	3

Source: authors' original elaboration from conference databases

8.4 Government Programmes on Science Awareness

As an increasingly prominent part of science or S&T policies, governments across the world set down targets and actions for increasing public awareness of science. For example, Japan's *Science and Technology Basic Plan* (2011-15) links innovation and knowledge creation with efforts to establish 'a sound infrastructure of science and technology information and raise awareness and

understanding of science and technology-related issues'[92]. The Japan Science and Technology Agency's divisions include a Centre for Science Communication that, 'in addition to communication conveying the knowledge and enjoyment of previous achievements in science and technology, also seeks to promote constructive communication by sharing the tentative nature, uncertainty, and latent risks possessed by science and technology with the nation's citizens, its government, its research institutions, and researchers, for a better society and lifestyle'[93].

This represents a more comprehensive view of public communication of science and of its contexts than may be found in many other similar documents. Perhaps the most frequently shared feature of such policies is a concern about children's and young people's competence in scientific and technical subjects and their attitudes to developments in science and technology. The context of this concern is also competitive: government policies are often targeted at closing a gap or maintaining a lead in relation to comparator countries.

Comparing four national science awareness programmes, Bultitude et al (2012) found that Brazil's and China's were more oriented to development and addressing social inequalities than those of Australia and Britain; emphasis on education was stronger for China and Britain, and emphasis on culture was strongest for Brazil. In the world's two most populous countries, China and India, the state's commitment to popularise science has been written into fundamental legislation for several decades. China's 'science popularisation' programme employs many thousands of science communicators.

In a largely linear conception of the relations between education and economy, many government focus their attention on encouraging young people towards 'STEM' (science, technology, engineering and mathematics) subjects; this is widely seen as assisting skills supply to the economy. Informal education initiatives of the kind typically endorsed in programmes for science awareness are assigned a complementary role in this national effort. In countries where science communication has been institutionalised in recent years, the emphasis tends to be more strongly – or, in some cases, exclusively – on children and young people. This is reflected in programmes to build or support science centres.

The most ambitious programme by far is that of China, where the number of science and technology centres almost doubled, from 185 to 380, between 2004 and 2008 (Shi and Zhang 2012). In India and South Korea, science centres are counted in their tens or twenties and the networks have continued to expand through the 2000s and 2010s with support from regional authorities or state governments. Turkey (see Section 8 below) is planning to build over 70 science centres in all cities and large towns.

Various models can be found, illustrating that the development of science communication globally is uneven: the ArtScience Museum in Singapore is part of a commercial leisure and entertainment complex; Miraikan, the National Museum of Emerging Science and Innovation, in Japan states, as a founding principle, that 'science and technology are part of our culture. We provide an open forum for all to ponder and discuss the future roles of science and technology'[94]; Petrosains in Malaysia (see Section 8b below) 'is a Science Discovery Centre that uses a fun and interactive approach to

[92]See http://www.jst.go.jp/EN/about/index.html#NOTE2
[93]See http://www.jst.go.jp/EN/operations/operation2_e.html
[94]See https://www.miraikan.jst.go.jp/en/aboutus/

tell the story of the science and technology of the petroleum industry', housed in one of the world's tallest buildings, built for the energy company, Petronas[95].

An Australian study of over a decade ago noted that it had not been established whether that country's awareness programme of the 1990s 'caused Australians to become more or less aware of science and technology or of the part science plays in stimulating social and economic development' (Gascoigne and Metcalfe 2001); the authors recommended that evaluation needed to be built into such programmes from the start. That recommendation remains valid today.

8.5 International and Non-governmental Organisations

As well as national governments, international organisations of various kinds play significant roles in the diffusion of ideas and initiatives in science in society. The Organisation for Economic Co-Operation and Development is considering whether and how it could assess countries' comparative performance in this sector. UNESCO supports science communication initiatives and in October 2013 organised the First Regional Science Promotion conference in Serbia, bringing together science promotion professionals, practitioners, and enthusiasts from south-eastern Europe to 'share experience, network and formulate the next steps towards strengthening the link between science and society'.

In Africa, global and continental inter-governmental organisations supported a 2012 workshop in Addis Abeba that gathered science and technology journalists from various African countries, heads of key media institutions and scientists to 'discuss how best to communicate scientific issues to the public'.

The non-governmental cultural relations agency, British Council, is a primary player in science communication, principally through the Famelab competitions. These are based on researchers presenting a chosen scientific topic in three minutes before non-specialist audiences and have spread to over 20 countries, mainly among the newer member-states of the European Union but also including Egypt, Hong Kong and Israel, The British Council has helped with the organisation and promotion of the competitions and with the provision of the associated training. The British Council has also helped organised science cafés in many countries and this format has also been applied elsewhere to familiarise scientists and others with communicating about science in informal public settings.

Also based in Britain, the Wellcome Trust has a significant international programme in public engagement, now increasingly referred to as informal learning. Wellcome Trust support helped establish Café Khoa Huc in Vietnam, where Wellcome-supported medical researchers were aiming to create 'a friendly atmosphere in which everyone feels free to question and offer their ideas'. The spread of science cafés across the continents is a strong example of a global format, now adapted to local circumstances very widely. The international movement, Café Scientifique, counts 236 science cafés across all continents[96].

The promoters of these and similar initiatives, both professionals and volunteers, are often banded together in national associations of science communicators but REDPOP (Network for the

[95] See www.petrosains.com.my
[96] See http://www.cafescientifique.org/

Popularization of Science and Technology in Latin America and The Caribbean) is one of the few examples of a network of science communication professionals and agencies at continental level. REDPOP holds annual conferences around its region and stimulates reflections and research on issues in science in society.

Originating in Britain in 2002 with support from professional societies and private companies, the Science Media Centre (SMC) has come to be seen as a model capable of being applied in other countries; as of mid-2014, similar centres were established in Australia, Canada, Japan, and New Zealand, with more planned[97].

Among non-governmental organisations, Scidev.net and the World Federation of Science Journalists (WFSJ) deserve specific mention. Scidev.net provides an Internet platform for reporting and discussion of scientific developments particularly in – or from the perspective of – less-developed countries. The service has the support of the journals, Nature and Science, and of development aid agencies and charities with a particular interest in supporting science and technology in developing countries. The WFSJ provides experienced mentors for journalists in developing countries wishing to specialise in science, and offers an online course in science reporting.

8.6 University Programmes in Science Communication

Over the past 25 years, programmes leading to awards specifically in science communication have come to be recognised as one of the features of a developed science communication infrastructure. From the earliest examples of Masters and Postgraduate Diplomas in science communication established in Australia, Britain, France, Italy and Spain, such programmes are now found in many western European and in Latin America, Asia and Australasia.

In New Zealand, Otago University in 2014 recruited a second professor of science communication for its programmes; over half of its students in this field come from abroad. In Brazil, a Masters in Scientific and Cultural Communication was added to the existing offering in science journalism at the University of Campinas (Vogt et al. 2009). At the National Autonomous University of Mexico, the programme in science popularisation, started in 1996 through a close association with a science museum, has been linked to longer-established studies in the philosophy of science (Haynes 2009). Laurentian University, Ontario, Canada, set up a Graduate Diploma in Science Communication as a joint initiative with the Science North science centre, declaring it 'North America's first and only comprehensive Science Communication program', though preparatory work on a new single-subject masters in science communication has begun at another Canadian university.

These programmes show some common characteristics across quite different cultural and educational settings, though the relative emphasis on social studies of science, communication theory and professional skills does vary considerably (Mulder et al 2008; Trench 2012). The trend is not in one direction only: there are also examples of programmes that have been reduced, suspended or cut as part of their host institutions' rationalisation (Trench 2012).

[97] See http://www.sciencemediacentre.net/

The countries that were earliest to establish postgraduate taught programmes have tended also to be the most strongly represented in formal academic research. In China, however, research in science communication has developed in the absence of postgraduate teaching in this subject area. The China Research Institute of Science Popularisation (CRISP) has facilitated many doctoral research projects, often also including periods of study abroad. A report on the development of science popularisation studies in China found 1,795 papers published between 2002 and 2007 (Ren, Yin and Li 2012).

An attempted characterisation of topics, theories and methods in current PhD research in science communication showed wide variation (van der Sanden and Trench 2010). While the pattern may be complex and even contradictory, the trend in numerical terms appears clear from informal evidence gathered for network meetings in 2012 and 2014 of early-career researchers: there may be more PhD projects in science communication currently underway than have been completed. A study of science communication research in Australia noted the increase in PhD students from three in 1997 to twenty in 2012, and a doubling of the output of research papers written by Australian researchers from the 1990s to the 2000s (Metcalfe and Gascoigne 2012).

A further outgrowth of postgraduate teaching in science communication has been the publication of specialist academic journals in the field. Joining *Public Understanding of Science* (Britain), *Science Communication* (USA) and *JCOM – Journal of Science Communication* (Italy), The *Japanese Journal of Science Communication* (Kyoto), *Indian Journal of Science Communication, Science Communicator* and *Journal of Scientific Temper*, all originating in India, have emerged in more recent years.

8.7 Supports for Scientists in Public Communication

Short courses in media and presentation skills are increasingly available to scientists and other academics from research funders, universities, professional societies, and private providers. Courses are also provided on an international basis, as in the case of a 2011 communication course held at The World Academy of Sciences (TWAS) in Trieste, Italy, for scientists in developing countries; this was promoted on the basis that 'communication skills are particularly important for scientists in developing countries, where the infrastructure for science is weak and where science education needs more support at all educational levels'[98]. The course hosts noted that 'by improving their communication skills, scientists can play an important role in the development of science in their countries'.

A cross-country survey reported a significant correlation between communication training and confidence among researchers in communicating with the public (Peters et al. 2008). But in many countries where there are similar expectations of researchers that they engage in various ways with the general public, there is little or no provision of relevant training.

Despite the increasing attention to the broader 'third mission' of higher education institutions, encompassing many aspects of civic engagement, and to public access to research centres, there are few formal incentives for scientists to be publicly active. The institutions and countries in which

[98]See http://twas.ictp.it/common/files/files-announce/ict-twas-workshop-on-science-communication

there is formal recognition of public communication in the selection and promotion of academics and researchers are exceptional, both within and beyond the EU. A study in the United Kingdom based on interviews with scientists reported that public engagement 'is universally seen to be under-incentivised and under-rewarded, potentially detrimental to research, and professionally stigmatising' (Burchell, Franklin and Holden, 2009). In a letter to *Nature*, correspondents from leading research institutions and the national science centre in Japan noted that the government 'has urged the researchers it funds to improve communication with the tax-paying public' but 'time and effort spent on science communication will not help scientists to secure funding, promotion or employment' (Koizumi, Morita and Kawamoto 2013).

Communication training is often focused on early-career researchers or PhD students, as, for example, in the science and communication workshops held in recent years in India, with funding support from The Wellcome Trust and India's Department of Biotechnology. Meanwhile, training for wider groups involved in science communication is spreading, and increasingly internationalised: in September 2013 the first Euro-Mediterranean and Middle East Summer School of Science Communication took place in southern Spain, supporting science communication professionals in their efforts 'to drive development of new science communication endeavours'.

A key issue for the design and delivery of such training is the strength of emphasis on technical and formal aspects of communication. An approach to public communication oriented to dialogue requires preparing scientists to consider carefully the needs of their audiences and to listen well to their concerns. Encouraging scientists to take part in informal conversation, as at science cafés, may require specific forms of support (Trench and Miller 2012).

8.8 Country Reports

As a further means of demonstrating the global spread, the shared trends but also the national variations in science in society policies and programmes, we present in this section a series of brief reports outlining recent developments in selected countries. These countries span the continents but are deliberately chosen as cases that are not obvious regional leaders; in this way, they illustrate the percolation of ideas and concerns about science in society across the world. The reports all refer to the leading roles of government, of higher education and research sectors and of media and media professionals in promoting and implementing increased attention to science in society. They demonstrate the general trend for increased attention to science in society at the same time as they point to significant differentiation. More detailed reports might show better the weaker or stronger role of committed individuals, as mentioned explicitly below in the case of Mexico and implicitly in the reference to science broadcasting in New Zealand. Equally, the role of high-technology companies exemplified only in the Malaysia report might be a differentiation factor between countries.

Argentina[99]**:** The creation in 2007 of a ministry for science, technology and productive innovation was a signal of new times. Over recent years, R&D investment grew faster than in Europe, USA and Canada, though behind Asia. The public policy discourse shifted towards a knowledge

[99] Based on the contribution of Carmelo Polino to Trench et al, 2014

economy and reducing dependence on commodities production. Within this framework, the importance of social communication of science, including the reinforcement of traditional museums and new science centres, has been emphasised.

Scientific institutions have progressively incorporated media and public-opinion orientations, as in the creation or consolidation of facilities for public communication in universities and S&T institutions; the intensification of contacts between scientists and journalists; the increasing salience of a rhetoric of engagement, dialogue and public inclusion. This is connected with tendencies for intellectuals and scientists in general to claim a stronger public role (Polino 2013).

However, institutional communication shows some structural weaknesses: despite university and federal institutions acknowledging the importance of press offices, funding is scarce: most of these groups have no guaranteed budgets or permanent positions to produce science communication materials, so many of their practices are voluntary (Polino 2013). Scientists are not clearly incentivised to engage in public communication.

Another problem is the conception of communication and the perception of the public that underlie many institutional initiatives in science communication and science popularisation. Many university efforts in science communication are still inspired by the notion that the public and journalists need to be educated (by the scientists). This produces an obvious tension, that is recreated many times in public lectures, talks and media interventions.

Science journalism is also becoming incrementally professionalised and institutionalised (Gallardo 2011; Vara 2007). During the past fifteen years, the media have appointed specialist journalists and increased coverage of S&T-related issues. Coverage of Argentina's research and development has become more prominent in the mass media.Science journalists have organized themselves through a network and a professional association[100] and young professionals with new expectations are entering science journalism and science popularisation (Bauer et al 2013). Many of these are coming through new university programmes (Murriello 2011), though the spread of science communication training programmes is still limited. We can also observe that media tend to favour descriptive rather than analytical perspectives; science news is often reduced to scientific discoveries, leaving out perspectives on risks, conflicts of interests or the connections between science and economy.

Malaysia[101]: The importance attached to science and technology has been reflected in several Malaysian government key policies such as Vision 2020, the 10th Malaysia Plan, the National Science and Technology Policy, the National Biotechnology Policy and the National Agricultural Policy. Related efforts to embed science and innovation in Malaysian society include the declaration of 2010 as Malaysia Innovation Year, 2011 as the Year for the Promotion of Science and Mathematics and 2012 as the National Science and Innovation Movement Year.

The National Science Centre (PSN)and Petrosains Science Discovery Centre are at the heart of science promotion in Malaysia. The first is run by the government under the auspices of the Ministry of Science, Technology and Innovation (MOSTI), and the second is the corporate

[100]See http://www.radpc.org/

[101]Based on the contribution of Latifah Amin to Trench et al, 2014

contribution of Petronas, the leading oil and gas company. PSN defines itself as an informal learning institution that 'hopes to raise interest, appreciation and understanding of the public of Science and Technology in order to increase scientific Malaysians'. Petrosains stresses the wonder and excitement of science and discovery in appealing to audiences mainly of schoolchildren and families. It also hosts a science festival for wider audiences, and with the ambition to add Kuala Lumpur to the cities around the world, 'such as Edinburgh, New York, San Diego, Abu Dhabi and Singapore', that host successful science festivals.

PSN supports a programme for school students in rural areas to experience the learning of science and technology through interactive hands-on activities. The centre also conducts a special programme for teachers and organises competitions and carnivals to instil interest in science and technology. The National Planetarium is also active in educational and outreach programmes on space education (Zainuddin, 2008).

The Academy of Science Malaysia has initiated programmes such as competitions, science camps, Science and Mathematics Expo, National S&T Month and exhibitions and publications to enhance public awareness.Universities and schools throughout the country conduct science camps during the school holidays.

MOSTI has supported the MyBiotech@School programme which has exposed nearly 40,000 students throughout the country to biotechnology through hands-on experiments, multimedia shows, demonstrations and talks by scientists and industry experts (Mivil 2013; BIO-BORNEO 2013; Firdaus-Raih et al 2005). The Ministry of Natural Resources and Environment and the Department of the Environment have conducted environmental awareness programmes (Pudin et al 2005) while the Ministry of Health has organized health-related campaigns (MOH2010; Malaysian Digest 2013; CAP 2011).

Mexico[102]: Over fifty years of active individual and institutional involvement in many forms of science communication, the sector has moved from one defined by volunteering to become a significant professional activity. Science communicators of many types are gathered in the Mexican Society for the Popularisation of Science and Technology, founded in 1986 and with over half of its members working in higher education and research institutions. These institutions are themselves at the forefront of science communication in the country.

The earliest initiatives were taken by Luis Estrada, a physicist of the National Autonomous University of Mexico (UNAM), later awarded the Unesco Kalinga Prize for his efforts. Today, UNAM through its Directorate of Science Dissemination operates two science museums and employs nearly 100 full-time science communicators, as well as organising public events, publishing several popular science publications and providing training in science communication. Over 300 students have completed the Diploma in Science Dissemination at UNAM in the past two decades and a new postgraduate programme in science communication is under development.

Other institutions active in the field include the Mexican Academy of Sciences, with its informal Sunday science talks, and the Mexican Society of Physics that has hosted Encounters in Science Communication for three decades. At government level, CONACyT (National Council for Science

[102]Based on Sanchez-Mora at al, 2014

and Technology) takes responsibility for public science communication; it has been publishing popular science magazines for nearly forty years and organising a national Science and Technology Week for twenty years. It oversees a National Strategy for the Dissemination and Popularisation of Science Technology and Innovation and administers funds targeted at bringing science and technology to marginalised communities.

The Mexican Association of Science and Technology Museums and Centres was started in 1996 and its thirty member-centres are spread across the country. The experiences of science centres and their visitors are the single largest area of formal research in science communication, exploring the complexities of informal science learning in museums. Another strong strand of work is on evaluationofscience communication projects and of science communicators themselves.

New Zealand[103]: New Zealand has defined itself with increasing emphasis in recent years as a high-technology and science-based economy, and this is represented in the appointment of a Minister of Science and Innovation and a Chief Science Adviser to the prime minister, but also in the level of public attention to science-based issues. A Royal Commission on Genetic Modification in 2000-01 received record numbers of public submissions and stated strongly in its report that 'appropriate participation by all stakeholders' was needed in the decision-making process on such issues.In 2014, a draft National Statement of Science Investment was opened for a three-month period to public feedback.

Audio-visual communication of science for diverse publics has had a central role in the development of the professional and institutional structures of science communication in New Zealand. A 1950s radio programme, Science Report, is credited as one of the earliest science communication initiatives in New Zealand. Through the 1990s and 2000s there have been several such radio programmes on Radio New Zealand, their presenters including scientists who took up popularisation and professional broadcasters.

As a country with very distinctive natural features and habitats, New Zealand has been a base for internationally significant natural history film- and documentary-making. This has also been the primary basis of the development of professional and academic education in science communication. Natural History New Zealand, based in Dunedin, has become a supplier to global outlets such as National Geographic, Animal Plant and Discovery.

Also in Dunedin, at University of Otago, a Masters in Science Communication was started in 2008; itattracts significant numbers of international and New Zealand students. The university's Centre of Science Communication at the University of Otago is the primary host of the 2018 Public Communication of Science and Technology conference, with support from government and the wider scientific and science communication sectors. New Zealand will become by a big margin the smallest country (in population) to host this biennial conference. The Science Communicators Association of New Zealand (SCANZ) was founded in 2004 with support from its longer-established Australian counterpart and hosts workshops, conferences and other events in several of New Zealand's larger cities.

[103]Based mainly on the presentation of Jean Fleming to PCST Conference, Salvador, Brazil, May 2014

Nigeria[104]**:** The future of the Nigerian economy is considered to be predicated on the rapid diffusion of science and technology as the government has adopted this approach as the best way forward for accelerated growth. The successes of the technology-driven mobile telephony industry in generating employment and increasing wealth no doubt contributed to this policy direction and to the hope that this success can be replicated in other sectors.

A science and technology summit held in Nigeria in 2010 aimed to stimulate the interest of the public in science, technology and innovation, to encourage indigenous researchers, inventors and innovators and to promote the domestication of modern technologies.A new science, technology and innovation (STI) policy was subsequently launched in 2011, emphasising innovation and technology transfer and setting specific objectives for the promotion of STI communication and inculcation of science culture.

The Nigeria Academy of Science provides advisory services for the federal government on STI, of which one was an audit of research and development agencies; one recommendation was for more synergy among the agencies and the institution of an annual national science and technology forum. The Academy is also actively involved in popularising science. In 2012, it held a workshop on effective communication of science research aimed at bridging the gap between scientists and the public and bringing together young scientists and journalists. The Academy also works with several partners on the SEED programme[105] that gives students and teachers the opportunity to work together on a research project. The programme provides learning and teaching resources, aiming to ignite a passion for science and develop the student's technical potential by building critical thinking, creativity and innovation skills.

The Nigerian press regularly feature science and technology articles and *The Guardian*, regarded as the flagship of the Nigeria press, has maintained regular science columns for several decades and media analysis (Falade 2014) has shown that the percentage of science in the news compares with what obtains in the United Kingdom and the United States.

Turkey[106]**:** Turkey has acknowledged the value of science communication through investment of large amounts of money to enhance public engagement with science and technology, promote a scientific culture, and develop a dialogical science communication culture. The Scientific and Technological Research Council of Turkey (TUBITAK), in cooperation with local authorities, has been establishing science centres around the country, aiming to complete a science centre in all 16 metropolitan areas by 2016, and in all 81 cities by 2023. TUBITAK is also responsible for promoting, funding and carrying out cutting-edge scientific research, and making the findings available to the public. It publishes popular science books as well as popular science magazines for children and for the general public.

The Ministry of National Education has also been working with TUBITAK and the Turkish Radio and Television Corporation on developing effective ways of science communication. The involvement of the education ministry reflects recent changes in science education: creating engaged and scientifically literate citizens has become a focus of the new science curriculum[107].

[104]Based on the contribution of Bankole Falade to Trench et al, 2014

[105]See www.planetseed.com

[106]Based on the contribution of Gultekin Cakmakci to Trench et al, 2014

[107]See Turkish Ministry of National Education, *Science Curriculum*, at http://goo.gl/jSSG5w

The new media literacy curriculum[108] specifically endorses public participation in policy debates about science-related social issues; this is seen as essential to maintain a healthy democracy (Cakmakci and Yalaki 2012).

However, there are few researchers in science communication and there is very limited output of research on science communication. There is no science communication division in any Faculty of Communication or in other faculties. The Turkish press often covers science and technology-related issues, but few of the newspapers have a separate science section.

Another challenge that Turkey faces is the unsustainably short cycle of policies in science outreach. Over little more than a decade, the minister of education has changed five times and each person in that role has had different priorities, agendas and different kinds of science communication models. This has caused tensions among the public, policy-makers, science communication researchers and practitioners.

8.9 Closing remarks

Science in society has become in the past few decades a global concern and a global enterprise with important common denominators as well as distinctive regional characteristics. This reflects the broadly shared public policy attention to the knowledge economy as well as the increasing salience of science and of science-related issues to social and economic development generally. This global spread expands opportunities for applying common formats and sharing experiences and tools; this happens already at a fairly high level, engaging EU and non-EU partners with each other, for example, although largely through professional networks rather than governmental or inter-governmental initiative. The global spread presented here also enlarges the field for comparative analysis of similar approaches adopted in different contexts. Through such analysis the contextual interaction of science in society patterns with broader cultural, social and political landscapes becomes more visible.

It should be noted that the phrases, 'science in society' and 'science communication', are far from universally recognised, nor are they used uniformly, where they do occur. Some key terms and phrases have distinctive or exclusive usage in particular countries or regions: 'scientific temper' in India, 'science popularisation' in China, 'social appropriation of science' in Latin America. But in disparate countries, with notably different cultural contexts, similar kinds of commitments are being made to promote science and, with it, to promote awareness and appreciation of science. Across these examples, there are similar references to science's role in technological and economic development and to the need to encourage interest in science particularly among children and young people.

In countries and regions with longer traditions of institutionalised science communication it is widely assumed that the preferable (and, in fact, dominant) approach to science in society is based on dialogue rather than on the 'deficit model' – that is, an approach based on an assumed lack of knowledge, trust or appreciation of science among the lay public. Whether or not this is generally the case in practice, the assumption does not apply in regions where the science communication

[108] See http://www.medyaokuryazarligi.org.tr

culture is, in the terms of the European mapping mentioned above, 'developing' or 'fragile'. (The MASIS report indicates that the depth of the science communication tradition and of democratic participation in a country influences the character of the science communication culture.) On the other hand, we have seen plentiful evidence that didactically oriented programmes of science awareness can co-exist with interactive and conversational forms of communication in science centres, science festivals, and science cafés.

Policy and reflection in the field of science in society in Europe should be aware of these general trends and regional diversity and be prepared to confront and take them into account, particularly as some of the areas treated above become increasingly relevant contexts for global research and its communication, models and experiences. As it was also remarked during the World Café discussions at the Rome conference, the global dimension should be viewed not just as a challenge, but as an opportunity for European actors and institutions to rethink and expand their vision and definition of the theme. In this light, the European Union and governments within and beyond the EU should consider how best to track changes in science in society, allowing forboth comparisons among countries and with areas outside the EU. A framework for this task could be built by combining the template for national reports in the MASIS project and a process of validation of those reports through broader expert consultation, as represented in Science Culture in Canada (Council of Canadian Academies, 2014). This recent expert panel report analyses Canada's standing in terms of traditional statistical indicators of public perception and understanding of science but also looks at broader perspectives on science culture, considering, for example, citizen science and relationships with indigenous knowledge. Also, thorough understanding of trends in European science culture in a global contextmight benefit from going beyond the aggregation of trends at the national level, for example by looking at the emergence of actors, interaction styles and audiences cross-cutting different countries.

Taking greater account of the global dimension should reinforce the view that the models of science/society interaction are not to be seen in evolutionary or hierarchical perspective, i.e. that 'dialogue' or 'public engagement' is a necessary and improved replacement of 'deficit' and 'dissemination'. On a global scale, but also in given (and changing) local contexts, any or all of these approaches – and others besides – may have their place. The global overview highlights how difficult and even misleading it would be to expect a single, straightforward response to contemporary challenges of science in society such as those outlined above, or to fulfil the expectation of eventually finding the 'best' and most appropriate, one-size-fits-all model and toolbox.

References chapter 8

Bauer, M. et al. 2011. « The Culture of Science – how the public relates to science across the globe."London: Routledge.

Bauer, M. et al. 2013. "Global Science Journalism Report: working conditions and practices, professional ethos and future expectations." London: Scidev.net, LSE, Museu da Vida.

Beltrame, L. et al. 2013. "Climate change as a rhetorical resource and masterframe. An analysis of the daily press coverage and public opinion in Italy." In *Rethinking the Public Sphere Through Transnationalizing Processes*, edited by H. Trenz, A. Salvatore, O.Schmidtke, 187-207. London: Palgrave Macmillan.

BIO-BORNEO. 2013. "Accelerating Biotechnology For Borneo Through Bioeconomy." www.mosti.gov.my/index.php?option=com_content&view=article&id=2642&lang=bm

Bucchi, M. and B. Trench. 2014. "Science communication research: themes and challenges." In *RoutledgeHandbook of Public Communication of Science and Technology*, 2nd edition, edited by M. Bucchi and B. Trench. London and New York: Routledge.

Bultitude, K. et al. 2012. "Comparison of national strategies: documentary analysis for Australia, Brazil, China and the United Kingdom". In *Quality, Honesty and Beauty in Science Communication – 12th International Public Communication of Science and Technology*, edited by M. Bucchi and B. Trench, 43-48. Vicenza: Observa Science in Society.

Burchell, K. et al. 2009. "Public Culture as Professional Science – Final report of the SCOPE project (Scientists on public engagement: from communication to deliberation?)." London: BIOS (Centre for the Study of Bioscience, Biomedicine, Biotechnology and Society), London School of Economics.

Cakmakci, G. and Y. Yalcin. 2012. "Promoting Student Teachers' Ideas about Nature of Science through Popular Media." Trondheim: S-TEAM/NTNU.

CAP, 2011, "Health campaigns must be concerted and supported by every government body", www.consumer.org.my/index.php/health/healthcare/474-health-campaigns-must-be-concerted-and-supported-by-every-government-body

Council of Canadian Academies, 2014. "Science Culture: Where Canada Stands. Ottawa (ON): The Expert Panel on the State of Canada's Science Culture, Council of Canadian Academies."
http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/science-culture/ScienceCulture_fullreportEN.pdf

Falade, B. 2014. "Vaccination Resistance, Religion and Attitudes to science in Nigeria, PhD Diss." London: LSE.

Firdaus-Raih et al. 2005. "A nationwide biotechnology outreach and awareness program for Malaysian high schools." *Electronic Journal of Biotechnology* 8, 1: 10-16.

Gallardo, S. 2011. "Profesionalización del periodismo científico. Avances y desafíos. Qué se espera hoy de un periodista científico." In *Periodismo y comunicación científica en América Latina*, edited by Ministerio de Ciencia, Tecnología e Innovación Productiva, OEA. Buenos Aires: Ministerio de Ciencia, Tecnología e Innovación Productiva.

Gascoigne, T. and J. Metcalfe. 2001. "The evaluation of national programs of science awareness." *Science Communication*, 23: 66-76.

Jensen, E. and N. Buckley. 2014. "Why People Attend Science Festivals." *Public Understanding of Science*, July 2014: 557-573.

Haynes, E. 2009. "A graduate course for science communicators: A Mexican approach." *Journal of Science Communication*, 8: 1.

Koizumi, A. et al. 2013. "Reward research outreach in Japan." *Nature*, 500: 29.

Malaysian Digest. 2013. "Health Ministry targets 'less salt' after 'less sugar' campaign" (15 March) www.malaysiandigest.com

Mejlgaard, N. et al. 2012. "Monitoring Policy and Research Activities on Science in Society in Europe (MASIS). Final synthesis report." Brussels: European Commission, Directorate-General for Research and Innovation.
http://ec.europa.eu/research/science-society/document_library/pdf_06/monitoring-policy-research-activities-on-sis_en.pdf

Metcalfe, J., and T. Gascoigne. 2012. "The evolution of science communication research in Australia". In *Science Communication in the World – practices, theories and trends*, edited by B. Schiele, M. Claessens and S. Shi, 19-32. Dordrecht: Springer.

Mivil, O. 2013. "40,000 students get a taste of biotechnology." *New Straits Times*, 22 February.
http://www.nst.com.my/nation/general/40-000-students-get-a-taste-of-biotechnology-1.222852
MOH. 2010. "Launch of the 1 Malaysia MDA-GSK oral health awareness campaign." http://imuoralhealth.blogspot.ie/2010/03/launch-of-1malaysia-mda-gsk-oral-health.html

Mulder, C. et al. 2008. "The state of science communication programs at universities around the world." *Science Communication*, 80, 2: 277-287.

Murriello, S. 2011. "Especialización en divulgación de la ciencia, la tecnología y la innovación. Universidad Nacional de Río Negro." In *Periodismo y comunicación científica en América Latina*, edited by Ministerio de Ciencia, Tecnología e Innovación Productiva, OEA. Buenos Aires: Ministerio de Ciencia, Tecnología e Innovación Productiva.

Peters, H. P. et al. 2008. "Interactions with the mass media." *Science*, 321: 204-205.

Polino, C. 2013. "Science communication in Latin American countries: Some comments on its current strengths and weaknesses." In *Science Communication Today: international perspectives, issues and strategies*, edited by P. Barenger and B. Schiele, 263-280. Paris: CNRS Éditions.

Pudin, S. et al. 2005. "Environmental education in Malaysia and Japan: a comparative assessment." Paper presented at the Education for Sustainable Future International Conference, Ahmedabad, India, 18-20 January 2005.
www.ceeindia.org/esf/download/paper20.pdf

Ren, F. et al. 2012. "Science popularisation studies in China". In *Science Communication in the World – practices, theories and trends*, edited by B. Schiele, M. Claessens and S. Shi, 65-80. Dordrecht: Springer.

Sanchez-Mora, C. et al. 2014. "Public Communication of science in Mexico: past, present and future of a profession" published online first, 30 April.
http://minimanuscript.com/manuscripts/public-communication-of-science-in-mexico/dashboard

Schiele, B. et al. 2012. "Science Communication in the World – practices, theories and trends." Dordrecht: Springer.

Shi, S., and Zhang H.. 2012. "Policy perspectives on science popularisation in China". In *Science Communication in the World – practices, theories and trends*, edited by B. Schiele, M. Claessens and S. Shi. Dordrecht: Springer.

Trench, B. 2012. "Vital and vulnerable: science communication as a university subject." In *Science Communication in the World: Practices, Theories and Trends*, edited by B. Schiele, M. Claessens and S. Shi, 241–258. Dordrecht: Springer.

Trench, B. and Steven Miller. 2012. "Policies and practices in supporting scientists' public communication through training." *Science and Public Policy*, 39(6): 722–731. DOI: 10.1093/scipol/scs090.

Trench, B. et al. 2014. "Global spread of science communication: institutions and practices across continents." In *Routledge Handbook of Public Communication of Science and Technology*, 2nd edition, edited by M. Bucchi and B. Trench. London and New York: Routledge.

Van der Sanden, M. and B. Trench. 2010. "Analysis of doctoral research in science communication." In *Science Communication without Frontiers: Proceedings of 11th International Conference on Public Communication of Science and Technology*: 92–95. New Delhi: National Council for Science and Technology Communication.

Vara, A. M.. 2007. "Periodismo científico: preparado para enfrentar los conflictos de interés." *Revista Iberoamericana de Ciencia, Tecnologia y Societad*, 9 (3): 189–209.

Vogt, C. A. et al. 2009. "Master's degree program in scientific and cultural communication: Preliminary reports on an innovative experience in Brazil." *Journal of Science Communication*, 8(1): 1-8.

Zainuddin, M. Z.. 2008. "Perspective of space science education and awareness in Malaysia." *Thai Journal of Physics*, 3: 1-2.

Annex 8 – SiS-FP7 Projects with International Partners.

Project Acronym	Project Title	Coordinator (Name of the Organization and Country)	Number of Partners Involved	Start Date	End Date	Duration (Months)	Total Cost (€)	Total Funding (€)	Contract Type
2WAYS	Two ways for communicating european research about life sciences with science festivals & science centres/museums, science parliaments impact survey	EUROPEAN SCIENCE EVENTS ASSOCIATION, AUSTRIA	6	01 -01-09	31-12-10	24	992076	966600	CSA-SA
ACCENT;	Action on climate change through engagement, networks and tools	FONDAZIONE IDIS-CITTÀ DELLA SCIENZA, ITALY	15	01-04-09	31-03-11	24	1348965	1017880	CSA-CA
ACUMEN;	Academic Careers Understood through Measurement and Norms	UNIVERSITEIT LEIDEN, NETHERLANDS	9	01-03-11	28-02-14	36	2025827	1495412	CP-FP
ASSET	Action plan on sis related issues in epidemics and total pandemics	VITAMIB SAS, FRANCE	14	01-01-14	31-12-17	36	4496454	EUR 3 939 880	CSA-SA
BEWATER	Making society an active participant in water adaptation to global change	CENTRO DE INVESTIGACION ECOLOGICA YAPLICACIONES FORESTALES, SPAIN	11	01-10-13	31-03-17	42	3588713	2934724	CSA-SA

CASC	Cities and science communication: innovative approaches to engaging the public	BIRMINGHAM CITY COUNCIL, UK	19	01-05-09	28-02-11	21	1119582	870980	CSA-CA
CEECEC	CSO engagement with ecological economics	NIVERSITAT AUTONOMA DE BARCELONA, SPAIN	13	01-04-08	30-09-10	30	814101	730011	
CHREACT	Chain Reaction: A Sustainable Approach to Inquiry Based Science Education	SHEFFIELD HALLAM UNIVERSITY, UK	11	01-06-13	31-05-16	36	4040400	3601587	CSA-SA
COREFLECT;	Digital support for inquiry, collaboration, and reflection on socio-scientific debates	CYPRUS UNIVERSITY OF TECHNOLOGY, CYPRUS	7	01-03-08	28-02-11	36	916260	768942	CSA-CA
ECB	European Coordinating Body in Maths, Science and Technology Education	EUN PARTNERSHIP AISBL, BELGIUM	28	01-02-11	31-10-14	36	8134001	3578912	CSA-SA
EJOLT	Environmental Justice Organizations, Liabilities and Trade	UNIVERSITAT AUTONOMA DE BARCELONA, SPAIN	19	15-03-11	14-03-15	48	4078038	3651921	CSA-SA
ENGAGE;	Equipping the Next Generation for Active Engagement in Science	SHEFFIELD HALLAM UNIVERSITY, UK	13	01-01-14	31-12-16	24	2804226	2476238	CSA-SA
ENGINEER;	brEaking New Ground IN the sciencE Education Realm	BLOOMFIELD SCIENCE MUSEUM JERUSALEM (BSMJ), ISRAEL	25	01-10-11	30-09-14	36	3151188	2795871	CSA-SA
EPOCH	Ethics in Public Policy Making: The Case of Human Enhancement	UNIVERSITY OF BRISTOL, UK	9	01-11-10	31-10-12	24	1477603	1150012	CP-FP

ETHICAL	Promoting international debate on ethical implications of data collection, use and retention for biometric and medical applications	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V, GERMANY	7	01-01-09	31-12-10	24	1080930	742394	CSA-CA
EUROSIS	EUROSIS	EUROSCIENCE GREEK REGIONAL SECTION, GREECE	34	01-02-08	30-06-10	29	1292380	1201886	CSA-CA
EUZOOS-XXI	EU Zoos and science in the 21st Century: engaging the public in nature conservation	NORDECONSULT SWEDEN AB, SWEDEN	6	01-09-09	31-08-12	36	862134	758178	CSA-CA
FASMED	Improving progress for lower achievers through Formative Assessment in Science and Mathematics Education	UNIVERSITY OF NEWCASTLE UPON TYNE, UK-	8	01-01-14	31-12-16	24	2478828	1918076	CP-FP
FIBONACCI;	The FIBONACCI Project - Large scale dissemination of inquiry based science and mathematics education	ECOLE NORMALE SUPERIEURE, FRANCE	26	01-01-10	28-02-13	38	5343520	4784597	CSA-SA
GENDERA	Gender Debate in the European Research Area	TUDOMANYOS ES TECHNOLOGIAI ALAPITVANY, HUNGARY	8	01-11-09	30-04-12	30	1030585	798666	CSA-SA
GENDER-NET	Promoting gender equality in research institutions and the integration of the gender dimension in research contents	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, FRANCE	11	15-10-13	14-10-16	36	1931665	1545219	CSA-CA
GENDERTIME;	Transfering Implementing Monitoring Equality	EGALITE DES CHANCES DANS LES ETUDESET LA PROFESSION D'INGENIEUR EN EUROPE	9	01-01-13	31-12-16	36	3329404	2328077	CSA-SA

		ASSOCIACION, FRANCE							
GENIS LAB	The Gender in Science and Technology LAB	FONDAZIONE GIACOMO BRODOLINI, ITALY	8	01-01-11	31-12-14	36	2393332	1674932	CSA-SA
GEST	Global Ethics in Science and Technology	UNIVERSITY OF CENTRAL LANCASHIRE, UK	4	01-02-11	30-04-14	39	892295	696820	CP-FP
HELENA;	Higher education leading to engineering and scientific careers	SIAULIU UNIVERSITETAS, LITHUANIA	6	01-04-09	30-09-11	30	1212390	930433	CP
HIDE	Homeland security, biometric identification and personal detection ethics	CENTRE FOR SCIENCE, SOCIETY AND CITIZENSHIP, ITALY	10	01-02-08	31-01-11	36	1244393	963762	CSA-CA
HIPST	History and Philosophy in Science Teaching	DEUTSCHE GESELLSCHAFT FUR INTERNATIONALE ZUSAMMENARBEIT (GIZ) GMBH, GERMANY-	10	01-02-08	31-07-10	30	1099238	998211	CSA-CA
INNOVA-P2	Pharma-innovation - patent-2	UNIVERSITY OF CENTRAL LANCASHIRE, UK	7	01-06-08	31-05-11	36	930130	728640	CP-FP
INQUIRE;	Inquiry-based teacher training for a sustainable future	UNIVERSITA ET INNSBRUCK, AUSTRIA	18	01-12-10	30-11-13	36	4040400	3601587	CSA-SA

IRRESISTIBLE;	Including Responsible Research and innovation in cutting Edge Science and Inquiry-based Science education to improve Teacher's Ability of Bridging Learning Environments	RIJKSUNIVERSITEIT GRONINGEN, NETHERLANDS	13	01-11-13	31-10-16	36	2795284	2498840	CSA-SA
ISWA	Immersion in the Science Worlds through Arts	UNIVERSITA POLITECNICA DELLE MARCHE, ITALY	15	01-03-11	28-02-13	24	1225522	1103791	CSA-SA
KIDSINNSCIENCE	Innovation in Science Education - Turning Kids on to Science	Ã–STERREICHISCHES Ã–KOLOGIE-INSTITUT, AUSTRIA	9	01-11-09	31-07-13	45	1233444	999224	CP-FP-SICA
MIC	My ideal city	MUSEO TRIDENTINO DI SCIENZE NATURALI, ITALY	4	01-06-09	31-05-11	24	776000	682070	CSA-CA
NANOCODE	A multistakeholder dialogue providing inputs to implement the European Code of Conduct for Nanosciences & Nanotechnologies (N&N) research	ASSOCIAZIONE ITALIANA PER LA RICERCA INDUSTRIALE – AIRI, ITALY	9	01-01-10	30-11-11	23	1417801	1243777	CSA-SA
NECOBELAC	Network of collaboration between Europe and Latin American Caribbean countries to spread know-how in scientific writing and provide the best tools to exploit open access information in public health	ISTITUTO SUPERIORE DI SANITA, ITALY	5	01-02-09	31-07-12	42	907177	800000	CSA-CA
PARRISE;	Promoting Attainment of Responsible Research and Innovation in Science Education	UNIVERSITEIT UTRECHT, NETHERLANDS	17	01-01-14	31-12-17	36	2899979	2498125	CSA-SA

PATHWAY	The Pathway to Inquiry Based Science Teaching	UNIVERSITAET BAYREUTH, GERMANY	27	01-01-11	31-12-13	24	4143983	3378770	CSA-SA
PATS	Privacy awareness through security branding	TECHNISCHE UNIVERSITAT BERLIN, GERMANY	6	01-08-09	31-03-12	32	1080607	964594	CSA-SA
PERARES	Public Engagement with Research and Research Engagement with Society	RIJKSUNIVERSITEIT GRONINGEN, NETHERLANDS	19	01-05-10	31-10-14	54	3085511	2728041	CSA-CA
PRACTIS;	Privacy - Appraising challenges to technologies and ethics	INTERDISCIPLINARY CENTER FOR TECHNOLOGICAL ANALYSIS AND FORECASTING, ISRAEL	7	01-01-10	31-03-13	38	1267956	988456	CP-FP
PRAGES	Practising gender equality in science	DIPARTIMENTO PER I DIRITTI E LE PARI OPPORTUNITA', ITALY	10	01-04-08	31-12-09		1498040	998418	CSA-CA
PROFILES	Professional Reflection-Oriented Focus on Inquiry-based Learning and Education though Science	FREIE UNIVERSITAET BERLIN, GERMANY	23	01-12-10	30-11-14	48	3837022	3447910	CSA-SA
PROGRESS	PROmoting Global REsponsible research and Social and Scientific innovation	UNIVERSITY OF CENTRAL LANCASHIRE, UK	9	01-02-13	31-01-16	36	1715490	1486664	CSA-SA
RESPONSIBILITY;	Global Model and Observatory for International Responsible Research and Innovation Coordination	FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., GERMANY	12	01-02-13	31-01-16	36	1779733	1484427	CSA-CA
RISE	Rising pan-european and international awareness of biometrics and security	CENTRE FOR SCIENCE, SOCIETY AND CITIZENSHIP,	9	01-03-09	29-02-12	36	1253746	919501	CSA-CA

	ethics	ITALY							
RRI TOOLS;	RRI TOOLS, a project to foster Responsible Research and Innovation for society, with society	FUNDACIO CAIXA D'ESTALVIS I PENSIONS DE BARCELONA, SPAIN	25	01-01-14	31-12-16	24	7762043	6942 31	CSA-SA
SATORI;	Stakeholders Acting Together On the ethical impact assessment of Research and Innovation	UNIVERSITEIT TWENTE, NETHERLANDS	15	01-01-14	30-09-17	46	4723129	3662800	CSA-SA
SED	Science Education for Diversity	THE UNIVERSITY OF EXETER, UK	5	01-01-10	31-12-12	24	1409821	999982	CP-FP-SICA
SERSCIDA;	Support for Establishment of National/Regional Social Sciences Data Archives	UNIVERZITET U SARAJEVU, BOSNIA HERZEGOVINA	6	01-01-12	30-06-14	30	699025	625573	n.a.
SET-DEV	Science, etchics and technological responsibility in developing and emerging countries	CONSIGLIO NAZIONALE DELLE RICERCHE, ITALY	10	01-03-08	31-05-11	39	1590047	1343477	CSA-CA
SHEMERA	Euro-Mediterranean research cooperation on gender and science: SHE Euro-Mediterranean Research Area	UNIVERSITE LIBRE DE BRUXELLES, BELGIUM	17	01-05-11	31-10-14	42	2363343	1991838	CP-FP-SICA
SIS.NET	Network of Science in Society National Contact Points	THE ICELANDIC CENTRE FOR RESEARCH, ICELAND	11	01-11-11	30-06-14	32	683858	599989	CSA-SA
SIFORAGE;	Social Innovation on active and healthy ageing for sustainable economic growth	UNIVERSITAT DE BARCELONA, SPAIN	18	01-11-12	31-10-16	36	4093588	3484788	CSA-SA
SISOB	An Observatorium for Science in Society based in Social Models	UNIVERSIDAD DE MALAGA, SPAIN	7	01-01-11	31-12-13	24	1810212	1411858	CP-FP

S-TEAM	Science teacher education advanced methods	NTNU - NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET, NORWAY	26	01-05-09	30-04-12	36	5240157	4699928	CSA-SA
STUDIOLAB;	a new European platform for creative interactions between art and science	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN, IRELAND	13	01-07-11	31-12-14	42	1652634	1496349	CSA-SA
SYN-ENERGENE;	Engaging with New and Emerging Science and Technology in Responsible Governance of the Science and Society Relationship	KARLSRUHER INSTITUT FUER TECHNOLOGIE, GERMANY	27	01-07-13	30-06-17	48	4590081	3960810	CSA-SA
SYNTH-ETHICS	Ethical and regulatory challenges raised by synthetic biology	TECHNISCHE UNIVERSITEIT DELFT, NETHERLANDS	4	01-03-09	31-08-11		770608	531276	CP
TEMI;	Teaching Enquiry with Mysteries Incorporated	QUEEN MARY UNIVERSITY OF LONDON, UK	13	01-02-13	31-07-16	42	3558128	3135919	CSA-SA
TRACES	Transformative Research Activities. Cultural diversities and Education in Science	UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II, ITALY.	5	01-07-10	30-06-12	24	1198000	996700	CP-FP-SICA

TWIST;	Towards Women In Science and Technology	CENTER FOR FORMIDLING AF NATURVIDENSKAB OG MODERNE TEKNOLOGI FOND, DENMARK	10	01-01-10	31-12-12	24	3048097	2755692	CSA-SA

**SICA: Small/medium-scale focused research project for specific cooperation actions dedicated to international cooperation partner countries(SICA); CP-FP: Small or medium-scale focused research project; CSA-CA: Coordination (or networking) actions; CSA-SA: Support actions; CP: Collaborative project (generic).

Notes on contributors

Ilaria Ampollini is a PhD candidate in History of Science and collaborates to Observa research centre Science in Society.

Daniele Archibugi is a Research Director at the Italian National Research Council (CNR-IRPPS) in Rome, and Professor of Innovation, Governance and Public Policy at the University of London, Birkbeck College. He works on the economics and policy of science, technology and innovation and on the political theory of international relations. He has chaired the European Commission's Expert Group on "A Wide Opening of the European Research Area to the World" and he has been a member of the Expert Group of the European Commission "Global Europe 2030/2050". In the field of innovation studies, he co-authored The Technological Specialization of Advanced Countries, prefaced by the then EC President Jacques Delors and co-edited with Bengt-Aake Lundval, The Globalizing Learning Economy. His latest co-authored book is Innovation and Economic Crisis. Lessons and Prospects from the Economic Downturn. He is now co-editing, with Andrea Filippetti, The Handbook of Global Science, Technology and Innovation (Wiley, 2015).

Carla Basili Carla Basili is Senior Researcher at the Cnr-Ircres (former Cnr-Ceris) Institute, responsible for the research line "Knowledge circulation and scientific information policies". Since 2009, is the scientific responsible of the research project Information Policies in Science: Knowledge Sharing and Transfer in Scholarly Disciplines. Her research interests focus on Scientific Information, Scientific Information Policies and Information Literacy. Selected authored books: La biblioteca in rete: strategie e servizi nella Società dell'Informazione (1998), La biblioteca virtuale: accesso a risorse informative in rete (1994) (with C. Pettenati). Selected edited books: Information literacy in Europe. A first insight into the state of the art of information literacy in the European Union (2003), Information Literacy at the crossroad of Education and Information Policies in Europe (2008), The Observatory on Information Literacy Policies and Research in Europe (2009), Sinergie invisibili. Ricerca e Informazione Scientifica nell'Economia della Conoscenza – Invisible synergies. Scientific Research and Information in the Knowledge Economy (2010), Information Policies in the Humanities (2014). http://www.ceris.cnr.it/Basili/

Massimiano Bucchi is Professor of Science and Technology in Society at the University of Trento, Italy and has been visiting professor in several academic and research institutions in Asia, Europe and North America. He has published several books (published in Italy, Brazil, Finland, China, Korea, UK and USA), including *Science in Society* (Routledge, London, 2004) and *Beyond Technocracy* (New York, Springer, 2009) and papers in journals such as *Nature*, *Science*, and *Public Understanding of Science*. He chairs the scientific committee of research center Observa Science in Society and has served as advisor and evaluator for several research and policy bodies, including the NSF, the Royal Society and the European Commission. He is a member of the

international scientific committee in Public Communication of Science and Technology for and has co-chaired the programme of the XIIth world conference of Public Communication of Science and Technology (2012).

Tommaso Castellani is Researcher at the IRPPS-CNR in the *Science Communication and Education Studies* Research Unit, where he mainly works on participatory methodologies in science-society relationship. Ph.D. in Physics, among his present research topics there are science-policy making interface, scientific citizenship, public engagement in scientific debate. He is at the moment project assistant for CNR of the FP7 project REPOPA on the relations between science and policy in health and Work Package leader of the FP7 project SciCafe 2.0 on the development of platforms forpublic participation indecisionsinvolvingscientific issues.He has been national coordinatorof three projects for the dissemination ofscientific culture of Italian Ministry of Education, University and Research.As a science communicator he wrote three books, he participated to TV programs and he organized many public events of public engagement in science.

Rossella Palomba is social demographer, former research director and CNR Associate. Her main fields of interest aregender mainstreaming in science policies, equal opportunities in labour market policies, gender equity and equal opportunities in scientific careers and gender indicators in science. Rossella was member of the ETAN Report working group, Italian EU Ambassador for equal opportunities in science, member of the Gender and Excellence EC experts' group and member of Gender and excellence in research fundingworking group of Directorate-General for Research, Science and Society.Rossellahas set the guidelines of the first edition of She Figures, and organised various conferences andmedia events on Gender and Science.She wrotemore than 190 articles, books and research reports on social policies and gender. She also conducted research studies for the Council of Europe mainly in the field of women participation in the labour market. In the field of gender in science, shewas co-author of *Science policies in the European Union, ETAN Report European Community*, European Commission- Research Directorate General, Luxembourg (2000); *She Figures*,EU, Luxembourg (2004); T*he Gender Challenge in Research funding*, EU Commission, Luxembourg (2009). Amongst others, she is author of *Figlie di Minerva*, Franco Angeli Milan (2000);*Minerva's Daughters – Filles de Minerve*, EU (2001); *Women in science*, Third European Report on Science & Technology, EU, Luxembourg, (2003),*Sognando parità*, Ponte alle grazie, Milan (2012).

Emanuela Reale is Senior Researcher at CNR CERIS-Institute for research on firm and growth. From 2004 she has beenPrincipal investigator or Coordinator in European and national projects on: higher education, governance, R&D funding and research evaluation, STI indicators. Actually she is WP leader in three FP7 projects: POCARIM-Mapping population, career and impact of advanced research degree graduates in SSH, RISIS-Research infrastructures for research and innovation policy study, and IMPACT-EV-Evaluating impact and outcome of European SSH research. She is Vice-President of the European Forum for Studies on Policies for Research and Innovation-EU-SPRI, Member of the CHER-Consortium of Higher Education Researchers Board, and Member of

the Executive Board of the ENID European STI Indicators Conference Series. She published and served as referee in international journals and book series.

Angela Taraborrelli (PhD in Philosophy) works with the Department the Human and Social Sciences - Cultural Heritage at the Italian National Research Council (DSU-CNR). She has been Adjunct Professor at the Department of Philosophy, Sapienza-University of Rome, Research Fellow at Institute ISPF-CNR, and Fulbright Researcher (Department of Philosophy, Princeton, US). The primary focus of her research lies on modern and contemporary moral and political philosophy. Author of several articles in refereed journals, she is often invited as key-note speaker in national and international Conferences. She is the editor of the Italian translation of Shaftesbury's *Characteristicks* (*Shaftesbury. Scritti morali e politici*, Utet 2007), and the author of two books: *Dal cittadino del mondo al mondo dei cittadini. Saggio su Kant* (Asterios, 2004), and *Il cosmopolitismo contemporaneo* (Laterza, 2011). An extended version of this latter book is to be published in English (Bloomsbury publishing, 2015).

Brian Trench, former head of the School of Communication at Dublin City University, is a member of Observa's international board and President of PCST (Public Communication of Science and Technology) network. He is co-editor (with M. Bucchi) of the *Routledge Handbook of Public Communication of Science and Technology* (2nd edition, 2014) and of *Critical Concepts in Sociology: Public Communication of Science* (Routledge, forthcoming, 2015) and has published extensively on science communication and science in society in several international journals.

Adriana Valente is a Research Director at the Italian National Research Council (CNR-IRPPS) in Rome, where she coordinates the Research Unit Studies of Science Communication and Education. She has been Contract Professor and Guest Professor of Sociology of Communication, Communication of Cultural Processes, Information and knowledge Management in several Universities. She is member of the School Commission of the National Academy of Science of Italy, and has been member of the Expert Groups "Social and Democratic Values" and "Universal Access" of the Information Society Forum. She is CNR-SCE responsible of the European projects "Research into Policy to enhance Physical Activity", "Scicafe2.0", "Representations of migration and implicit values in textbooks". With reference to studies of science education and communication she edited: *Sharing Science* (2011),*Science: Perception and Participation* (2009). http://www.irpps.cnr.it/it/chi-siamo/personale/adriana-valente

List of Acronyms

Alphabetic order

CERN, Conseil Européen pour la Recherche Nucléaire

CONACyT, National Council for Science and Technology (Mexico)

CRISP, China Research Institute of Science Popularisation

CSA, Coordination and Support Actions

EC, European Commission

ECSITE, European Network of Science Centres and Museums

ERA, European Research Area

ET, Education and Training

EU28, European Union 28 Member States

FP6, European Framework Programme VI

FP6/FP7, Sixth and seventh Framework Programmes for Research and Technological Development

FP6-SaS, 6th Framework Programme, Science and Society

FP7, European Framework Programme VII

FP7-SiS,7th Framework Programme, Science in Society

IBL, Inquiry based learning

IBSE, Inquiry based science education

IBSME,Inquiry based science and mathematics education

ICSU, International Council for Science

MASIS, Monitoring Policy and Research Activities on Science in Society

MML, Mobilisation and Mutual Learning

MOSTI, Ministry of Science, Technology and Innovation (Malaysia)

MST, Mathematics, science and technology

NCPs, National Contact Points

NGO, Non-Governmental Organization

NoS, Nature of science

OECD, Organisation for Economic Co-operation and Development

PCST, Public Communication of Science and Technology (international network for science communication)

PISA, Programme for International Student Assessment

PSN,National Science Centre (Malaysia)

R&I, Research and innovation

REDPOP Network for the Popularization of Science and Technology in Latin America and The Caribbean

RRI, Responsible Research and Innovation

RTD, Research and Technological Development

SaS, Science and Society

SCANZ, Science Communicators Association of New Zealand

SE, Science education

SiS Science in Society

SMC, Science Media Centre

SSH, Social Science and Humanities

STEM, Science, Technology, Engineering and Mathematics

STI, Science Technology and Innovation

STS, Science and Technology Studies

TIMMS, Trends in International Mathematics and Science Study

TPD, Teacher Professional Development

TUBITAK, The Scientific and Technological Research Council of Turkey

TWAS, The World Academy of Sciences

UNAM, National Autonomous University of Mexico

UNESCO United Nations Educational, Scientific and Cultural Organization

WFSJ, World Federation of Science Journalists