Interim evaluation & assessment of future options for Science in Society Actions

Assessment of future options

Final Report
Acknowledgements

The study team would like to express its gratitude to the large number of people who gave their time freely to contribute data, evidence and insight to this report. We are particularly grateful to the project Steering Group for their assistance throughout the study.
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1. Executive Summary

Aim and content
The assessment of future options for Science-in-Society (SiS) actions on the EU level, which is part of the study "Interim evaluation and assessment of future options for Science-in-Society Actions,” provides an impact assessment of different policy options that may be implemented in the future Horizon 2020 programme and provides evidence justifying a policy intervention on the EU level. The Impact Assessment takes into account on-going reflections on Responsible Research and Innovation (RRI) and the European Research Area (ERA).

Methodology
The impact assessment is based on a mixed-method approach, which combined a variety of quantitative and qualitative approaches. After an initial review of the relevant academic literature as well as documents produced in the SiS context, a Europe-wide public consultation survey was conducted. Through the self-selecting sampling technique a total number of 1,065 respondents and a wide range of actors, also many from outside the established circles of the SiS programme, could be reached. The results of the survey were validated in a public consultation workshop that was attended by 29 experts from various backgrounds, including academia, Civil Society Organizations, the public sector and public authorities. In order to assess the need for and impact of future policy actions, a second workshop was organized, which built on the combined knowledge and experience of 26 invited experts from those thematic fields which represent the future RRI keys, namely Ethics, Gender, Governance, Open Access, Public Engagement and Science Education.

Main Findings
The objective to promote excellent science, industry competitiveness and better society simultaneously, as formulated in Horizon 2020, is not only a challenge to European societies but has to be considered in a global context. There is a global debate about the need to create and implement new governance structures and processes in order to improve the performance and accountability of science and innovation systems. From a normative point of view there is strong consensus about the necessity of future policy actions that address the interrelationships between science, research and society.

Based on the Terms of Reference, three types of potential future policy options were differentiated:

- **Baseline option**: carry on along similar lines as under FP7
- **Policy off**: not doing anything at all, or continuing at a much reduced level
- **Doing something radically different**, for example hand over of the responsibilities to other DGs or public bodies at EU level

These three options were subdivided in different types of interventions that describe the specific arrangements of these policy options. The main types of intervention for the baseline option were: Implement a dedicated EU programme for research, coordination and support within H2020; embed good practices across H2020; coordinate and support Member States to implement suitable policies. Further policy instruments investigated in the course of this study were dissemination activities, regulation and the support for sustainable institutional structures. Beside the above described intervention types, the baseline option also meant that the managing responsibility remains with a dedicated SiS Unit within DG Research and Innovation and no other major actions alongside are intended.

The main finding of this impact assessment is that the policy off option, a discontinuation of SiS activities in the future, would carry the eminent risk of losing a lot of well-established structures and anchor points underpinning the respective themes. In concrete terms this might lead, for example, to a loss of public awareness for SiS issues, the discontinuation or at least weakening of the affected communities, a loss of “institutional ownership” and an overshadowing of the SiS topics by many other priorities. Overall, a significant reduction or even a ceasing of activities will cause primarily negative effects.
Second, neither the impact assessment nor the first part of this study, the interim evaluation conducted by Technopolis, delivered empirical evidence supporting the idea of a radical change, such as a purely decentralized approach with single SiS or RRI representatives across the different parts of Horizon 2020.

In contrary, all groups and experts involved in the course of the study agreed that the best-suited form of future policy option is the baseline one, which entails a dedicated funding programme within H2020 as well as embedding and coordination activities.

A crucial success factor for the implementation of the baseline option is a dedicated unit within DG RTD. The existence of a dedicated SiS programme managed by a dedicated policy unit is a precondition for the embedding of good practices within the other parts of Horizon 2020 and the coordination of Member States’ policies and actions.

However, due to the changed policy context, a pure continuation of the current arrangements does not seem to be appropriate either. There are several suggestions to be made concerning how to improve the efficiency and effectiveness of a European-level support for Science-in-Society activities at an instrumental level, for example through the extension of MMLs (Mobilisation and Mutual Learning Action Plans) and CPs (Collaborative Projects), through accompanying standard setting and regulatory activities and through a long-term-oriented support for the structures, platforms and networks established so far.

**Recommendations**

A dedicated programme should contain, as it does at the moment, different instruments like concrete funding possibilities, support for coordination activities and an embedding of the SiS topics across the entire Horizon 2020.

For all SiS topics analysed in detail (Ethics, Gender, Governance, Open Access, Public Engagement and Science Education) here there is a significant need to continue with the support for research funding projects in order to understand the requirements, mechanisms and impacts of an improved interplay between science, innovation and society. Particularly the aspect regarding how SiS topics can improve innovation outputs and outcomes is still underdeveloped, i.e. the positive contributions that a better integration of societal issues can make for the innovativeness and competitiveness of the European economy. More emphasis should also be placed in future on compiling and communicating evidence that Science-in-Society issues directly contribute to reaching the Horizon 2020 objectives, as for instance the involvement of broader actor groups may unleash the collective creativity of heterogeneous actors and thus contribute to innovation and competitiveness.

A continuation of coordination activities is needed too, for several reasons: First, coordination between Member States and between Member States and European policy-makers should be promoted for the sake of efficiency, as it is a precondition for avoiding overlaps, duplications and conflicts. Second, coordination is necessary to develop a common understanding of the policy issues at stake among the main actor groups and create a common way of thinking about problems, processes and ideas. Third, improved coordination facilitates mutual learning. It brings together different stakeholders and groups and can help to mobilise a wide range of actors. There are many “islands” of innovation in which good practice exist but without coordination it is impossible to learn from these islands and to apply their good practices in other areas and thus bridge the gaps between these islands. Coordination activities might also help to overcome the problem of diverging capacities of Member States in the SiS fields and to reduce regional disparities.

Science-in-Society topics strongly need structures, policy-makers and stakeholders who are fully aware of the need for a firm long-term orientation: The issues at stake are complex and still evolving. At this point in time it is still too early to expect a wide range of quantititative, measurable and tangible results. Therefore Science-in-Society needs to be approached with a decided long-term commitment and realistic expectations on what can be achieved in the short-, mid- and long term.
2. Aim and context of the study

2.1 The context: Horizon 2020 and the concept of RRI

The European Union has set out to achieve, an ambitious goal, endeavouring to become a genuine Innovation Union\(^1\), in which "research and innovation are key drivers of competitiveness, jobs, sustainable growth and social progress".\(^2\) To this end the Horizon 2020 strategy comes to the fore, revolving around the triad excellent science, competitive industry and a better society. Horizon 2020 is the financial instrument implementing the flagship initiative of creating the Innovation Union and it will create a new set of rules for innovation funding throughout Europe. It will run from 2014 to 2020. The proposed budget is approx. €80 billion. Horizon 2020 will combine all research and innovation funding currently provided through the Framework Programmes (FPs), the innovation-related activities of the Competitiveness and Innovation Framework Programme (CIP) and the European Institute of Innovation and Technology (EIT).

In the light of these rearrangements of European research funding, the Science-in-Society (SiS) programme faces certain challenges. The SiS programme has been evolving since the first debates in 2000 under the general heading of "Science, society and the citizen"\(^3\) with the aims of bringing research closer to society, using progress responsibly and stepping up dialogue. The shift from Science and Society in FP 6 to Science-in-Society in FP 7 points out the fact that the programme has gained significantly in conceptual terms in recent years.

In the European Commission proposals for Horizon 2020, the SiS programme disappeared as such but much of its focus continues within a cross-cutting approach called "Responsible Research and Innovation" (RRI). "Responsible research and innovation" (RRI) is a fairly new concept being debated primarily in the European and Anglo-American STI policy communities. In Europe, the European Commission is currently an important advocate of the concept within the European Research Area (ERA). RRI is part of a general approach in the governance of science and technology to increase the concordance of innovation impacts with societal demands and values.

Von Schomberg has recently presented a rather influential working definition for RRI\(^4\):  
"Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)."

The starting point of the recent debate is that Research and Innovation (R&I) in the ERA must respond to the needs and expectations of European society while respecting its values. In order to do this, all societal actors (researchers, citizens, policy makers, business, third sector organisations etc.) must work together during the whole R&I process. This co-creation aligning the R&I outcomes to the values, needs and expectations of European society is termed Responsible Research and Innovation (RRI).

Even though no broadly accepted understanding and scope of the term has evolved, the debates on RRI tend to focus on the following main aspects:\(^5\)

- A purposeful focus of research and innovation to achieve societal benefits,

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\(^1\) In the context of the EU growth strategy "Europe 2020", the EU aspires to become a smart, sustainable and inclusive economy. In this regard the Union has set itself five ambitious objectives (on employment, innovation, education, social inclusion and climate/energy) to be reached by 2020.

\(^2\) European Commission 2012: Science in Society (SiS) work programme.


• The comprehensive and meaningful involvement of all relevant societal stakeholders (including the public) throughout the complete innovation process with the aim to enhance the public good,
• Comprehensive (ex-ante) impact assessments,
• The development of flexible governance arrangements in order to better respond and adapt to changing circumstances and new knowledge.

The idea behind the concept of RRI is to boost European creativity and growth, i.e. making EU R&I processes evolve towards more inclusiveness and making all actors co-responsible for developing adequate solutions to European societal challenges.

Responsible Research and Innovation (RRI) is also the new label used by the Science-in-Society (SiS) group in DG Research & Innovation (R&I) to position its activities. The underlying idea is to bring together the experiences from different governance instruments shaping science and society relationships, and to integrate these into a comprehensive approach for stimulating research and innovation in the European Research Area (ERA).

The framework developed so far for RRI consists of six keys which resemble the most central aspects of the SiS programme: People and Civil Society Engagement, Gender Equality and Gender in R&I content, Science Education, Open Access to Science Information, Ethics Compliance and Governance Framework. The following impact assessment will therefore concentrate on these six keys.

2.2 Aim of the study

The assessment of future options for SiS actions on EU level, which is part two of the study "Interim evaluation and assessment of future options for Science-in-Society Actions", provides an assessment of potential impacts of SiS actions on EU-level, including a prospective analysis of different policy options that may be implemented in the future Horizon 2020 programme according to the specific guidelines for impact assessment. The leading questions of the study are:

• How to proceed with the SiS topics beyond FP7?
• What are the main issues and gaps in the relationship between science and society, their relevance and potential for action?
• Which should be the core issues and activities a future programme should concentrate on?
• What is the adequate level of resources and what are the appropriate tools to tackle these issues?
• How do the different policy options compare and how effective, efficient and coherent are they in achieving the objectives?
• What are the advantages and disadvantages of the different options?
• What does the SiS community consider to be possible paths?
• Which kind of (direct and indirect) impacts (scientific, economic, social) is associated with the different policy options?

To respond to these central issues the following main working steps and actions have been taken by the study team:

1. A public consultation process organised through a Europe-wide online survey, to identify the balance of opinion across the SiS communities but also other Civil Society Organisations on key issues like SiS challenges, policy objectives and policy options.

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6 See also Opening Speech by Commissioner Máire Geoghegan-Quinn "Science in Dialogue Conference – Towards a European Model for Responsible Research and Innovation" Opening session, 23 April 2012, Odense, Denmark
2. A validation workshop with stakeholders from the different SiS fields representing researchers, networks, CSOs, private sectors, public authorities etc. to validate the survey results and to elaborate appropriate future options for the SiS programme.

3. For the detailed assessment of the policy options, extensive desk research to assess the pros and cons, expected benefits and risks of the main policy options was undertaken.

4. A second workshop with representatives from the different fields, policy experts plus additional EU officials to evaluate future options was organised.

5. As a final step, several suggestions for suitable monitoring and evaluation arrangements were developed.

As a result, this final report of the assessment of future options for Science in Society actions sets out the principal findings, conclusions and recommendations.

2.3 Methodological approach

This part of the study is based on the following broad mix of different methods, whose combination was meant to maximize the strengths of each individual method while minimizing each method's weakness.

1. Extensive desk research, including a review of the relevant literature

The literature review was meant to provide a solid knowledge base and be as comprehensive and up-to-date as possible. However, it usually takes several years before research results have gone through the cycle of conference presentations, peer-review and finally appear in publications. Therefore, the literature review was complemented by two workshops with experts, who are currently working at the cutting edge of their respective disciplines. This way it was possible to find out what top researchers are working on today. Furthermore, the experts provided answers to the questions specifically concerned with SiS and its impacts – questions that may not have been explicitly addressed in the existing literature so far. But without the preliminary literature review it would not have been possible to identify these experts and to structure the workshops.

2. A Europe-wide survey, conducted from March to June 2012, based on the self-selecting sampling technique (n= 1065):

A Europe-wide public consultation survey based on the self-selecting sampling technique delivered substantial new evidence on questions regarding future options of the SiS programme. The decision to conduct such a large survey was based on a variety of reasons. First of all, social inclusiveness and broad public engagement represent major aims of SiS and the new RRI approach and should therefore also be considered within the methodological approach for this impact assessment. Second, workshops or focus groups are only feasible with a rather restricted number of participants where mainly the narrow community of scientists and science managers could have been involved, which may be the most vocal but certainly not the only group of stakeholders concerned. Third, through the self-selecting sampling technique it is possible to reach potentially hidden parts of a large and heterogeneous population, which is difficult to define at its margins. With the survey, so the intention, all concerned stakeholders across the entire EU 27 as well as across all thematic fields of SiS should be able to give feedback to the core question of the future of the SiS programme.

The approached networks and intermediaries of the self-selecting sampling method are shown in Figure 1.
The Delphi-style survey included various statements concerning future situations or outcomes in relation to the various SiS themes Ethics, Gender, Governance, Open Access, Public Engagement and Science Education and asked respondents to indicate their desirability, expected positive impacts, means of achievement, risks and timeframe for occurrence. In addition, the public consultation canvassed opinion on the most appropriate option in terms of mechanisms for advancing SiS/RRI objectives in the future.

**Characteristics of the respondents**

Ultimately, a total number of 1,065 respondents participated in the survey. In addition to the usual experts, which make up 59% of the respondents, 38% of the participants indicated that they only had "common knowledge" in the respective field, whereas the share of experts and non-experts differs according to the SiS topics (see Figure 2).

**Figure 1 - Approached networks and intermediaries**

![Approached networks and intermediaries](image)

Source: own illustration

Due to the particular sampling method and structure of the questionnaire, only 296 out of 1,056 gave information about their socio-demographic background. From those 296, about half come from...
universities, but also groups from the private sector, Civil Society Organisations and public authorities participated. The age and gender distribution is rather balanced, as shown in Annex II.

As shown in Figure 3, there appears to be a strong representation of the large Member States. With the exception of the Netherlands, which ranks very highly, this distribution appears to reflect the actual distribution of the number of inhabitants per country. Moreover, potential biases were largely addressed by means of triangulation and the validation workshops, as discussed further below. Moreover, this appears to be an acceptable price for reaching a population, which is a much broader and much more heterogeneous than would have been possible through a conventional survey limited to the usual expert communities.

Figure 3 - Country of residence of the respondents (n=291)

Source: own illustration

9 This figure does not include the entire sample as only 28% of the respondents provided information on their personal background.
3. Validation workshop (25th April 2012) with 29 invited experts

The survey was complemented in a qualitative way by a validation workshop, to which well-known experts from the different thematic communities were invited. The participants represented the science system as well as public bodies and the private sector in a rather balanced way. The workshop participants were presented with the results of the public consultation survey and asked to analyse and validate the findings, but also to identify future needs and suitable policy support for their fields. The workshop participants thus added much more in-depth, qualitative information than could be gained through the survey.

The experts confirmed that the survey results gave a good representation of the issues discussed in the various communities and largely agreed with the results.

4. Impact assessment workshop (22nd June 2012) with 26 invited experts

The impact assessment workshop was also designed to serve as a consensus building device, providing further qualitative information and supporting arguments by the expert community. Therefore again representatives from all different thematic fields as well as policy experts and EU officials were invited and grouped along Ethics, Gender, Governance, Public Engagement, Open Access and Science Education. Within the different thematic groups focussed, in-depth discussions dealing with the policy objectives, the different future policy options and appropriate interventions that the Commission could make under Horizon 2020 as well as the potential impacts and risks associated with each option took place.
3. Problem definition and rationale for EU action

3.1 Identifying the problem

During the past years, several studies have shown an increasing divergence between the EU citizen’s attitude and the goals defined by the EU for science and technology. The Special Eurobarometer report about “Science and Technology” published in 2010, for instance, confirmed this trend: Even though nearly 80% of Europeans express their interest in scientific discoveries and technological developments and have predominantly a positive view about the image of science and technology, they do not have a clear view about the current level of research investments made by the EU. Only 11% feel very well informed about scientific issues and almost 70% thinks that the public should be informed or even involved in decisions about science. Scientists should hence endeavour to communicate their work much better with the public to address society’s concerns with risks stemming from new technologies, the power that knowledge gives to scientists and human rights issues linked to science. Moreover, Europeans feel that governments should seek to encourage young people and women to be involved in scientific issues.10

On the other hand, scientists often feel misunderstood and bewildered by the way their findings are portrayed in the media, perceived by the general public and treated by policy-makers. Scientists often feel particularly frustrated when consumers reject new technologies or research findings or when their implementation is constrained by policy-makers. This shows that communication is troubled in both ways, from scientists to the society and vice-versa.

Thus there is a strong need to motivate European citizens to become more engaged in science and to strengthen the relationship between science and society.11

The FP7 Science-in-Society programme, which has also played a major role in the implementation of the European Research Area, the Ljubljana process and the Lisbon strategy though the development of structural links and interactions between scientists, policy-makers and society, is addressing precisely these issues:12

• Insufficient public participation in priority-setting and in establishing science policy directions, which would allow a wider debate on possible associated risks and consequences;
• Growing reservations with regard to certain scientific developments, the feeling of lack of control, and open questions concerning the respect of fundamental values;
• The perceived isolation of the world of science from the everyday realities of economic and social life; questioning the objectivity of scientific evidence made available to public policy-making;
• Insufficient quality of scientific information available to the public.13

Without an ambitious research and innovation agenda, the objective of transforming Europe into the most competitive knowledge-based region in the world is unlikely to be achieved. Effective investments in research, development and innovation are important driving forces14 to strengthen Europe's competitiveness, social inclusion and scientific excellence. The 2020 Vision for the European Research Area (ERA) adopted in 2008 underlines that the ERA "is firmly rooted in society and responsive to its needs and ambitions in pursuit of sustainable development", confirming the orientation of the Science-in-Society work programme. Without the support of the wider public, however, such an agenda cannot be implemented.

The Science-in-Society (SIS) programme thus ties in with the aim to contribute to the implementation of the European Research Area and to help build a democratic knowledge-based society by addressing societal engagement from different thematic perspectives:

- Promoting an adherence to ethical standards (Ethics),
- Achieving greater gender equality in science (Gender),
- Shaping dynamic and responsible governance structures of the research system and science-society relations (Governance),
- Developing better ways for disseminating and accessing research results (Open Access)
- Encouraging dialogue between scientists and the public (Public Engagement),
- Supporting new methods to interest young people in STEM (Science, Technology, Engineering and Mathematics) careers (Science Education)

By taking a closer look at the relationship between science and society from these thematic perspectives, the following gaps can be revealed, based on the annual work programmes of SiS. These main challenges should be the core of future actions:

Figure 4 - Main challenges for future SiS actions

<table>
<thead>
<tr>
<th>Thematic field</th>
<th>Main Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethics</td>
<td>The public often mistrusts widely accepted research findings, and has no way to scrutinize or participate in science (especially when new technologies, scientific directions or research techniques threaten cultural, environmental, social or ethical values). Ethical issues often do not play the critical role in science and research that they should play.</td>
</tr>
<tr>
<td>Gender</td>
<td>Continued male-bias at senior levels of business and politics across the EU. Female talent, skills and potential continue to be wasted (c.f. 'leaky pipeline'). Feminine perspectives in innovation continue to be under-represented.</td>
</tr>
<tr>
<td>Governance</td>
<td>Values and principles of preventing harm and improving the lives of EU citizens are not sufficiently embedded. Research systems are not managed as effectively as they could and should be.</td>
</tr>
<tr>
<td>Open Access</td>
<td>Publicly funded research is neither free nor easy to access by all societal actors. Challenges remain in developing models for the assessment and dissemination of high-quality scientific research. Researchers need to be aware of options, coordination improved and questions of costs tackled.</td>
</tr>
<tr>
<td>Public Engagement</td>
<td>There is insufficient involvement of public, policy and industrial actors in the prioritization, design, execution and exploitation of scientific research. Eurobarometer 2010 shows that people see a need for greater public consultation.</td>
</tr>
<tr>
<td>Science Education</td>
<td>Europe needs more researchers and innovators to boost its economy. Modern debates require people to be better informed about science issues. Traditional (i.e. textbook-based) science education teaching methods are proving inadequate.</td>
</tr>
</tbody>
</table>

3.2 The rationales for EU-level intervention

There are a number of reasons why policy actions should be taken at the EU-level rather than the national or regional level.

First, many actions can only be achieved at the European level as in many areas national R&D programmes are individually not able to reach a "critical mass". Often this can only be achieved collectively at the European level. A good example for clarification is the case of the GSM technology in the 1980s. While many individual countries struggled to develop and launch their own mobile telecom systems, the technology only became a great technological and commercial success once the Member States started collaborating at the EU level. Economies of scale and network effects were so strong that deployment of this technology was only viable at the European level.\(^{17}\)

Second, the issue of externalities has to be mentioned. It might be that policy actions by one Member State might have negative externalities on another. If any one given country would significantly reduce ethical standards for a certain type of research, for instance, other countries might lose researchers to this country. If the countries losing out would respond by lowering their standards, a race to the bottom might be triggered. Coordinated EU-level actions could prevent the emergence of such vicious circles. Similarly, there are positive externality problems that can only be solved at the European level. Investments in knowledge, for instance, have a strong positive externality. Knowledge and skills can hardly be contained within borders. As countries may not feel all benefits from their investments they are unlikely to invest as much as to maximize these benefits. This is a classic public good problem. Likewise, single countries might be tempted to simply stop funding research and try to free ride on the knowledge and skills base created by their neighbours. Because of the public good nature of knowledge, Stiglitz, for instance, explicitly calls for supranational policy action.\(^{18}\)

Another factor justifying EU level action is that policy learning by means of information sharing is sub-optimal at the purely national level. Based on the principle of subsidiarity, EU level actions thus seem justified as many policy actions such as coordination, harmonization, information sharing, and regulation, where necessary, would be more difficult to carry out at a lower level of governance. To enable cross-border policy learning there needs to be a central actor to make information available, share it among the Member States and to orchestrate the flow of information.\(^{19}\)

As shown in the following Figure 5, the majority of the survey respondents also support an EU level intervention and are clearly in favour of a shared responsibility between the EU and the national level, which explicitly legitimates the treatment of SiS topics on EU level\(^{20}\). The second most frequently chosen option was to focus policy action exclusively at the European level. The shared responsibility, but also the particular valued added through mainly European activities was strongly supported by the two expert workshops.


\(^{19}\) Rahel Falk, Werner Hölzl, Hannes Leo. (2007) TITEL fehlt!! Working Papers Österreichisches Institut für Wirtschaftsforschung, No. 299

\(^{20}\) The detailed analysis of the appropriate level of intervention for the different SiS topics and the challenges at stake can be found in Annex I-II, 3.
Figure 5 - Preferred political level by the respondents

Source: own illustration
4. Policy objectives

In order to tackle the problems identified above, it is important to clarify the objectives of action in the field of Science-in-Society. Within the following set of objectives, which have been identified by desk research and further evolved during the public consultation process, three different levels of objectives can be distinguished: general, specific and finally operational objectives.

In order to achieve the **general objective**, which refers to the **creation of a democratic, competitive and inclusive knowledge-based society by stimulating a harmonious integration of scientific and technological endeavour in Europe**\(^{21}\), the following specific objectives can be deduced from the main challenges within the thematic areas (see Figure 6):\(^{22}\)

**Figure 6 – Specific objectives**

<table>
<thead>
<tr>
<th>Thematic field</th>
<th>Specific Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethics</td>
<td>Develop and uphold the highest standards of ethics and scientific integrity</td>
</tr>
<tr>
<td></td>
<td>Achieve more trust in science, research and innovation throughout society</td>
</tr>
<tr>
<td>Gender</td>
<td>Achievement of gender equality at all career levels and throughout Europe</td>
</tr>
<tr>
<td></td>
<td>Integration of the gender dimension within research and innovation activities and outputs</td>
</tr>
<tr>
<td>Governance</td>
<td>Development of harmonious models for responsible research and innovation</td>
</tr>
<tr>
<td></td>
<td>Foster responsible research and innovation at all levels throughout Europe</td>
</tr>
<tr>
<td>Open Access</td>
<td>Expand open access publishing for publicly-funded research</td>
</tr>
<tr>
<td></td>
<td>Develop appropriate checks, balances and incentives that assure quality</td>
</tr>
<tr>
<td></td>
<td>Development of funding models for Open Access</td>
</tr>
<tr>
<td>Public Engagement</td>
<td>Engage all societal actors in a mutual understanding of scientific issues and challenges</td>
</tr>
<tr>
<td></td>
<td>Help CSOs to become more involved in scientific research</td>
</tr>
<tr>
<td></td>
<td>Mobilise and network different groups of actors for mutual learning</td>
</tr>
<tr>
<td>Science Education</td>
<td>Educate and interest pupils in STEM subjects using the latest, most innovative tools</td>
</tr>
<tr>
<td></td>
<td>Improve science and mathematics education through teacher training</td>
</tr>
<tr>
<td></td>
<td>Guide curricula to recognise / reward creativity and divergent thinking</td>
</tr>
<tr>
<td></td>
<td>Improve linkages between science education, skills and careers</td>
</tr>
</tbody>
</table>

Source: own compilation

To reach the specific objectives above, several operational objectives have been identified through the public consultation phase of this study: For each statement developed for the public consultation questionnaire, the respondents were asked to assess the desirability of possible future activities depending on the respective thematic area. For the definition of the operational objectives, those statements were included which received more than 50 % agreement by the respondents. Partially, statements with similar contents have been summarised. The results have been validated by well-known field experts at the validation workshop in April 2012. In this regard the objectives highlight core issues and activities a future programme should concentrate on.


Figure 7 – Operational objectives

<table>
<thead>
<tr>
<th>Thematic field</th>
<th>Operational Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethics</td>
<td>Increase the provisions in publicly funded research projects to conduct ethically sound science.</td>
</tr>
<tr>
<td></td>
<td>Implement an EU Ethics Framework for responsible research and innovation, based on fundamental ethical principles and European values in coordination with relevant international organisations.</td>
</tr>
<tr>
<td></td>
<td>Increase awareness of ethical issues among EU researchers and companies by embedding Ethical, Legal and Social Aspects (ELSA) as compulsory requirement in research and development (e.g. product development).</td>
</tr>
<tr>
<td>Gender</td>
<td>Create transparent recruitment processes for jobs in science, in which merit is assessed and selection process functions by giving all members of project assessment panels training to raise their awareness of possible gender bias.</td>
</tr>
<tr>
<td></td>
<td>Offer alternative career paths in research.</td>
</tr>
<tr>
<td></td>
<td>Provide all universities and research organisations in Europe with gender action plans in order to recruit and retain more women for science.</td>
</tr>
<tr>
<td></td>
<td>Make the early integration of gender aspects in research part of the project selection process and common standard at EU and MS level to increase innovative approaches and improved quality of methods and outcomes.</td>
</tr>
<tr>
<td></td>
<td>Support the development of research-related standards by regulatory organisations (establishing criteria for integration of sex/gender analysis in research).</td>
</tr>
<tr>
<td>Governance</td>
<td>Improve policy coordination across all levels as well as the management of research institutions.</td>
</tr>
<tr>
<td></td>
<td>Encourage universities to strengthen knowledge exchange with the society.</td>
</tr>
<tr>
<td></td>
<td>Consider scientific advice and expertise in policy-making processes in a transparent and inclusive way to strengthen the European science system.</td>
</tr>
<tr>
<td></td>
<td>Adopt common guidelines including the formulation of good practices regarding the dimensions of SiS in the ERA ensuring responsible research and innovation.</td>
</tr>
<tr>
<td></td>
<td>Integrate SiS aspects into the selection process of funding programmes of the EC (and not separated from technology development programmes).</td>
</tr>
<tr>
<td>Open Access</td>
<td>Increase awareness of the importance of Open Access among researchers.</td>
</tr>
<tr>
<td></td>
<td>Increase the availability of research data and publications of publicly funded research in Europe via Open Access.</td>
</tr>
<tr>
<td></td>
<td>Strengthen the use of creative common licenses or similar mechanisms.</td>
</tr>
<tr>
<td></td>
<td>Support the access of all existing repositories via a unified interoperable European search portal (prerequisites are unified meta-data and document standards).</td>
</tr>
<tr>
<td></td>
<td>Increase competencies of the general public for science and technology appraisal (understanding political/ power and ethical, environmental, legal and soci(et)al aspects).</td>
</tr>
<tr>
<td>Public Engagement</td>
<td>Increase the involvement of stakeholders (not only sciences-related communities, but also the general public, NGOs, industry, etc.) in the development of research priorities, including broadly based consensus-building processes.</td>
</tr>
<tr>
<td></td>
<td>Promote and consolidate social platforms to broaden the scientific interest of the civil society and to increase input for the development of responsible strategic research agendas.</td>
</tr>
<tr>
<td></td>
<td>Support the publication of the results of every publicly funded research project in a citizen-oriented way.</td>
</tr>
<tr>
<td>Thematic field</td>
<td>Operational Objectives</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>Promote the integration of social perceptions, political and cultural frameworks, economic circumstances and ethical compatibility as a key concept in R&amp;D processes</td>
</tr>
<tr>
<td>Science Education</td>
<td>Support and strengthen international co-operation and exchange in science education research to improve science teaching practice.</td>
</tr>
<tr>
<td></td>
<td>Increase government actions (e.g. National Action Plans) and implement systemic reforms that support science education practices sensitive to students’ gender, ethnic, culture and social class variations.</td>
</tr>
<tr>
<td></td>
<td>Identify the most successful IBSE projects and networks and build on / strengthen these (i.e. concentration of effort).</td>
</tr>
<tr>
<td></td>
<td>Develop and promote a more diverse range of pedagogical approaches and other types of science activities like science centres, science museums or classroom projects (i.e. diversifying efforts).</td>
</tr>
<tr>
<td></td>
<td>Increase the use of new media and social networks to promote a positive image of working in science.</td>
</tr>
<tr>
<td></td>
<td>Encourage the offer of partnerships between industry, schools, and research organisations to bridge the gap between science education and science careers</td>
</tr>
</tbody>
</table>

Source: own compilation
5. Policy options

Based on the Terms of Reference\(^{23}\), the study team developed an analytical distinction between three types of potential future policy options, which are subdivided into different types of interventions that describe the specific arrangements of these policy options. The "options" refer to mutually exclusive action alternatives whereas "intervention types" means different degrees and levels of actions and are mainly deducted from the current SiS programme structure and instruments.

The **three main policy options** that underwent the detailed impact assessment are:

- Baseline option: carry on along similar lines as under FP7, with a hybrid programme containing dedicated funding for research, coordination and support, embedding approach and coordination and support to Member States' policies
- Policy off: not doing anything at all, or continuing at a much reduced level
- Doing something radically different (increase the intensity, nature or scale of the intervention)

In the following these three identified future options will be described in detail, with the possible form of intervention within the respective option. Where a specific option is seen as warranted and useful, the subsequent aim is to establish what form the option should take, its ideal scale, the activities involved etc. Having established what the option would look like, the costs and benefits of this option are described and compared to the costs and benefits of the other two options (see chapter 5).

The following Figure 8 illustrates the main characteristics of the baseline option for those SiS topics which are also mentioned under the new RRI umbrella, based on the current FP7 arrangements\(^{24}\).

The **main types of intervention** for the baseline option are:

- Implement a dedicated EU programme for research, coordination and support within H2020;
- Embed good practices across H2020;
- Coordinate and support Member States to implement suitable policies;

Beside the above-described intervention elements, the baseline option also means that the managing responsibility remains with a dedicated SiS Unit within DG Research and Innovation and no other major actions alongside are intended.


\(^{24}\) This information was also used as input for the impact assessment workshop, as the basis for the more detailed assessment and comparison of action alternative
### Figure 8 - Main characteristics of the baseline option

<table>
<thead>
<tr>
<th>RRI Key</th>
<th>Dedicated budget for research, coordination and support</th>
<th>Embedding good practice across the FP</th>
<th>Coordinating Member States' policies and actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethics</strong></td>
<td>• Budget remains around €5m per year (some 12% of total for SiS)</td>
<td>• Ethical requirements imposed on projects</td>
<td>• Some high-level coordination and capacity-building actions through the 'European Research Ethics Committees' Network</td>
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<td></td>
<td>• Coordination and support actions focusing on ethics within particular topics (e.g. human enhancement; telecare technologies; emerging ICTs...)</td>
<td></td>
<td>• Further collection of detailed information via the 'European Ethics Documentation Centre' (ETHICSWEB)</td>
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<td></td>
<td>• Public opinion surveys and some awareness-raising activities</td>
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<td></td>
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<tr>
<td></td>
<td>• Some crosscutting work on 'ethical governance' within particular fields</td>
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<tr>
<td><strong>Gender</strong></td>
<td>• Budget remains around €4m per year (some 10% of total for SiS)</td>
<td>• 'Gender mainstreaming’ – targets for gender balance</td>
<td>• Benchmarking progress on gender equality throughout Europe</td>
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<tr>
<td></td>
<td>• Multiple projects addressing gender balance in research</td>
<td>• Projects required to develop 'Gender Action Plans'</td>
<td>• Steady structural change to research bodies – ‘mainstreaming gender’</td>
</tr>
<tr>
<td></td>
<td>• Support for the 'European Platform for Women Scientists' (EPWS)</td>
<td>• Projects required to report on gender balance within consortia</td>
<td>• Continuation of the EOWIN project (ERA-NET)</td>
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<tr>
<td></td>
<td>• EU-wide statistics to monitor progress ('SHE Figures')</td>
<td></td>
<td>• Support to Helsinki Group on Women in Science</td>
</tr>
<tr>
<td><strong>Governance</strong></td>
<td>• Budget remains around €10m per year (some 25% of total for SiS)</td>
<td>• Efforts to embed and monitor compliance with good SiS practices (e.g. Gender Action Plans, Open Access publishing, Ethics reviews, etc.)</td>
<td>• Implementing EU-wide codes and legislation, such as</td>
</tr>
<tr>
<td></td>
<td>• Governance frameworks and best practices developed in various scientific fields and disciplines (particularly nanosciences and healthcare)</td>
<td></td>
<td>– 'European Code of Conduct for Nanosciences and Nanotechnologies’</td>
</tr>
<tr>
<td></td>
<td>• Empowerment of environmental or cultural CSOs, NGOs and other stakeholders</td>
<td></td>
<td>– 'European Research Agenda for Disability Equality'</td>
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<tr>
<td></td>
<td>• Some crosscutting topics also relate to the governance of gender, ethics and science communication</td>
<td></td>
<td>• Further work on coordinating the various National Contact Points</td>
</tr>
<tr>
<td>RRI Key</td>
<td>Dedicated budget for research, coordination and support</td>
<td>Embedding good practice across the FP</td>
<td>Coordinating Member States' policies and actions</td>
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</tbody>
</table>
| Open Access      | • Budget remains small at around €1m per year (2.5% of SiS total)  
                  • Coordination and support actions  
                  • National and regional data archives are supported and set up and the overall vision and principle of Open Access is disseminated | • All projects are asked to seek to publish results open access  
                  • Monitoring activities to establish the extent to which this is happening | • International networks developed for coordinated access to published material on specific health research topics – ‘NECOBELAC’ and ‘EUROCANCERCOMS’ |
| Public Engagement| • Budget remains around €7m per year (some 18% of total for SiS)  
                  • Mainly coordination and support actions for public and CSO engagement  
                  • Build and empower diverse networks (and ‘deliberative platforms’) at various levels to communicate, debate and discuss science  
                  • Use of MML Action Plans to engage and involve wider groups of actors  
                  • Some training activities on communication for scientists and journalists  
                  • Some crosscutting work also taking place on ethics and governance | • All funded projects to report on public engagement and science communication (dissemination) activity via reporting questionnaire  
                  • Introduction and promotion of the BSG-CSO funding scheme (Research for the Benefit of Specific Groups – CSOs). This scheme can be made available in specific calls for proposals and proposes to conduct joint projects which encompass both research itself and dialogue on the societal relevance and impact of the project | Some initiatives are paving the way for future coordinated targeted actions:  
                  – MASIS monitoring/ mapping of SiS activities in Europe (including public engagement)  
                  – MMLs |
| Science Education| • Budget remains around €12m per year (some 33% of total for SiS)  
                  • Support and focus on developing and implementing IBSME materials  
                  • Teacher-training being directly ‘multiplied’ across Europe  
                  • Two big annual events – EUCYS and Lindau Nobel Laureates Meeting  
                  • Some crosscutting themes also look at gender or communication issues | • Disseminating to researchers, policymakers and industry through an MML and bodies like the ECB  
                  • Monitoring questionnaire covers research training carried out within projects | • No major actions to coordinate or support MS policies and practice  
                  • Only incremental changes to curricula and educational policies |
In case of the "policy off – option", no further EU-level work and expenditure in the respective thematic fields would be done. This means

- No dedicated budget in H2020,
- No requirement to address the thematic issues in H2020 actions,
- No support for coordination or regulation of MS activities on these issues,
- No assignment of responsibility to other DGs or H2020 programmes and
- No other ad-hoc actions.

Obviously the option "doing something radically different" cannot be elaborated at the basis of the current arrangements, but derives from some of our own considerations within the study team. In principal, it would be possible to implement the following forms of intervention within this option:

1. Handing over of the responsibilities to other DGs or public bodies at the European level
2. Pure decentralised approach: horizontal integration of the topics across all parts of Horizon 2020 with official representatives for gender, ethics etc.
3. Mainly rule-setting activities, such as the formulation of formal requirements for the integration of the different SiS aspects, for instance the introduction of quotas to achieve more gender equality

Figure 9 summarizes the main advantages and disadvantages associated with the three policy options on a general level. The topic-specific pros and cons connected with the different policy options and the specific intervention types within these options are discussed in chapter 5 in more detail.
Figure 9 - General advantages and disadvantages of the different policy interventions

<table>
<thead>
<tr>
<th>Policy Option</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline option</strong></td>
<td>• Continuation of successful work in the past</td>
<td>• Organisational inertia</td>
</tr>
<tr>
<td></td>
<td>• Building on experiences and lessons learned</td>
<td>• Difficulties for newcomers to enter the established networks</td>
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<td></td>
<td>• Support of sustainable structures (like expert groups)</td>
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<td></td>
<td>• Stabilisation of the programme, in particular improvements within the</td>
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</tr>
<tr>
<td></td>
<td>thematic fields</td>
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</tr>
<tr>
<td></td>
<td>• Continuity for the affected communities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• High public awareness about the overall importance of the SiS topics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Broader reach and stronger impact across the whole innovation system</td>
<td></td>
</tr>
<tr>
<td>**No EU level</td>
<td>• Saving resources (e.g. money, personnel resources)</td>
<td>• Loss of the EU-level momentum already gained</td>
</tr>
<tr>
<td>activity**</td>
<td>• More funding available for alternative purposes within Horizon 2020</td>
<td>• SiS issues will disappear from the agenda</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Loss of continuity and visibility through the lack of engaged main actors</td>
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<tr>
<td></td>
<td></td>
<td>• H2020 objectives will be compromised and may not be achieved</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Loss of EU economic competitiveness through a shortage of skills in key areas</td>
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<tr>
<td></td>
<td></td>
<td>– Increasing gap between EU and other world regions in supply of STEM graduates for KET / ICT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Decrease of scientific excellence through a lack of diversity of thoughts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Existing communities and established networks will be weakened</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Disintegration of the existing platforms, networks and initiatives</td>
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<td></td>
<td></td>
<td>• Loss of coordination of Member States’ policies, which is bound to lead to policy conflicts,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>duplications and other inefficiencies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Loss of existing knowledge base on good practices related to the RRI keys</td>
</tr>
<tr>
<td>Policy Option</td>
<td>Advantage</td>
<td>Disadvantage</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>Doing something radically different</strong></td>
<td></td>
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</tr>
</tbody>
</table>
| 1. Hand over of the responsibilities to other DGs or public bodies at EU level | • Involvement of further experts/expert groups  
 • Access to manifold and complementary expertise  
 • Spread of SiS topics to the whole society/ economy | • Specific SiS challenges cannot be addressed in a coordinated way as they are different within the science and innovation system than those in other societal fields  
 • Lacking appropriateness and as a consequence acceptance of policy interventions |
| 2. Pure decentralised approach: horizontal integration of the topics across all parts of Horizon 2020 | • Increased awareness about the overall importance of the SiS topics  
 • Wider reach and stronger impact across the whole Horizon 2020 | • Loss of visibility of the topics  
 • Strategies of the relevant (science) actors to ignore the requirements  
 • Communities are weakened  
 • Less sustainability through the lack of engaged main players  
 • Crowding out by other agendas  
 • Overshadowing by other priorities |
| 3. Rule-setting activities, like the formulation of formal requirements for the integration of the different SiS aspects | • Reduced / missing possibility of the relevant (science) actors to ignore the requirements  
 • Easing learning-effects also within reluctant target groups  
 • Increased awareness about the overall importance of the SiS topics  
 • Wider reach and stronger impact across the whole Horizon 2020 | • Lack of acceptance  
 • Bureaucratic overload  
 • Deterring top-researchers |
The considerations shown in Figure 9 suggest that the baseline option assures the widest benefits and is associated with only few disadvantages whereas the other two options – policy off as well as doing something radically different – evoke much more disadvantages than advantages. The interim evaluation study concluded too that there are good reasons for continuing the strong commitment to SiS at the European level, comprising an enhanced multi-layered approach, which includes

- A clearly identifiable vertical SiS programme, with a dedicated budget for SiS research (at least along similar lines to FP7),
- Continued and increased efforts to encourage the embedding of SiS issues through better obligations and rewards, and
- Efforts to embed SiS research as a horizontal activity within other thematic areas.26

Additionally, the survey respondents as well as the workshop participants supported the idea of carrying on with the baseline option. Within the baseline option, however, there are different policy intervention types possible and also a combination of them, as mentioned at the beginning of this chapter.

5.1 The intervention types within the baseline option

Based on the public consultation process and both expert workshops, a dedicated funding programme is the most preferred intervention type within the baseline option, followed by activities promoting the embedding of the RRI keys into the whole Horizon 2020 framework and the coordination of Member States’ policies and actions (see Figure 10). Most workshop participants actually supported a combination of a research funding programme as well as the embedding and coordination options.

Figure 10 - Relative importance of the different intervention types within the baseline option according to expertise (n=295) 26

Source: own illustration

26 The requested items "Don’t know/Not specified" are not shown in these figures.
People who assess themselves as possessing "expert knowledge" much more frequently choose the option of a "dedicated programme" than people with "common knowledge" (39 % versus 25 %) whereas respondents with "common knowledge" more often mentioned the option "coordination of national and community policies and actions" than respondents with "expert knowledge" (26 % versus 9 %).

As regards the policy intervention types within the baseline option, several differences can be found between the thematic fields (see Figure 11): The respondents from Science Education, Public Engagement and Gender are most clearly in favour of a dedicated research funding programme whereas the respondents from Ethics and Governance rather frequently opt for an embedding approach. Additionally, many respondents from Gender and Science Education consider the coordination of Member States policies and actions as significant means to gain improvements within their fields.

Figure 11 - Preferred intervention type within the baseline option according to the thematic field

For an effective and efficient implementation of the baseline option under Horizon 2020, however, additional requirements regarding the use of particular policy instruments and support mechanism are crucial:

5.2 Appropriate policy instruments

From an analytical point of view there are also other important factors influencing a suitable policy mix apart from the policy options and intervention types. Based on typologies developed within political science, we differentiated four main types of policy instruments that were used for the survey as well as the discussion during the validation workshop: concrete research funding, regulation, dissemination and support for sustainable institutional structures.

27 Please note that multiple answers were possible in most of the categories, for which reason the results cannot be added up to 100 %.
Figure 12 shows that the survey respondents assessed the different instruments rather equally with an average around 30%. There are, however, at least two "outliers": in particular, the respondents from Gender (49%) and Open Access (43%) see a high demand for the implementation of regulatory activities as concrete measures, and the respondents from the Public Engagement field support above-average dissemination activities. This is fully consistent with the results of the validation workshop where the regulation group was clearly dominated by Gender experts.

Besides this, most respondents are clearly in favour of a research-funding programme enabling the communities to investigate in more detail the complex science-in-society relationships.

5.3 Accompanying success factors

Regarding the critical success factors that go beyond merely political actions but are also essential to gain improvements within the thematic fields, the respondents voted relatively concordantly for the interconnectedness of major stakeholders as the most important success factor. This result can be easily explained by the increased number of both public and private stakeholders involved in Science-in-Society issues and the diversity of their interests, which has challenged the role of Science-in-Society. Given the fact that more stakeholders (e.g. Civil Society Organisations), and existing stakeholders in new roles are involved, the importance for cooperation and networking is raised, as well as the importance to increase the transparency of stakeholders. There is thus a strengthened demand for a multi-stakeholder approach, which means the necessity of bringing all different stakeholders together to share experiences and learn from each other.

Source: own illustration

One recently implemented instrument in this regard are the MMLs, the Mobilisation and Mutual Learning Action Plans, which aim to "create mechanisms to address societal challenges where science and technology are involved, bring together a wide range of actors, pool partners' knowledge and experience and develop mutual understanding and joint solutions." They thus aspire to bring research actors together with a much wider community than they would ordinarily associate with, including members of Civil Society Organisations (CSOs), policymakers, the public and various other media and business actors connected to the particular societal challenge being addressed.

5.4 Appropriate institutional structures

The current arrangements include a dedicated own unit within DG RTD responsible for the programme. Within the course of this impact assessment, particularly the second workshop, where the invited experts assessed the pros and cons of the different policy options and intervention types, they strongly emphasised that appropriate governance structures are a crucial prerequisite for the full implementation of the RRI concept. The advantages of having clear institutional responsibilities are manifold and can be summarised as follows: A dedicated unit and therefore a clear institutional ownership assures a long-term commitment as well as a high sensibility and willingness to further support the SiS topics. This eases the continuation of success activities in the past and an increased effectiveness and coherence of SiS actions. Centralised competencies and oversight are also expected to provide more efficient and effective planning and implementation of EU efforts and avoid duplication of efforts. As a central anchor point they may also improve policy learning.

Potential tasks of such a dedicated and specialised unit should include:

- Ensure visibility and promotion for RRI
- Project management activities (e.g. organisation of the research funding process, organisation of coordination and support actions)

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• Raising awareness and willingness across the different directorates, at all levels, to support and take up the new RRI arrangements – particularly in areas that are furthest behind (probably some of the more technical fields)
• Encourage buy-in from different units and directorates as to the need for and importance of RRI, ensuring high-level support for the process
• Providing the necessary tools and approaches to include RRI at each step in the process (e.g. assessing the risks and making strategic choices from a societal perspective, applying good governance in research, etc.)
• Create a short written list of principles and / or generic rules for responsible science, that can be used by different programmes, and that project applicants can address during the proposal process
• Provide or coordinate in-house capacity and training in RRI issues (both practical training and 'training the mind') – as has already begun with training on ethics and open access
• Monitoring progress and activity
• Feeding into and encouraging a process of continuous revision, improvement and (policy) learning
• Monitoring and coordinating Member States' activities

Without a clear institutional and organisational responsibility, which means a dedicated unit within DG Research and Innovation paying attention to these issues, there is a certain risk that the influence and impact of the SiS topics will decrease. Even though there are societal goals set out within high-level treaties, research strategies do not properly reflect these goals. As each part of Horizon 2020 will build its own work programme using inputs from expert groups, and reflecting thematic strategies, Responsible Research and Innovation issues should likewise be an important consideration in this process. Research should be 'responsible by design' and thus account for societal risks, benefits and impacts right at the beginning. To achieve improvement, there needs to be a top down prioritisation and encouragement given for good governance, as well as provided support to integrate these priorities within the programme and at project level.

In sum, a dedicated unit for SiS/RRI issues within DG RTD can help to set the basic rules, supporting adherence as well as monitoring progress. But as a precondition, the different parts of the Commission should take responsibility for implementing the embedding activity and for making the choices about how the SiS topics should be applied in the respective areas. This should be based on what is the most appropriate approach, and on the extent to which different elements of RRI are relevant and important. A ‘one size fits all’ approach will be sub-optimal in this regard.
6. Analysing the impacts

6.1 Introductory remarks

Due to the complexity of the relationships between the various aspects of the SiS programme and its declared objectives, linear cause-and-effect relationships are difficult to make, as there are too many intervening variables that are hard to control\(^{31}\).

This is not to say, however, that these effects do not exist. The measurement problem is exacerbated by the fact that many of the potential impacts will only occur and become visible in the long run. In Science Education, for instance, a new curriculum would first have to be implemented, which in itself takes time, and then a whole cohort of students needs to be exposed to this new curriculum and leave school, which can take between one and 11 years, before first effects become visible. Until then, however, a whole array of unforeseen and uncontrollable events can influence the intended impacts. Moreover, many impacts are likely to go beyond the intended effects and others may be unintended. While these effects are difficult to identify, any impact assessment that ignores these would be incomplete. Based on these premises, the methodological design of this impact assessment foresaw a Europe-wide public consultation survey complemented by two expert workshops as the core instruments to deliver the respective evidence for future benefits and risks\(^{32}\).

The relevance of the SiS topics "as such" is uncontested, as numerous studies have shown and also the survey respondents have emphasised. However, it is hardly possible to indicate or even quantify a concrete influence of EU level intervention, since, as already mentioned above, (1) there are too many intervening variables like the frames set by the single Member States, (2) the influence of EU action is only one among others\(^{33}\) and supporting success factors often play a crucial role; (3) especially DG RTD has limited direct influence on the behaviour of the R&D actors since the FPs mainly give incentives for research and support networks and platforms, but seldomly dispose of the possibility to introduce clear regulations (except from requirements for tenders and proposals).

6.2 Assumed impacts of the SiS topics on science, industry and society

The analysis of the impacts will be mainly structured around the three complementary and interlinked key priorities of Horizon 2020, which are (1) Scientific Excellence, (2) Industry Competitiveness and (3) Better Society where also the effects on policy-making are debated\(^{34}\). The SiS topics have a strong influence on the main challenges emphasised within Horizon 2020 in various ways. The subsequent examples do not claim for completeness but shall illustrate the breadth and diversity of impacts to be reached by an improved interconnectedness between science, innovation and society.

6.2.1 Excellent Science

For the aim of "Excellent Science", we may differentiate between the following main paths of influence: (1) quantitative and qualitative enlargement of the talent pool, (2) improved exchange with other parts of the innovation system, (3) enhanced effectiveness of the science system.

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\(^{33}\) If we compare the scale of the FPs to the scale of investments in R&D made by the Member State Governments at national level, it is clear that FP funding cannot in and of itself direct the whole EU research system. At an average of €7.7 billion per annum the budget for FP7 represented less than 10% of EU-27 Government investment in R&D, and was commensurate with the GBAORD for Spain (see Eurostat Pocketbooks, Science, technology and innovation in Europe, 2011 edition, p. 25).

\(^{34}\) As was agreed between the European Commission and the study team.
A larger and more diverse talent pool

Obviously, improvements in current science education teaching methods as well as appropriate mechanisms and activities to promote Gender equality in science will contribute to an enlargement of the European talent pool, both in quantitative and qualitative terms as not only more, but also different actor groups can be better mobilised for science jobs. As the recent She Figures\(^{35}\) show, the average share of women amongst the employed scientists and engineers is about 32%: despite the significant improvements made during the past years, there is therefore still further potential for a better representation of women in science.

Several studies show that the performance of women and men hardly differs.\(^{36}\) Male and female researchers reach the same quality (e.g. in terms of citations). In addition, the productivity of male and female researchers does not differ, i.e. the number of publications and patents per capita is more or less the same.\(^{37}\) Therefore more women in research would not necessarily increase the output of a research unit directly.

A further argument concerns the qualitative aspects, i.e. the fact that the heterogeneity of (research) teams positively influences their creativity and output.\(^{38}\) The integration of more women as well as other previously underrepresented groups – both of which can be linked to the gender and public participation dimensions of SiS – can thus be assumed to have a positive impact.

The recent "Innovationsindikator" clearly shows that diversity (variety of actors according to gender, age, geographical/social origin) is strongly associated with the innovation performance of the countries investigated in the report.\(^{39}\) If this potential is not used, there is a significant loss of the European innovation potential.

Exchange with other parts of the innovation system

Better governance of science-industry relations may make research institutions more responsive to industry’s needs and, in turn, prompt industry to provide more private research funding to research institutions. Since the introduction of New Public Management approaches, the successful acquisition of external research grants has become more and more important, being often a highly weighted performance indicator within the internal resource allocation processes. Additionally, an improved exchange with other stakeholders outside science might lead to an enhanced attractiveness for students, which might generate important advantages within the "war for talents".

Also, Science Education experts have emphasised\(^{40}\) that the focus should lie in knowledge exchange, which means collective learning processes, where different kinds of stakeholders can learn from each other to increase the scientific excellence in Europe by implementing the most effective approaches (best practice). As breakthrough solutions come from multidisciplinary collaboration, more collaborative research is essential. The main emphasis should lie on the evaluation and identification of the most successful IBSE projects and networks (i.e. concentration of effort) as well as the development of a more diverse range of pedagogical approaches and other types of action (i.e. diversifying efforts) in order to foster sustainable education in the STEM field.

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40 Validation workshop
Effectiveness of the science system

The scientific literature clearly shows that research institutions with optimized governance structures produce better research. Appropriate governance structures support a more effective use of scarce research funding and infrastructures, improve cooperation across national and disciplinary boundaries, create synergies and prevent duplication. Additionally, if ethical considerations are part of daily (research) routines and internalised, this leads to a facilitation and acceleration of normative decision-making among researchers, which in the end improves the science process.

Open Access raises citations by increasing visibility, fundability and accessibility. In 2001, Steve Lawrence analysed nearly 120,000 computer science articles cited in a standard disciplinary bibliography and discovered a correlation between the number of citations and open access articles. Between 1989 and 1998 the strength of the correlation increased, and in 1997-1998, 85% of the most highly cited articles were open access. In 2010, Swan carried out a meta-analysis of studies dealing with the impact Open Access has on citations. 35 studies had been investigated; very few of them indicated that there is no increase in citations, the rest, about 30 studies, demonstrated that Open Access increases citations impact up to 200%. Some studies even show an increase of up to 600%.

6.2.2 Competitive Industry

The main arguments regarding how the SiS topics influence the main challenge "competitive industry" refer mainly to a better performance of the national economies, but also to concrete KPIs (key performance indicators) of the single business actors. Additionally there is a lot of evidence supporting the effects of the SiS topics on the labour market.

Performance

During the past years, many studies demonstrated the "business case", i.e. the positive benefit that can be generated if gender equality is reached in boards and decision-making bodies in companies, but also within the different working units. These benefits refer, for example, to better decisions and better research quality (through gendered product development) which in its turn supports economic returns and consequently the competitiveness of European industry. An example for market success through gendered product development is the more small and compact cordless screwdriver (IXO) by Bosch, whose introduction was also advertised in women's magazines. By now the IXO is the most successful product launch in recent years and the most popular electrical tool in Europe – with women as well as men.

Studies in the Open Access area show that a quick, easy and free access to the scientific literature is especially important for small and medium-sized enterprises (SME). Houghton, for instance, compared costs and benefits of alternative open access for scholarly publishing in three countries: the UK, the Netherlands and Denmark. The authors of the study estimate that the Gold Open Access (Open access or author pays publishing model) might save EUR 70 million per annum nationally in Denmark, EUR 133 million in the Netherlands and EUR 480 million in the UK. Green Open Access

(the self-archiving model) might save around EUR 30 million per annum nationally for Denmark in a worldwide Green OA system, EUR 50 million in the Netherlands and EUR 125 million in the UK. 47

National Economies

The effects of the SiS topics on the national economies are manifold. Mattalia (2012) for example shows that a 1% productivity increase of education leads to an increase in growth of around 1.04% to 1.24%.48 Moreover, Human capital externalities have a significant influence on regional wages of highly qualified and non-highly qualified workers, e.g. in Germany. Employing the regional number of grammar schools and of students attending them as instruments, the regional share of highly qualified workers increases wages by 1.8% for highly qualified workers and by 0.6% for non-highly qualified workers. 49

Also the way universities are governed can have a measurable effect on economic growth.50 The promotion of science-industry-links strengthens industrial competitiveness by facilitating and accelerating the translation of inventions into innovations. Better governance of science-industry relations may also accelerate the transfer of technologies. In literature, several reasons are mentioned concerning why firms participate in R&D cooperation with public research organisations. One strand emphasises that in order to develop an innovation, firms require complementary intangible assets, basic tacit knowledge and know-how, which cannot be easily contracted and monitored through market-based transactions. R&D cooperations enable firms to internalise incoming knowledge spillovers and allow them to increase knowledge transfers voluntarily among the cooperating partners51. Studies in management and technology policy stress the role of factors such as sharing risks and costs52, shortening innovation cycles53 as well as the exploitation of economies of scale and scope in research and development54 55. Last but not least, industry participation in R&D cooperation may occur to enable partners to increase market power56 for example by learning through monitoring technologies and market developments57 or dealing with

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49 Daniel Heuermann (2011): Human Capital Externalities in Western Germany, Spatial Economic Analysis, 6/2, 139-165
rules, industry standards and government policies. A large body of empirical literature has found engaging in R&D cooperation to have positive impacts on innovation performance, sales growth, and productivity growth.

Particularly in case of large-scale infrastructure technologies (such as telecoms), where successful roll out depends on the achievement of a critical mass, EU level coordination can play a crucial role. This may provide a tangible competitive advantage vis-à-vis the US and other advanced economies. Also the equipment with excellence in e-skills helps Europe to remain a lead contender in the global race for innovation.

Improved involvement of the broader public will increase the acceptability and accelerate the market uptake of new technologies. Consumers are less likely to reject something about which they feel sufficiently knowledgeable. Technological development processes are generally more successful when users are involved from the beginning (open innovation).

On the other hand, there are tangible costs associated with the failure to conduct ethically oriented research. One example mentioned by the workshop experts is the case of patient data management system, it was immediately shot down by the House of Lords because of concerns about data privacy. If ethics would have been embedded across the entire UK policy and such issues would have been taken into account from the beginning, this would not have happened and a lot of taxpayers’ money could have been saved.

**Labour market**

A better integration of women into the labour market can also help to overcome the expected shortage of skilled labour, especially regarding the most highly qualified jobs.

This is particularly important because labour-market demands for higher literacy skills have increased over the past two decades. In their 2008 publication, Goldin and Katz describe an almost century-long “race” between education and technology: wages and economic growth depend on how

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63 For details, see: http://e-skills-week.ec.europa.eu/web/guest/e-skills-manifesto


65 Validation Workshop

66 McKinsey 2007
well workers can keep up with changes in the complexity of job tasks.\textsuperscript{57} In this regard the Eurostat figures published in 2009 indicate that for the 27 MS of the European Union, only 14.3 people out of 1,000 aged 20-29 are studying scientific and technical subjects at early tertiary level. Whereas young people are particularly engaged IT users these days, less than 30\% of boys, and 15\% of girls plan to study IT-related subjects at tertiary level.\textsuperscript{68}

Regarding these current shortfalls in the supply of skilled workers, a factsheet from the recent ‘e-skills week’ writes: "By 2015 it is expected that 90\% of jobs across all sectors will require tech skills [...] But at the same time, a growing professional ICT shortage in Europe will generate a shortfall of as many as 700,000 professionals by 2015..."\textsuperscript{69}". As disengagement with scientific and technical subjects starts from late primary and early secondary education, the EU’s 'e-skills manifesto' reveals a commonplace view amongst businesses that education is not doing enough in order to supply these young talents and required e-skills within the labour market. The report also highlights the strong advances being made outside Europe and the potential risks this is likely to cause in the future unless Europe takes action.\textsuperscript{70}

In terms of unlocking future markets, the literature also focuses on ‘key enabling technologies’ as a very rapidly growing sector ("forecast to grow from €646b to over €1,000b between 2008 and 2015 [which is] more than 8\% of the EU’s GDP..."\textsuperscript{71}), where education is expected to supply the huge rise in jobs that has been forecast.

An improved understanding of the relationship between science and industry may allow for an optimization of education funding. Aghion und Howitt (2006) notice that investments in higher education are likely to have a more positive influence than investments in secondary education.\textsuperscript{72} More industry-led initiatives may in addition establish strong career paths for STEM graduates and enhance the attractiveness of the respective degrees. This means that greater efforts are needed to link education to skills and skills to STEM jobs. Pupils ought to become more interested in STEM careers, rather than just in science\textsuperscript{73}.

As a concrete example for the (job) benefits generated by the principles of Open Access, literature often cites the Human Genome project, where thousands of scientists around the world worked together on the effort to sequence the human DNA complement on the basis of common principles of data sharing. The US coordinated research project had an economic impact worth $796 billion and created 310,000 jobs.\textsuperscript{74}

6.2.3 Better Society

The following examples illustrate the wide range of positive impacts associated with the different SiS topics: They refer to the aspects of social inclusion and poverty reduction, health issues, the reduction of unintended effects and technological disasters and effects on the civil society.

\textsuperscript{58} For details, see: http://eskills-week.ec.europa.eu/web/guest/e-skills-manifesto
\textsuperscript{59} E-skills week 2012 Factsheet
\textsuperscript{60} For details, see: http://eskills-week.ec.europa.eu/web/guest/e-skills-manifesto
\textsuperscript{63} A report from BITCOM (2012) states that Germany has up to 28,000 open vacancies in the IT sector that cannot be filled, as well as a further 50,000 medical specialists. This is estimated to be generating a direct loss of €1b for the country’s economy. Excess demand for a skilled workforce is therefore not a future concern but very much a contemporary problem.
\textsuperscript{64} Communication from the commission (2012): Towards better access to scientific information: Boosting the benefits of public investments in research, http://ec.europa.eu/research/science-society/document_library/pdf_06/era-communication-towards-better-access-to-scientific-information_en.pdf
Social inclusion and poverty reduction

Better governance of the rollout of new technologies will increase the speed at which consumers will benefit from new technologies and prevent early adopters from being stranded with technologies that were not rolled out.75

Through greater and more effective investment in (science) education, consumers, and especially minority groups, benefit from greater product diversity (horizontal innovation)76 as well as better product quality.77

Promoting "inclusive science" also includes the struggle against any form of discrimination, in order to guarantee equal opportunities for all citizens and measures of inclusion also in the scientific domain.78

Job security and income is strongly associated with the educational attainment.79

Excluded groups in communities can be tackled through models of non-formal education, for instance IT-based community telecenters are an excellent channel across Europe for digital literacy and adult education of disadvantaged target groups.80

Improved health

Better governance of science and technology could potentially lead to faster and better decision-making in the face of crisis, such as pandemics (BSE example).81 Grossman and Kaestner (1997) and Grossman (2000) conclude that years of formal schooling completed is the most important correlate of good health.82

Reduction of unintended effects and technological disasters

The risk that large-scale technology projects are subsequently shut down due to ethical concerns or consumer boycotts can be reduced if ethical questions are addressed and concerned stakeholders are involved from the beginning:

- Preventing disaster like asbestos or chlorofluorocarbon (CFC),
- Avoiding unintended consequences of seemingly beneficial innovations,
- Avoiding losing out as regards technological advance and thus social and economic benefits,
- Avoiding irreversible human health or environmental disruption.83

The importance of governance issues is also demonstrated by the Fukushima accident. A recently published report by an independent committee of the Japanese parliament concludes that the Fukushima accident was a "man-made disaster" that unfolded as a result of governance failings by

80 For details, see: http://eskills-week.ec.europa.eu/web/guest/e-skills-manifesto
the facility's operator, regulators and the government. The root causes were thus the organisational and regulatory systems, rather than issues relating to the competency of any specific individual.  

**Effects on the civil society**

Scientific literature shows that a better integration of science in policy-making leads to better-informed policy decisions. Additionally, education leads to greater civil engagement.

### 6.3 Results from the public consultation survey

The consultation survey as well as the two workshops carried out underlined the importance of the SiS topics and an expected multitude of positive impacts. The survey respondents, for example, clearly expected a strong impact of the SiS-related developments described in the statements on the "better society/social inclusion" dimension (on average 34%), followed by positive impacts on scientific excellence (26%) and economic competitiveness (21%), across all thematic areas.

Figure 14 - Socio-economic impacts assessed by the survey respondents

![Socio-economic impacts](image)

Source: own illustration

The comparably low shares for Ethics and Public Engagement (less than 20%) regarding their contribution to scientific excellence and economic competitiveness enhance the need to invest more efforts in the dissemination of results in the future. Additionally, more emphasis should be placed on compiling and communicating evidence that Science-in-Society issues directly contribute to the increase of economic competitiveness.

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84 The National Diet of Japan (2012): The official report of the Fukushima Nuclear Accident Independent Investigation Commission


These results are in line with the outcomes from the interim evaluation conducted by Technopolis\textsuperscript{87}, which recognized an evident ‘gap’ in terms of efforts to appraise, aggregate and package the programme’s content and results into a digestible form, and disseminate this information widely to relevant audiences to raise the general awareness of SiS and the key achievements of the programme.\textsuperscript{88}

Depending on the way policy-makers implement the different SiS topics across Horizon 2020, there might be also antagonistic effects. An important hint in this regard is given by the survey respondents: Considerably fewer respondents associate risks with the different developments outlined in the questionnaire than positive impacts, there are nonetheless certain concerns among the European scientists and practitioners. Especially the fear of overburdening costs for all stakeholders is mentioned and should be seen by the Commission as a request to be rather careful when setting formal requirements in the respective fields.

Figure 15 - Most potential risks assessed by the survey respondents

<table>
<thead>
<tr>
<th>Risk of a decrease of scientific excellence</th>
<th>Overburdening costs for all stakeholders</th>
<th>Loss of economic competitiveness</th>
<th>Migration of risk technologies</th>
<th>Enlargement of regional and social disparities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of respondents: 18%</td>
<td>12%</td>
<td>6%</td>
<td>9%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Source: own illustration

The risk of a decrease of scientific excellence can be interpreted as the concern that (too) much time is needed for matters that are not directly related to the conduct of actual research in a narrow sense and afterwards this time is missing for the basic tasks. The results confirm a particular uncertainty among those people who participated in the survey, how to cope with the challenges regarding a better integration of societal (and industry-related) issues in science and prove at the same time that it is not yet fully understood that the consideration of societal needs has the potential to enlarge and improve scientific discoveries. Workshop participants criticized too that the administrative effort required to coordinate and manage SiS projects is excessive. The current system is seen as too complex and bureaucratic at the moment. In this context, the experts also criticized the high number of partners that usually participate in SiS funded projects. This was deemed to make it very difficult to make any advancement on the scientific front because the researchers involved are just overburdened with the need to coordinate their work.


\textsuperscript{88} Interim evaluation & assessment of future options for Science in Society Actions, Draft Final Report (D8), page 5.
7. Future policy needs

7.1 Suitable policy instruments

The previous chapters demonstrated that the baseline option, i.e. a dedicated programme for research, support and coordination, managed by a specialised unit within DG RTD, is the most preferred policy option, which assures that the challenges of the European innovation policy regarding a seriously improved interplay between science, innovation and society are successfully addressed in the future.

A dedicated programme is associated with numerous benefits. First of all it enhances the visibility for the RRI keys. Having one’s own programme offers the opportunity to fund activities that would be unlikely to be funded otherwise. It encourages people to come together from across Europe, sharing different approaches, perspectives and intelligence, and building on this combined knowledge and expertise. It delivers information and evidence that is needed to make wider changes and improvements to the RRI challenges. Additionally it can generate arguments and evidence to influence decision-making elsewhere and encourage change in the approaches that are taken to RRI (e.g. in other parts of the Framework programme, at Member State level, by other DGs, etc.). It symbolises to the research community, to policy makers, funders, and others societal groups that the RRI keys are deemed important and that the support thereof has been institutionalized and is likely to stay available in the foreseeable future. Through a dedicated programme, the RRI keys can be kept on the agenda and established as a real "brand" in the economy, politics and the world of science. One’s own programme is also an important prerequisite to maintain other, wider activities relating to embedding and coordination of Member States’ activities. One’s own programme creates a central place from which to communicate the message about the importance of RRI, and to encourage this belief more widely. Finally, the RRI idea would be institutionalised on the European level and seen as a priority in the European research strategy.

Within the baseline option, there is a certain need for a tailored policy-mix to realise a broad array of impacts. It has to be emphasised again that the different intervention types are not mutually exclusive, but instead would generate the largest benefit if further used in combination. A continuation of the baseline option as it is could at least stabilise the topics implemented during SaS/SiS. However, due to the increased relevance of the RRI concept underlined in the different EU documents, one could also think about an increased effort as a larger budget available obviously means supporting more activities then before. At the current stage it is rather difficult to indicate concrete shares of financial support for the different policy instruments. However, as many of the RRI topics are still developing and the requirements and barriers for a better interconnectedness between science, innovation and society are not fully known, a strong research component will be needed in future too.

On a general level, the study highlighted the need for the following concrete policy intervention types:

1. Research funding

A continuation and strengthening of research funding activities would enable the European researchers and practitioners to

- Elaborate and understand the complex mechanisms leading to long-term impacts in complex environments
- Define ways how the concept of RRI can be used as a key to stimulate new research themes
- Investigate what kind of differences but also commonalities exist between the scientific disciplines
- Better understand the effects of RRI for the innovation cycle
- Elaborate the cultural differences across Europe and their effects on Ethics, Gender, Governance, Open Access, Public Engagement and Science Education
- Deliver more evidence for the "business case"
- Find out ways regarding how to best transfer research results into practice
• Identify the most appropriate ways to adapt the innovation systems to the requirements of modern society
• Elaborate how to manage the necessary organisational changes in different countries, research fields and organisations
• Better understand how the involvement of broader parts of society will impact on future policy-making, as public policy literature suggests that the inclusion of new and more actors may change the image of the policy issue and dynamics of the policy-making process\(^9\).

The SiS programme implements its activities *inter alia* through: (1) Coordination & Support Actions, (2) Collaborative (research) projects and (3) the ‘Mobilisation and Mutual Learning (MML) Action Plans’. Although these instruments are suitable, there may be a need to invest more in collaborative research projects to achieve even more progress in the respective SiS fields, especially when national research funding is hardly available for more applied oriented social science research. This is particularly important for non-research players such as CSOs, but also research organisations with less basic funding for whom the current arrangements are sometimes sub-optimal and inhibit stronger participation in the SiS programme.

2. **Embedding approach**

A continuation of the embedding approach is important for raising the visibility of RRI more widely and in consequence contributing to a more “responsible research and innovation” regarding design as well as implementation. Through a widespread reach of different kinds of actors, an embedding approach might also contribute to accelerate structural change within research systems and new research cultures. It would enable European researchers to collect more evidence on the relevance of the RRI keys for science and innovation. Additionally, an embedding approach would provide useful data on the extent to which projects actively engage with RRI and its development over time.

3. **Coordination of Member States activities**

With regard to the rationales for enhanced coordination at EU level, they can be roughly clustered into three main categories:

• Coordination to increase efficiency:
  – Better coordination to achieve European synergies and avoid duplication
  – More coordination between different levels can contribute to highlighting the benefits and added value of responsibility in research and innovation

• Coordination as a process to develop a common understanding of the policy issues at stake:
  – Coordination is needed to reach agreement on the nature and extent of problems / opportunities, what solutions are possible and how to develop and implement these
  – Based on shared values, coordination can facilitate a common way of thinking about problems, processes and ideas
  – Without coordination between different stakeholders, policy impact cannot be achieved

• Coordination as a means to facilitate learning processes between different stakeholders and groups:
  – Coordination is a facilitator for mutual learning, and this can help to mobilise a wide range of actors
  – Many “islands” of innovation and good practice exist, but coordination is important to take these to scale
  – Coordination can avoid disciplinary islands of good practices
  – Coordination helps science to find best practice

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The following **benefits** are associated with a continuation of coordination activities:

- Ensures a systematic approach to RRI across Europe, including putting in place rules and structures that encourage the consideration of the wider implications of activities
- Supports the integration of RRI at the Member State level, for example through some kind of intermediary platform
- Helps to open the minds of policy makers and funders across Europe
- Eases the development of standards suitable across the whole Horizon 2020
- A clear policy lead from the Commission should positively influence MS-level activities
- Fosters the diffusion of good practices and approaches throughout the Member States
- Supports more coordinated and joined up policies at MS level
- Helps to better understand the nature and extent of the challenges and leads to larger political will at MS level to tackle them

### 4. Regulation

A comprehensive use of standards, guidelines and formal requirements is expected to improve the goal attainment in the various SiS fields as it promotes the necessary change in attitudes and behaviour among the different actor groups. Examples for regulatory needs are:

- Strong recommendations to Member States to implement the respective policies
- Strong recommendations to Member States and research funders to introduce into reward systems that taking into account the requirements associated with an improved link between science, innovation and society is a merit
- Strong recommendations for responsibility standards and interoperability in research
- Clear definitions of quantifiable goals, sanctions when not reaching goals
- Quality standards and guidelines for integrating RRI requirements in research projects
- Guidelines and formal requirements to consider RRI themes within research themes and application processes
- Obligations to member states to annually report on progress in the various fields

### 5. Improved monitoring and evaluation arrangements

The monitoring and evaluation arrangements are expected to be more effective in future if there is a clear commitment among the reviewers regarding the importance of the RRI keys, a common understanding how to treat the various RRI requirements as well as clearly defined sanction mechanisms. Improved monitoring and evaluation arrangements might help to stimulate learning processes, support change processes within organisations and deepen the understanding of the complex interrelationship between science, innovation and society.

In the following chapter we summarize the main findings regarding a future policy-mix for the different SiS topics.

#### 7.2 Suitable instruments in relation to the SiS topics

##### 7.2.1 Ethics

The public consultation carried out within the context of this study has affirmed the importance of ethical issues to future R&I activities. The majority of respondents consider it desirable for further provisions to be made to ensure that publicly funded research projects are carried out according to ethically sound principles. A majority welcome the implementation of an EU ethics framework for responsible research and innovation based on fundamental ethical principles and European values, and most consider it desirable for awareness of ethical issues among EU researchers to increase within all scientific fields, and that proper treatment of ethical, legal and social aspects should become a fundamental part of conducting research rather than simply a form of external control.
In terms of suitable policy measures and instruments, the consultation exercise suggested that a variety of actions are needed, including (i) changes to regulatory systems, via the introduction of new standards, guidelines, codes of conduct, etc., (ii) research funding programmes to support the investigation, development, and appraisal of appropriate solutions, and (iii) effective dissemination activities and implementation mechanisms to ensure wide take-up, including sustainable institutional structures. Success will be contingent on effective interconnections between the major stakeholder groups (regulators, funders, research institutions, industry, civil society organisations), and on suitable structures that enable policy learning. In the longer term, empirical evidence as to the tangible benefits realised as a result of improved ethical frameworks and practices is needed, in order to assure the sustainability of the solutions.

The experts of the two workshops unanimously agreed on the need for dedicated funding at EU-level in the coming years, and concluded that support for ethical debate and research needs to be extended beyond the most high profile areas of science and innovation (e.g. nanotechnologies, genetics, etc.) and into more mainstream areas such as environmental management, healthcare, social science research, etc.

As Horizon 2020 focuses efforts on leading-edge scientific research and industrial innovation in order to address the major societal challenges, it will be more rather than less important that there are dedicated structures and funding to ensure that sound ethical practices are applied. The experts also affirmed the importance of having a dedicated central unit in place to manage the ethical review process applying to EU-funded research and innovation projects. This review process, substantially improved under FP7, is still developing and there will be significant risks to the integrity of EU research if this review process is to be curtailed or left solely in the hands of sectoral units. Redistribution or reallocation of responsibility for ethics to other DGs, units or agencies was considered to be a step back, carrying high risks and few clear benefits.

While the experts from the ethics field argued strongly for a continuation of a dedicated budget for research, support and coordination in the field of ethics under Horizon 2020, the baseline option, the importance of actions to support, coordinate and influence Member State policies and practices were also highlighted. Such efforts should not involve the imposition of any kind of 'hard' legislation (such as EU Directives or Regulations) but should relate to voluntary codes of conduct, standards and the like. In addition, there are clear benefits to be gained from further efforts to share good practices across countries and to promote the uptake and widespread application of new standards, codes and practices.

7.2.2 Gender

The public consultation carried out within the context of this study found very high levels of support for the contention that further progress needs to be made in relation to gender in the science field. The majority of respondents consider it desirable that targets should be set for gender balance within publicly funded research and innovation activities, and that gender action plans, training initiatives and transparent recruitment / selection processes should be used to help such targets to be met. There is also widespread support for the need to develop policies to address known barriers to entry and retention of women scientists, such as the need for alternative career paths, and to raise the general level of awareness of the scientific and economic benefits of improved gender balance at all levels.

Suitable policy measures and instruments for EU action include changes to regulatory systems, via the introduction of new standards, guidelines, codes of practice, etc., particularly in relation to ensuring transparent recruitment processes, gender action plans, and increased gender balance in decision-making bodies, evaluation committees and in the research process as a whole, if necessary through quotas. EU actions are also needed to support sustainable institutional structures and to fund further research to better understand the benefits of good gender balance in research and innovation activities, not only within research but also within public and private innovation processes. Success will be contingent on effective interconnections between the major stakeholder groups (regulators, funders, research institutions, industry, civil society organisations), and on the provision of improved empirical evidence as to the tangible benefits that can be realised through gender balance and mainstreaming of gender within all aspects of the research and innovation process. Without continuing further European effort, according to the experts everything we have achieved so far will be wasted and the demand for this knowledge from the member states will not be met.
The findings of the consultation exercise were confirmed and refined through two expert workshops. At an overall level, the need for continuation of a dedicated funding programme was emphasised in order to (i) maintain and strengthen the range of platforms and initiatives that have proved successful in developing understanding of this area and in promoting effective solutions (for example the EPWS), and (ii) continue to develop data to strengthen the business case for active policies to improve gender balance in all aspects of the research and innovation process. The risks of a loss of momentum at EU level are significant in both social and economic terms, particularly given the shortage of STEM graduates entering and retaining scientific careers within Europe.

The importance of ensuring that all EU-funded research observes good gender diversity policies and practices, not just in terms of gender balance within project teams but also within research content and within decision-making bodies, was also emphasised. The progress made to date within FP7 in 'embedding' good practices across the programme is significant and provides an important lead to the Member States and major institutions in terms of their own policies and practices. Again, the risks of non-continuation of these efforts are seen to be significant. Ongoing coordination and support from the Commission for Member States’ own activities in this area is also crucial in order to avoid a loss of momentum. It is not considered possible or appropriate for the EU to regulate or enforce its policies ‘top down’ on Member States and so the role of the Commission is to provide leadership and support, accepting the different conditions, starting points and cultures of the individual countries. In concrete terms, the gender experts particularly highlighted the need for a special programme to promote the new conceptions of gender as a condition of quality in research, for cross-programme actions to promote gender mainstreaming in themes addressing social challenges but also for an external monitoring and evaluation body that oversees progress across all DG's involved in HORIZON 2020.

7.2.3 Governance

Research and innovation activities and institutions have to be effectively governed to ensure their relevance, integrity, and utility. Science increasingly represents a collaborative venture between researchers, industry, policy makers and society at large, and it is therefore vital that effective governance structures are in place to ensure proper stewardship of this key resource. However, it is also important to preserve an appropriate degree of academic and industrial freedom in order to allow new avenues to be opened and new methods to be developed.

The public consultation carried out within the study reinforced the importance of effective governance and signalled that it should remain as a high priority component within the RRI framework. The public consultation also affirmed that governance is increasingly concerned with ensuring an effective interplay between scientific research, industrial innovation and societal needs, encompassing elements of stakeholder involvement, good ethical practices, and effective policymaking based on sound scientific advice.

The public consultation highlighted that support for sustainable institutional structures and the management of research funding flows are key mechanisms through which good governance may be ensured. Success will be contingent on effective interconnections between the major stakeholder groups (regulators, funders, research institutions, industry, civil society organisations), and on the establishment of suitable structures to enable policy learning.

The experts contributing to the study emphasised the importance of continuation of dedicated funding for research, support and coordination in the field of R&I governance, as this permits the coming together of relevant actors from across the EU to debate and agree on the most important actions, to share good practice and agree on appropriate solutions. Without a dedicated mechanism to support such collaboration at the EU-level there is a significant likelihood that efforts to improve governance systems at national levels would be curtailed, and there would be detrimental impacts on the ability to take the RRI agenda forward in other areas. Advances in science education, ethics, gender, public engagement and open access all require effective governance systems to be in place to drive forward developments and appraise progress.

The experts also emphasised the importance of ensuring that good governance continues to be an integral part of the FPs, and that Horizon 2020 should retain a dedicated RRI unit to raise awareness of the importance of RRI and to support and monitor its implementation across all programme areas.
7.2.4 Open Access

The public consultation carried out within the study confirmed a generally high level of support for the idea that publicly funded research should be made available via open access, that this should be a policy priority for action within all Member States and that researchers should be made aware of open access opportunities and should be able to make choices regarding its use.

The public consultation highlighted that changes to regulatory systems (through standards, guidelines, etc.) and to research funding programmes are the most appropriate policy measures through which to increase open access publishing. Critical success factors for the realisation of open access publishing were increased empirical evidence as to the benefits that this move would bring, along with good connections between the various stakeholders involved in the funding, production and dissemination of scientific knowledge. Suitable structures to enable policy learning about the costs and benefits of open access moving forward were also considered to be of high importance.

The experts contributing to the study emphasised the importance of continuation of dedicated funding for research, support and coordination in the field of open access. While further research into the most appropriate solutions is still required and while certain technical and financial barriers have to be overcome, coordination of and support to Member States to assist them in taking forward the open access agenda was considered to be just as important, arguably more so, that the funding of further research per se. Awareness raising activities were also highlighted as important.

In addition to a dedicated budget to support open access research, support and coordination, the experts highlighted the need for Horizon 2020 to continue to demonstrate and build on the good practice embodied in the FP7 open access pilot. Experts would wish to see the pilot extended to cover all research outputs, meaning that all funded projects would be expected to publish their results and data within open access journals or repositories. Open access principles and practice would therefore be fully embedded within all areas of Horizon 2020.

The experts also see a continued need for the Commission to help to coordinate and support Member States to implement suitable open access policies, and argued that a system of monitoring of Member State activities and progress should be implemented.

7.2.5 Public Engagement

The public consultation exercise carried out within the study affirmed the central importance of public engagement for Responsible Research and Innovation. Contributors supported the idea that efforts should be made to raise the competencies of the general public to enable citizens to better engage with science and technology, and that social platforms should be promoted as a means to broaden the interest of civil society in science and technology and to enable their greater input into agenda setting.

As with the other components of the RRI framework, public engagement was seen to be an activity that requires policy action at both EU and Member State level, and progress is expected to be realised most effectively through improved dissemination activities to a broader public. Opportunities for citizens to participate more fully in science and technology exist but awareness of such mechanisms can and should be improved. The public consultation also revealed that research-funding programmes could involve a greater degree of public input to their design and implementation, with the aim of increasing the public relevance and utility of the supported activities. Successful public engagement will be critically dependent on strong connections between the various stakeholders and on suitable structures and mechanisms for public engagement to be established. While increased public engagement in S&T is widely accepted as a desirable outcome, important questions remain as to what we mean by ‘public’ (e.g. civil society organisations, public representatives, individual citizens) and how they can engage effectively and efficiently.

Experts in the field of public engagement endorsed the findings of the public consultation and stressed the importance of continued action at EU-level. Within the current economic climate and within the context of the major challenges facing society, a fuller engagement by the public in S&T processes is necessary to ensure that appropriate pathways are followed and that continued high levels of investment in research and innovation are delivering the outcomes that society wants. The experts highlighted the need for future investments in the training of scientists and scientific institutions in methods and techniques for public engagement, identification and sharing of good practices, and in monitoring and evaluation systems for tracking progress.
The need to embed and ensure good practice in public engagement across the whole of Horizon 2020 was also endorsed by the experts in the field. The need to ensure ‘full’ public engagement throughout the entire research process (rather than for example simple dissemination activities carried out at project completion) was emphasised, which implies the need for (i) new tools and methods to foster public engagement at the work programme and individual project levels across all areas of Horizon 2020 and (ii) appropriate monitoring activities that can differentiate between the simple ‘transmission of results’ approaches and those involving full engagement with the public at all stages in the research and innovation cycle.

There is still a long way to go in order to move from a purely normative ("citizens who will be affected by decisions should be allowed to participate") or instrumental ("dialogues may reduce conflicts, help rebuild trust and pave the way for new innovations") view to a more substantive one, clearly emphasizing the large benefits to research and innovation systems.

7.2.6 Science Education

The public consultation carried out to assess future options in this area confirmed that there is widespread support for the need to further address the issue of science education. The vast majority of contributors see it as desirable for governments to take action to increase the number of young people entering science, research and technology careers, and most consider that inquiry-based science education will help to increase the number of young people studying science at a higher level. Contributors also endorsed the need for greater international cooperation and exchange in the field of science education, and that more science activities such as science centres, museums and class room projects are also needed in order to effect progress. Partnerships between industry, schools and research organisations are also needed to help bridge the gap between science education and science careers, and new media and social networks also offer the potential to create a more positive image of scientific careers.

Science education takes place at national level but the need for international cooperation and exchange, and the sharing of effective practices, implies that EU-level action will be an important enabler of future progress. Suitable policy measures and instruments for EU action include support for sustainable institutional structures and dissemination activities to promote and assist in the take-up of effective solutions. Success will be contingent on effective interconnections between the major stakeholder groups (science and education ministries, schools, authorities, etc.), the provision of improved empirical evidence as to the tangible benefits of different strategies, and suitable structures that enable policymakers to learn about effective measures.

The findings of the consultation exercise were confirmed and refined through two expert workshops. At an overall level, the need for continuation of a dedicated funding programme was emphasised in order to continue to tackle this major problem, but the experts argued that a more diverse range of actions are needed if further progress is to be made. These include further efforts to involve industry in addressing the problem of science education and to ensure a better connection between education and skills and between skills and jobs. Within this context there is a need to look beyond IBL methods to encompass other effective techniques for interesting young people in STEM subjects and scientific careers. There is also a need for further research into effective strategies and for the ongoing exchange of practices across institutions and countries. The experts also highlighted the importance of not losing the momentum that has been built up by successful initiatives, and called on the Commission to ensure that the most effective ones (based on comparative evaluation) are supported into the future. The experts wholly rejected the idea of ceasing support for improved science education, due to the devastating consequences that this would have for Europe’s future economic competitiveness.

The experts also indicated that while the Commission is not in a position to regulate in the area of science education, it could use its significant influence to support and help coordinate member state actions. Efforts to help identify and share effective practices are legitimate and should be pursued.

particularly in light of the large differences between Member States with regard to this issue and the fact that language barriers exist between the national educational systems. A pan-European mapping study would also help to highlight areas where further action could be taken at Member State level.
8. Monitoring and evaluation arrangements

The aim of this chapter is to suggest Monitoring and Evaluation arrangements that allow policy makers and budget holders to be able to track the progress of their policies and programmes. In order to develop concrete monitoring and evaluation provisions for the developed policy options the following questions will be addressed:

- What kind of data is needed to be able to monitor the progress of the actions implemented?
- Is all the information needed readily available and/or how great is the administrative burden in obtaining them?
- What will the monitoring data and evaluation findings be used for?
- To what extent do monitoring/evaluation structures already exist? Does new capacity need to be put in place?
- Is the baseline situation sufficiently well known or will further data collection be necessary once the proposal has been adopted?
- Who are the key actors in providing and using such information?
- In general terms, what will be the roles of these actors? How will information be shared and eventually aggregated?
- What will be the additional use for gathering this information?

The following suggestions concentrate on the idea of a dedicated programme, embedded within the new Horizon 2020 structure, as the most preferred policy option.

For years, substantial efforts have been made in the field of monitoring and evaluation arrangements at EU level, particularly regarding the FPs\(^1\). The current concepts can be seen as rather well developed and useful. Every proposed change now should keep in mind the complementarity and coherence regarding existing systems and be aware that the stakeholder communities are meanwhile rather familiar with the current arrangements so that any disruptive changes could lead to irritations and a lack of acceptance. Additionally it is always necessary to find a balance between the attempts to analyse outputs, outcomes and impacts in detail and understand the underlying mechanisms too and the need to keep the collection of new data and indicators to a minimum.

The strengths of the current system are the well-balanced combination between expert panels and evidence prepared by RDTI evaluation experts and STI policy researchers, a well-known system with a strong evidence base and that many of the issues which are on the agenda of the SaS/SiS programme like ethics, gender, public engagement etc. are already covered. However, as the context has changed significantly through the definition of the EU growth strategy "Europe 2020", where the EU aspires to become a smart, sustainable and inclusive economy and – for that purpose – has set five ambitious objectives on employment, innovation, education, social inclusion and climate/energy to be reached by 2020, this should of course have effects on the monitoring and evaluation arrangements too.

8.1 Monitoring Arrangements

The future monitoring system for Horizon 2020 should take the template for Project Final Reports as a starting point, where a number of useful indicators and concrete questions are already applied. Especially the report required on societal implications covers the main RRI keys Ethics, Gender, Science Education, Engagement with Civil Society and policy-makers, Open Access (for details see Annex III):

1. Ethics: Ethics Review / Screening undergone; issues with ethical implications

\(^1\) For details see http://ec.europa.eu/research/evaluations/
2. Gender: Gender Equality Actions, perceived effectiveness of the actions, gender dimension within research content, but also share of women with the workforce

3. Science Education: working with students and / or school pupils, generation of science education material

4. Engaging with Civil Society and policy makers:
   - Engagement with societal actors beyond the research community like citizens or organised civil society and in which ways;
   - Engagement with government, public bodies or policy makers; outputs which could be used by policy-makers – if yes, at which level

5. Use and dissemination, including Open Access:
   - Articles in peer-reviewed journals
   - Articles published by open access

However, the currently existing reporting questionnaire on Science-in-Society issues for all projects (Appendix 13) seems to be rather extensive. One joint template for all projects supported under Horizon 2020 would have the advantage of reducing the burdens for project coordinators, which have to meet several other requirements too.

8.2 Evaluation Arrangements

Due to the long-lasting experience with evaluation requirements established at the EU as well as the Member States level, especially under FP7, there is a lot of know-how already available concerning how to best evaluate RTD programmes. With regard to SiS respectively RRI issues, the Terms of Reference used for this study might also be taken into account when designing a future evaluation design.

As the concrete arrangements for an integration of SiS/RRI topics under Horizon 2020 are not yet clear, it is too early to develop an exhaustive set of evaluation dimensions, categories and indicators. What is possible, however, is to take the operational objectives defined in chapter 3 as a starting point and additionally outline some basic requirements for a future evaluation design.

8.2.1 Evaluation design

A future evaluation design should keep the basic format of the FP7 arrangements, implementing ex ante, interim and ex post evaluations as well as (annual) monitoring activities. A particular strength of the current arrangement is the wide reach of particular topics investigated in more detail (like internationalisation effects) in separate studies, enlarging the evidence base of the evaluation reports.

To make best use of the evaluation activities, every evaluation study should dispose of an appropriate level of resources, not only in terms of budget but particularly also in terms of the available time to conduct a sound empirical investigation.

Evaluations have to be based on a transparent conceptual and empirical basis, showing which effects and impacts are quantifiable and / or can be measured and which not. Especially in social sciences and complex environments it might be better to focus on "contributions" and not claim to analyse causal effects.

The current evaluation studies suffer from a lack of longitudinal data and perspectives. In order to measure long-term effects one might consider implementing arrangements like those implemented under the EUREKA Framework, asking the project beneficiaries two and four years after project completion about the Market Impacts like effects on turnover and employment.

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As a particular new approach one could also imagine introducing an overarching approach in form of an annual or biennial public-opinion poll among (1) European researchers and research employers and (2) European citizens about the extent to which European research is “responsible”, how the responsiveness developed during the past time period, how relevant responsiveness is in their view, what kind of measures or activities could be undertaken in order to strengthen the responsiveness of European research and whether they would support an increased investment of public research budgets in pursuing RRI, for example rising from an estimated 0.5% to 1% of total government and Higher Education expenditure on R&D.

8.2.2 Evaluation criteria

At the moment we can observe that the monitoring and evaluation arrangements are very much focussed on **pre-competitive collaborative research** where (tangible and measurable) outputs like publications, co-publications, citations and different kinds of IPR activities are in the foreground. Additionally, typical questions refer to results in networks structure and cooperation behaviour but also regarding knowledge gain. But topics regarding the main challenges under Horizon 2020 like economic competitiveness and a better society are still under-developed as well as indicators mirroring **longer-term effects**. The same holds true for the need to have a closer look at the Knowledge Triangle through taking into account training activities and career developments and the requirements associated with the Grand Challenges. Finally, the impacts on policy-making are also not fully understood.

In the future, the mid- and long-term impacts on the organisations involved in RRI projects and activities should be investigated in more detail. Potential questions in this regard are:

• Increased acceptance of RRI issues among the staff;
• Deepened competencies, knowledge and skills on RRI issues;
• Increased awareness evidence for the benefits associated with RRI issues within the organisation;
• Implementation of training opportunities / courses on RRI issues within the organisation;
• Existence of guidelines / standards how to implement RRI aspects within the R&D activities;
• Institutionalisation of responsibilities and dedicated resources for RRI issues (central unit, decentral representatives);
• Implementation of monitoring and evaluation systems taking RRI issues into account.

8.2.3 Future requirements

1. The evaluation procedures developed during the past years with their rich know-how about evaluation criteria and methods should be complemented by more innovative and experimental approaches (how to measure far-reaching impacts like structural and cultural change; best ways to involve stakeholders in evaluation processes not only as "object" but as co-evaluators; combination with other tools like foresight activities etc.). DG RTD could support this task in dedicating a certain part of the evaluation budget to innovative approaches.

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95 In a recent study on long-term impacts of the FP, the European Policy Evaluation Consortium (EPEC) defined a number of long-term impacts which deserve notice when designing future evaluation arrangements (EPEC (2011): Understanding the Long Term Impact of the Framework Programme Final Report to the European Commission, DG Research): (1) Emergence of new technologies or fields of science; (2) Technological trajectories; (3) Integration of research; (4) Cohesion of Europe; (5) Diffusion of innovation in products, services and processes; (6) Strengthened competitive position of industry; (7) Innovation in policy-making; (8) Innovation in the socio-economic sphere. These impact dimensions already take several of the RRI keys into account, for example when mentioning innovations in policy-making.

2. Independent (evaluation) experts should continue to build the core teams, but a stronger involvement of stakeholder groups, CSOs and citizens could yield further benefits.

3. The potential of more diverse evaluation teams, mirroring the European societies in an appropriate way (gender balance, different scientific backgrounds and age groups, interdisciplinarity) should be realised.

4. There is a substantial need to consolidate the information available (problem of information overload) and find a balance between the justified interest of taxpayers and Courts of Auditors to see the value for money and the need to create a trustful environment for supporting research and innovation activities. More meta-evaluations and dissemination of lessons learned could be helpful here.
9. Conclusions and Recommendations

9.1 Conclusions
The study has shown the rationale for EU policy action, the pros and cons of the different policy options and what policy-mix is best suited for the recent SiS topics, which in future will be under the common RRI umbrella. The policy options considered were the baseline option, policy off and doing something radically different.

The study has found that a continuation of the SiS programme in Horizon 2020 in the form of a dedicated programme supported by a dedicated unit within DG RTD (baseline option) yields significant benefits whereas a significant reduction or even stop of activities (policy off option) will cause primarily negative effects. Additionally, the study did not deliver any empirical evidence for a radical change (doing something radically different).

The baseline option in form of a dedicated programme raises the visibility of the covered thematic areas and the policy unit running the programme can help to coordinate action, to raise awareness and willingness, and to keep pushing it on the agenda. This is particularly important, as the need for a programme that addresses the interrelationships between science, research and society is uncontested. Survey results too show an overwhelming number of respondents in favour of a continuation of the SiS programme – the preferred option not only mentioned by the SiS experts in a narrow sense but also respondents with common knowledge in the respective fields. Only three out of 296 respondents demanded the termination of SiS activities. In all thematic areas, survey respondents saw more benefits than risks stemming from a continuation of the SiS programme. The SiS topics were linked closely with the advancement of RRI, the solution of grand challenges and the support of social inclusion, and to a lesser extent also with the improvement of economic competitiveness and scientific excellence. Besides the survey results, literature review shows that the main objectives of Horizon 2020 – excellent science, industry competitiveness and better society – depend on an improved interconnectedness of science, innovation and society, through, for example, an enlargement of the talent pool if more young people and women can be mobilised for science and innovations issues, an enhanced effectiveness of the science system through an improved exchange with other parts of the innovation system, a better performance of the national economies, but also concrete key performance indicators of the single business actors through processes of open innovation and more diversity among the staff, as well as more social inclusion and the reduction of unintended effects and technological disasters.

However, the experts as well as the survey respondents also perceive some risks, which need to be addressed by future actions under Horizon 2020, especially the risk of additional administrative costs for all stakeholders.

The RRI keys – ethics, gender, open access, public engagement, science education and governance—and their links to science and innovation are complex and to a large extent evolving. Policy-makers, programme officers, Courts of Auditors but also evaluators thus should not assume a linear cause-and-effect relationship of policy interventions leading to immediate and tangible outcomes. Given the far-reaching objectives of the SiS topics, effects are difficult to quantify. If there are measurable impacts, they can only be expected to show in the long run and will typically go far beyond the directly expected effects and benefits.

For the future it is crucial to demonstrate the benefits that RRI will bring to research and innovation. This all the more justifies and requires substantial support by EU and the Member States for the RRI keys, in form of research funding, coordination and regulatory activities.

9.2 Recommendations
1. Future policy should be based on a dedicated programme.

2. As the necessary governance structures for a horizontal integration and embedding of the SiS topics seem to be underdeveloped, a dedicated policy unit is needed too which could advance the development of the governance structures that may allow for a more horizontal approach in the future. A dedicated programme and unit should thus be seen as complementary.
3. A dedicated programme should contain, as it does at the moment, different instruments like concrete funding possibilities, support for coordination activities and an embedding of the SiS topics across the entire Horizon 2020. Furthermore, cooperation across Member States and policy networks at national and European level needs to be promoted further.

4. In future, a broader and more varied approach should be used, implementing a policy-mix consisting of stronger regulatory interventions and the support of sustainable institutional structures too.

5. For all SiS topics there is a significant need to continue with the support for research funding projects in order to understand the following aspects:
   - The requirements, mechanisms and impacts of an improved interplay between science, innovation and society.
   - How SiS topics can improve innovation outputs and outcomes, i.e. the positive contributions that a better integration of societal issues can make for the innovativeness and competitiveness of the European economy.
   - It is still not sufficiently well understood how the improved involvement of broader parts of society will impact on future policy-making. The Commission should therefore support studies, which further investigate the complex relationships between an extension of RRI concepts and their effect on policy-making in the area of science and innovation.
   - The existing funding mechanisms seem to some extent sub-optimal as they often focus on CSAs where CPs could lead to better outcomes. Therefore a critical review of the research needs and corresponding instruments is recommended.
   - The Commission focussed in the past on few, but very large projects with the inherent risk that a serious loss (of time, money, findings) might occur. Based on this premise, the Commission is asked to think about the possibilities to offer also opportunities for smaller, mid-term oriented research projects.

6. There is a clear need for enhanced coordination of activities to facilitate mutual learning, avoid overlaps, duplication and conflicts and help to overcome the problem of diverging capacities of Member States and to reduce regional disparities.

7. More emphasis should be placed in future on compiling and communicating evidence that Science-in-Society issues directly contribute to increase the economic competitiveness, as for instance the involvement of broader actor groups may unleash the collective creativity of heterogeneous actors and thus contribute to innovation and competitiveness.

8. At this point in time it is still too early to expect a wide range of quantitative, measurable and tangible results. Therefore Science-in-Society needs to be approached with a decided long-term commitment and realistic expectations on what can be achieved in the short-, mid- and long term.

9. Efforts should be made to avoid risks (perceived and actual) that might be associated with RRI, including imposition of excessive additional costs on research and innovation activities, and a loss of scientific excellence.

10. Efforts should be made to identify and promote the tangible benefits that result from Responsible Research and Innovation, in order to ensure and enhance acceptance among the main stakeholder groups.

11. For the successful integration of RRI keys into the science and innovation process, a combination of bottom-up as well as top-down approaches is needed: As long as the decision-makers at the top of the respective organisations are not committed to the overall RRI aims, every potential progress will be slowed down or even prohibited. On the other hand, the RRI keys need the engagement and commitment of every single researcher or innovator in order to yield the most benefits.

12. Appropriate structures and instruments should be created to facilitate the mobilisation of the central stakeholder groups such as CSOs. In this regard, the MMLs should be further utilised in future as an innovative instrument for bringing diverse actors groups together.
13. European innovation policy will more effectively reach its aims if a stronger involvement and engagement of the private sector is supported, as already foreseen through the shift from "science in society" to "responsible research and innovation".