STRATEGIC OPINION FOR RESEARCH AND INNOVATION IN THE HORIZON 2020 WORK PROGRAMME 2018–2020

Recommendations to the European Commission from the 'Science With and For Society' Advisory Group

Final version

31st May 2016

Table of Contents

Preamble:

'Science with and for Society' in its various guises has been part of European science policy since 2001, first as 'Science and Society' (FP6), then 'Science in Society' (FP7) and since 2014 in Horizon 2020 'Science with and for Society'(SWAFS). This attention to science and society has been coupled with an increasing shift of European science policy towards addressing societal challenges which strengthens both the science and society bond and Responsible Research and Innovation (RRI).

Since the Lisbon Strategy established in 2000[1] and followed by the Europe 2020 Strategy, research and innovation have been seen as key drivers of the European economy as witnessed by the ever-increasing budgets devoted to the research framework programmes. As science, research and innovation take on a wider economic significance for European society, the science and society nexus becomes increasingly important for supporting the delivery of relevant and more effective science, research and innovation.

Society now plays a more active role within science moving from a consumer of science to what might be defined as co-creation or the democratisation of science, which is illustrated by the increased interest in Citizen Science linked to the increasing opportunities of Open Science and Open Access to data and scientific results. Society can now work with and for science as much as science is working with and for society. Therefore, 'Science with and for Society' and 'Responsible Research and Innovation' are not an add-on to science activities but must be areas of enquiry in their own right and must also be embedded into scientific practice at all levels, individual (e.g. Citizen Science, researchers' careers) and institutions within the research and innovation ecosystem and this may require institutional change, for example, in performance metrics and reward and recognition systems.

While the present strategic opinion is largely inspired by the previous opinion delivered by the SWAFS AG in July 2014, the revisited strategy integrates the changes in economic, environmental, social and political contexts, new policy drivers as well as results from current and past projects in FP7 'Science in Society' and Horizon 2020 'Science with and for Society'.

1   Introduction

The *Horizon 2020 Specific Programme* sets the scope and content for the implementation of the Framework Programme for research and innovation (R&I) (2014–2020). Providing the

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[1] The original Lisbon Strategy was launched in 2000 with the objective for the EU "to become the most dynamic and competitive knowledge-based economy in the world by 2010 capable of sustainable economic growth with more and better jobs and greater social cohesion and respect for the environment". Underlying this was the realisation that the EU needed to increase its productivity and competitiveness in the face of ever fiercer global competition, technological change and an ageing population.

legal base as politically agreed with the Member States and the European Parliament, it determines the specific objectives for European Union support to the R&I activities for each Horizon 2020 part. On this basis, the Commission services prepare biannual work programmes of which the first Horizon 2020 work programme covering 2014–2015 was adopted on 10th December 2013, and the second work programme covering 2016–2017 was adopted on 13th October 2015.

The Horizon 2020 Specific Programme describes the aim of Part V 'Science with and for Society' (SWAFS) as follows:

> The aim is to build effective cooperation between science and society, to recruit new talent for science and to pair scientific excellence with social awareness and responsibility.

To achieve this aim, the programme indicates that the focus of the activities will be on eight specific lines including *scientific careers*, *gender*, *integration of society in science and innovation*, *formal and informal science education*, *accessibility and use of results*, *governance for the advancement of responsible research and innovation*, *due and proportional precautions*, and *improve the knowledge on science communication* (see Annex I of the present paper).

Furthermore, Horizon 2020 Specific Programme (in its Annex I-b) underlines the importance of the complementarities and cross-cutting issues between the various parts of Horizon 2020, notably for Science and Society:

> The relationship and interaction between science and society as well as the promotion of responsible research and innovation, science education, science communication and culture shall be deepened and public confidence in science and innovation reinforced by activities of Horizon 2020 favouring the informed engagement of and a dialogue with citizens and civil society in research and innovation" (see Annex II of the present paper).

On this basis, the present opinion provides advice on <u>potential strategic priorities</u> for Horizon 2020 funding for the three-year period 2018–2020, both for the Part V 'Science with and for Society' as well as for the remaining of Horizon 2020 as far as the relationship between science and society is concerned. It is a step towards preparing the next Horizon 2020 work programme covering 2018–2020. The present opinion will be supplemented by a second opinion in 2016/2017 on topics implementing the potential strategic priorities.

The mandate of the SWAFS AG stipulates that:

> advice should pertain to all activities under Horizon 2020 where the integration of a Science with and for Society dimension is relevant, as well as the possible interactions with the other crosscutting issues, as specified in Horizon 2020 (Art. 14), with a particular attention to 'Responsible Research and Innovation including Gender' (RRI)'.

The composition of the SWAFS AG is well adapted to this task, since the group – in addition to SWAFS experts – has members from each of the other Horizon 2020 Advisory Groups.

The reflections of the SWAFS AG have been structured around various reports and the consultation documents provided by the Commission services, and have built on the

experiences and progressive insights of the Advisory Group in 2014 and 2015. Within the general context of the evolution of science and society, the SWAFS AG opinion takes into account the general European policy framework set by Commissioner Moedas' 3 O's strategy (Open Innovation, Open Science, and Open to the World) as well as the Horizon 2020 Work Programmes for the period 2014–15 and 2016–2017. It also draws on the influential MASIS Expert Group Report[2] and topical reports on Responsible Research and Innovation (RRI), ethics, gender, science education, etc., as well as the Rome Declaration on Responsible Research and Innovation in Europe (November 2014)[3] coupled with the Competitiveness Council debate in December 2014[4] which commended the principles outlined in the Rome Declaration. Ministers agreed that Responsible Research and Innovation was a process and implied a close cooperation between all stakeholders in various strands comprising: science education, definition of research agendas, access to research results and the application of new knowledge in full compliance with gender and ethics considerations.

RRI is the process of aligning research and innovation to the values, needs and expectations of society. It requires that all stakeholders (researchers, citizens, policy makers, business, third sector organisations etc.) are responsive to each other and take shared responsibility for the processes and outcomes of research and innovation. RRI focuses on the participation of citizens and civil society organisations in research and innovation, the gender and ethical dimensions, the free accessibility to scientific knowledge and formal and informal science education. However, these benefits will only be realised by embedding RRI within research funding and research funding organisations and hence institutional changes in research performing and research organisations are necessary to incentivise collaboration with actors from civil society, public authorities, and business.

The benefits of RRI go beyond the fulfilment of societal needs and ensure that research and innovation deliver smart, inclusive and sustainable solutions to our societal challenges by engaging new perspectives, new innovators and new talents. RRI builds trust between citizens and public and private institutions in supporting research and innovation and reassures society about embracing innovative products and services and it assesses the risks and the way these risks should be managed.

More than a decade of research and pilot activities on the interplay between science and society illustrates that SWAFS and RRI have a long and evolving research tradition, including interactive and participatory research, which argues that technology acceptance should not be pursued by means of solely economic sustainability. Furthermore, diversity in research and innovation is vital for enhancing creativity and improving scientific quality and this includes the early and continuous engagement of all stakeholders essential for sustainable, desirable and acceptable innovation. Hence, excellence today is about more than ground-breaking

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[2] 'Challenging Futures of Science in Society. Emerging Trends and cutting-edge issues' http://ec.europa.eu/research/science-society/document_library/pdf_06/monitoring-policy-research-activities-on-sis_en.pdf
[3] https://ec.europa.eu/research/swafs/pdf/rome_declaration_RRI_final_21_November.pdf
[4] http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/intm/146048.pdf

discoveries: it includes openness, responsibility and the co-production of knowledge with civil society.

The earlier SWAFS AG's strategic reflections and advice focused on the one hand on <u>Part V</u> 'Science with and for Society' of Horizon 2020 and, on the other, embedding SWAFS/RRI content in other parts of Horizon 2020 and notably on the cross-cutting issue RRI as a sub-set of SWAFS. These two streams, SWAFS and Embedding RRI, still structure the work and reflections of the Advisory Group.

2 SWAFS AG's strategic reflections

The SWAFS AG's strategic reflections have been grounded in the MASIS Expert Group Report that has provided a base for reflection. Recent policy innovations and thinking such as European Innovation Partnerships, Smart Specialisation Strategies (which focus on the regional dimension to business and social innovation) and other activities such as the FP7 projects VOICES[5] and PLACES[6], and the Horizon 2020 CIMULACT[7] and RRI Tools[8] projects have contributed to this strategic thinking. The SWAFS AG also took advantage of the foresight document delivered by the Commission services for the consultation of the AGs as well as previous policy documents and reports from expert groups led by Commission services.

Since the launch of the European Research Area in 2000, science and society aspects have been explicitly present at the European level. The 2020 Vision for the European Research Area, adopted by the Council in December 2008, underlined that 'the ERA is firmly rooted in society and responsive to its needs and ambitions in pursuit of sustainable development' and one year later, in July 2009, the Lund Declaration called for a new deal in European research, advocating that the identification of the Grand Challenges must engage the major stakeholders including the European institutions, business, public services, NGOs and the research community. The recent ERA road map[9] argues for more attention to be placed on a limited set of objectives which includes the optimal circulation of knowledge through encouraging knowledge sharing and open access and gender equality and gender mainstreaming in science.

The latest Lund Declaration (December 2015)[10] reinforced this call by arguing for priority action to incentivise Europe's public research organisations to strengthen the interface and collaboration with stakeholders and actors outside the academic community and to strengthen the pro-active involvement of end-users, public sector and industry in addressing societal challenges including demand-side actions.

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[5] http://www.voicesforinnovation.eu/

[6] http://www.openplaces.eu/

[7] http://cordis.europa.eu/project/rcn/197909_en.html

[8] www.rri-tools.eu

[9] https://era.gv.at/object/document/1845/attach/ERA_Roadmap_st01208_en15.pdf

[10] http://www.vr.se/download/18.43a2830b15168a067b9dac74/1454326776513/The+Lund+Declaration+2015.pdf

The Commission's response[11] in January 2016 to the Evaluation of the Seventh Framework Programme Report of the Expert Group[12] explicitly recognises the need to 'bring science closer to the citizens' and agrees with the High Level Expert Group that the engagement of the general public with the Programme and more generally the active participation of citizens in science is important. In its implementation, Horizon 2020 engages citizens and other relevant stakeholders through the development of Responsible Research and Innovation agendas and by providing greater support to public outreach activities.

While some of these statements were programmatic, by now they are somewhat operational, and this can be further supported and stimulated in Horizon 2020 through Science with and for Society and the other lines adopting a Responsible Research and Innovation (RRI) approach. RRI is still open-ended, in the sense that its characteristics are not yet fully settled. It is a social innovation, and joint learning processes are needed to articulate and implement it.

2.1 Diagnosis of the interface between science and society

Although the diagnosis has not fundamentally changed from the 2014 strategy paper of the SWAFS AG, the societal and policy context is changing (e.g. the UN's Sustainable Development Goals, the adoption of the Paris Agreement on Climate Change and the current migration crisis) and has induced some fine tuning of the strategy.

There are broad and deep changes in the evolution of science and its interactions with society, which are a starting point and opportunities for SWAFS which go much further than work to restore trust and confidence in science. Science has the potential to help solve problems faced by European society.

Some of these problems have been identified in the Communication of the Commission 'Taking stock of the Europe 2020 strategy for smart, sustainable and inclusive growth' (COM (2014) 130) namely: societal changes in European and global society (e.g. new forms of urban and rural lifestyles, new consumption and mobility patterns, new and more diverse family settings), globalisation and trade, productivity developments, and pressure on natural resources.

Other problems were discussed in the 2009 MASIS Expert Group Report, particularly the diagnosis of the re-contextualisation of science in society, both as a trend and as something to be pursued as important. The background question, of course, is "what science (and innovation) for what society?"[13] The report suggests this is not a matter of stipulation, but of open-ended debate and learning-by-doing. However, there is an assumption that closer interaction can go hand in hand with high quality science.

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[11] http://ec.europa.eu/research/evaluations/pdf/archive/fp7-ex-post_evaluation/commission_communication_1_en_act_part1.pdf#view=fit&pagemode=none

[12] http://europa.eu/rapid/press-release_IP-16-145_en.htm

[13] The opposite may also be worth exploring.

The various and tentative accounts and narratives of the relationship between science and society, its importance, the degree of urgency to act, and the kind of activities that should be launched in response to these assessments, depending on the normative approach adopted imply that learning-in-interaction must be important for the SWAFS Work Programme as well as for RRI. This will shape the content of the calls (for example, the role of intermediary actors and organisations could be studied) as well as the nature and shape of activities.

There are a few immediate suggestions:

1. The adoption of Responsible Research and Innovation as a cross-cutting issue in Horizon 2020 is still seen as positive and instrumental to move towards open innovation and open science explicitly integrated in society;

2. Although there is a good basis of knowledge and understanding, including expert group reports to the Commission, action can be taken in a number of domains, and this basis of knowledge and understanding should be extended and constantly updated;

3. Past pilot activities have shown a great potential for the future, notably by establishing good practices, but there are bottlenecks in terms of knowledge, behaviours, and translations of good practices in public and private governance frameworks;

4. Responsible Research and Innovation encourages the democratisation of science which will lead to science, research and innovation having more impact at societal level thereby benefiting society and strengthening both engagement in and the acceptance and the quality of science, research and innovation.

In addition, the SWAFS AG made an attempt to formulate an overall guiding vision as a base for the 2016–2017 strategy and work programme. Below is a slightly edited version of that guiding vision:

> In tomorrow's Europe, science institutions and scientists engage with society, while citizens and civil society organisations engage freely with science; thereby contributing to a European society which is smart, sustainable and inclusive.

This vision is in line with visions that are formulated by the Commission and other relevant actors, but it is distinctive in two ways. First, it is explicitly interactive, in contrast to outreach activities where science as such is to be brought closer to citizens. This interactive approach has, for example, led the Advisory Group, in its proposal of options for the work programme 2016–2017, to include the topic 'Integration of society in science and innovation.'

Second, it explicitly addresses institutions and organisations. This is visible in the topics proposed for the work programme 2016–2017. The Rome Declaration on RRI, of November 2015, was similarly explicit in addressing research performing organisations and institutions where research is undertaken, and research using organisations where research is translated into policy and practice. This is because changes for the better (innovation), while instigated by individual researchers, do require institutional change, often at multiple levels, for example

the science institution, public authorities, business and voluntary sector organisations in what is sometimes referred to as the innovation eco-system or quadruple helix partnerships between research organisations, government, business and civil society actors.

2.2 Recent policy drivers for Horizon 2020

In a speech in June 2015[14], Commissioner Moedas identified three major challenges:

1. Lack of success in getting research results to market. Technologies developed in Europe are most of the time commercialised elsewhere;

2. Although Europe generates more scientific output than any other region in the world, in some areas we fall behind on the very best science. At the same time, there is a revolution happening in the way science works. Every part of the scientific method is becoming an open, collaborative and participative process;

3. Europe punches below its weight in international science and science diplomacy. Our collective scientific importance should be matched by a more active voice in global debates.

In order to address these weaknesses, Commissioner Moedas identified three strategic priorities: Open Innovation, Open Science, and Openness to the World. Since this landmark speech, flesh is being put on the bones as illustrated by the recently published *Open innovation, Open science, open to the world*[15] suggesting that:

> The research process of the future will be global, networked and open. Many more actors will take part in different ways and the traditional methods of organising and rewarding research will also see many changes (p. 55).

Commissioner Moedas is supporting a more inclusive science through Citizen Science that he sees in his 3Os strategy 'often linked with outreach activities, science education or various forms of public engagement with science as a way to promote Responsible Research and Innovation' (*ibid.*, p. 54).

Several Open Science initiatives deserve to be mentioned, such as the Open Science Policy Platform[16] and the Open Science Cloud. By bolstering and interconnecting existing research infrastructure, the Commission plans to create a new European Open Science Cloud that will offer Europe's 1.7 million researchers and 70 million science and technology professionals a virtual environment to store, share and re-use their data across disciplines and borders. This will be underpinned by the European Data Infrastructure, deploying the high-bandwidth networks, large scale storage facilities and super-computer capacity necessary to effectively access and process large datasets stored in the cloud.

In April 2016, the Open Science Conference in Amsterdam launched a call for action of 12 points[17] which could be summarised under removing barriers to open science; developing

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[14] http://europa.eu/rapid/press-release_SPEECH-15-5243_en.htm

[15] http://bookshop.europa.eu/en/open-innovation-open-science-open-to-the-world-pbKI0416263/

[16] http://ec.europa.eu/research/openscience/index.cfm?pg=open-science-policy-platform

[17] http://english.eu2016.nl/documents/reports/2016/04/04/amsterdam-call-for-action-on-open-science

research infrastructures; fostering, creating incentives and mainstreaming open science and embedding open science in society.

In May 2016, the Council recognised the 'on-going transformation and opening up of science and research, referred to as 'open science', affecting the modus operandi of doing research and organising science'. It is considered, inter alia, that:

> assessing scientific quality should be based on the work itself and be broadened to include an assessment of the impact of science on society at large, while the current focus is on indicators based on impact of journals and publication citation counts.[18]

The Commission have also identified key policy drivers for Horizon 2020 such as:

- Market creation and open innovation linked to the proposed European Innovation Council[19] (the EIC is very much linked to the Open Innovation pillar of Commissioner Moedas' 3O strategy)
- Migration
- Security (terrorism, radicalisation and cyber security)
- Physical meets digital (e.g. the Digital Single Market strategy – and the Science Cloud)
- Energy and resource scarcity (e.g. see the Circular Economy package launched in 2016)
- Sustainable Development Goals[20]
- Making the EU a stronger global actor.

2.3 Implications for Horizon 2020

The above vision, previous related FP6 and FP7[21] activities, the content of the first Horizon 2020 Work Programmes for 2014–15, as well as the content and policy context of Horizon 2020, lead the SWAFS AG to formulate implications for Horizon 2020 WP 2016–2017.

Below is a slightly edited version of the implications in the Strategic Opinion of the AG in July 2014.

1. Anticipation (including participatory foresight) should be an integral part of SWAFS activities, as well as in other parts of Horizon 2020 when articulating RRI. This should include consideration of dynamics in the evolution of science in its relation to society, at present and where it might be within 20 years.

2. Part of the Horizon 2020 funds should be reserved for research projects aiming to strengthen and update the knowledge base related to SWAFS topics and background issues.

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[18] 'Council conclusions on the Transition towards an Open Science system', Council conclusions (adopted on 27/05/2016): http://data.consilium.europa.eu/doc/document/ST-9526-2016-INIT/en/pdf

[19] http://ec.europa.eu/research/eic/index.cfm A recent consultation provoked over 1,000 responses and 170 position papers.

[20] http://www.un.org/sustainabledevelopment/sustainable-development-goals/

[21] See Technopolis and Fraunhofer's mid-term assessment of FP7-Science in Society:
https://ec.europa.eu/research/swafs/pdf/pub_archive/phase01-122012_en.pdf

3. Part of the Horizon 2020 funds should be reserved for projects that involve a stronger citizen/science engagement including broad consultations (going beyond the Commission's minimum standards) where citizens can co-construct future R&D and its design, often involving problem solving at the regional and local level.

4. Coordination, support and pilot activities should be continued and new activities launched in order to consider evolving institutional landscapes for research and innovation and thus help knowledge institutions to develop their leadership, management and governance frameworks to encourage and support Responsible Research and Innovation approaches, and embed SWAFS into institutional policy and practice.

5. Encouraging a wider participation of new actors in science stimulated by RRI activities. New actors should include business, social partners and citizens with more focus on the potential opportunities of citizen science in the broad sense of the notion.

3   Opinion on Part V: 'Science With And For Society' (SWAFS)

Taking into account the above vision outlined by the SWAFS AG and given its capacity to use various types of actions of Horizon 2020 (RIA (Research and Innovation Actions) and CSA (Coordination and Support Actions)), the SWAFS programme plays a strong role in understanding and contributing to enhancing the science and society interface and for advancing the governance of Responsible Research and Innovation in the ERA. This role focuses on three main areas:

1. supporting institutional change to strengthen the embedding of RRI,
2. supporting activities at the national, regional and local levels, and
3. contributing to the understanding of science and society by developing a strong knowledge base.

The strategic orientations for 2016–17 built on the strategic vision formulated in July 2014, and incorporated experience and increased understanding since then. The strategic orientations for 2018–2020 continue this process and add some further thinking. Because there are as yet few results from the first round of funding (work programme 2014–2015), and the work programme 2016–2017 has not yet really started, the AG cannot draw on systematic analysis of findings but has to work with impressions. One such impression is that the strategic orientations for SWAFS 2016–2017 are still relevant for 2018–2020 and that the importance of institutional change is now recognized. Nevertheless, there is still work to do, for example, many research performing organisations still endorse a linear model of research and innovation and do not have the structures in place to incentivise and support researchers in the process of co-creation of knowledge with the surrounding society and embedding this in social innovation. This institutional challenge needs to be pursued along with a stronger focus on what lies behind the concepts of open science and open innovation, and how they are related to each other.

3.1 Main strategic orientations for SWAFS 2018–20

1. **SWAFS Institutions:** Supporting institutional changes in research and science institutions and regional and local authorities which will strengthen the embedding of RRI in ERA through the spreading of good practice, encouraging collaborations between institutions, studies and innovative activities while acknowledging the diverse contexts of different institutions.

2. **SWAFS Local:** Networking regional and national 'SWAFS-type' quadruple helix partnerships involving universities, government, business and civil society organisations programmes; the European level is relevant for a number of specific activities but some other are better tackled at local, regional and national level where many societal challenges such as the need for sustainable, healthy and age friendly cities are made manifest and require new ways of working and modes of regulation. The EC has the possibility, e.g. with ERA-Net type of activities, to help the reinforcement and dissemination of SWAFS good practices between regions and Member States in their support of institutional changes. This could be linked to the work of the JRC/IPTS Smart Specialisation Platform which is helping to support regions partner with universities in implementing their regional innovation strategies and respond to societal challenges that have a territorial dimension. This regional level may have a stronger SWAFS relevance as EU cohesion policy (structural funds) shifts its funding to more research and innovation priorities.

3. **SWAFS Knowledge Base**: Understanding the evolution of science and society is important for building relevant policies. SWAFS could favour the launch of large bottom-up clusters of research projects likely to shed light on SWAFS topics and background issues. Our vision can be used to develop further topics for study and action, such as the role of intermediaries and boundary spanners on the interface between science and society, or the need for competencies and learning both at the side of scientists and science institutions, and at the side of citizens and civil society organisations. The interface between science and society must be more thoroughly addressed so as to shed light on how societal actors understand, react to and interact with science (understood in its broadest sense, i.e. not just limited to the STEM fields), and their motives for engaging in science-related activities. Another source of topics and issues, in addition to the themes already in the work programmes 2014–2015 and 2016–2017, are the broad and deep changes in science and its interactions with society. One example is how 'open access' and 'big data', presently high on the agenda, should be positioned as part of larger issues, starting with using phrases like 'open science'[22] and 'open innovation', and continuing by inquiring what 'open' could mean and what its function could be. This would include the rise of new scientific disciplines, innovative pathways in publishing (among them a substantial rise of open access journals), education and research careers that encompass

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[22] See also the *Draft European Open Science Agenda*:
https://ec.europa.eu/research/openscience/pdf/draft_european_open_science_agenda.pdf#view=fit&pagemode=none.

academic and extra-academic activities, new scientific reputation systems, including alternative metrics.

4. **SWAFS Citizen Science:** An important policy orientation at Commission level under the 3O's strategy is the promotion of Citizen Science. Some definitions of Citizen Science[23] suggest that Citizen Science spans a range of levels of engagement: from being better informed about science, to participating in the scientific process itself by observing, gathering or processing data. Citizen science goes beyond a pure data collection function and citizens can participate in the scientific research process in different possible ways such as observers and funders. It is clear that much more attention is needed regarding meanings, mechanisms, and the challenges of Citizen Science. One of these challenges could be the risk of neglecting existing wider public engagement tools for science. Citizen Science will also engender debate regarding professionalism both in terms of diversified research careers – that include interactions with society – and the way the quality and impact of research are evaluated. What oversight provisions should be put in place for citizen-initiated health research? How can scientists work with citizen-scientists without exploiting them and how should funding agencies determine the potential of citizen science projects? Citizen Science will therefore require relevant monitoring and an attached evaluation model to measure impact.

5. **SWAFS Challenges:** Substantial issues of science and technology in society are taken up in Horizon 2020 already, and there is the broader discussion (and some implementation) of Grand Challenges. SWAFS can and should contribute by locating them in overall changes in the interactions of science, technology and society. One example is the ever-increasing importance of the life sciences, which goes much deeper than global competiveness. The Strategic Foresight report by SAMI Consulting offers important analysis for several areas (and in different scenarios) like hyper-connectivity, health as a key driver of aspirations, and new biotechnology as a next revolution.[24] Such considerations should inform the present move towards so-called Focus Areas. What is also important (and where SWAFS can contribute) is that addressing Grand Challenges actually requires rethinking and re-doing our usual ways of research and innovation.[25]

4 Opinion on embedding RRI in Horizon 2020

All parts of Horizon 2020 have a clear role to play in embedding RRI. Parts II 'Industrial Leadership' and III 'Societal challenges' should devote part of their efforts and their thinking to that end. Progress has been done between WP 2014–2015 and WP 2016–2017 as three-quarters of Horizon 2020 lines are now explicitly, but not fully, addressing RRI. There is still

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[23] https://ec.europa.eu/digital-single-market/en/citizen-science

[24] http://bookshop.europa.eu/en/strategic-foresight-pbKI0215938/

[25] See Kuhlmann and Rip (2014), *The Challenge of Addressing Grand Challenges*. In this respect the Lund Declaration on Grand Challenges of December 2015 is disappointing, because it reverts to pushing traditional ways of doing things.

progress to be done nevertheless in shaping narratives, rationales and related topics. This is the real challenge for the last work programme of Horizon 2020.

The role of the SWAFS AG, composed in its majority of experts from other AGs, will take on added significance in spreading the RRI key messages. Indeed 20 experts belong to the 16 AGs advising Part I to IV of Horizon 2020 and eight experts are from the SWAFS fields. All 28 experts will work together in order to promote RRI in Horizon 2020 beyond its Part V.

The SWAFS AG recommends to the other AGs and to the EC services to consider the following strategic lines.

4.1 Main strategic orientations for better embedding RRI in Horizon 2020 Work Programme for the period 2018–2020

1. **Institutional RRI:** Institutions specific to the Horizon 2020 fields should receive support to evolve and integrate RRI including gender in their governance settings. These changes should involve all stakeholders and not only research funding and performing organisations. Civil Society Organisations, business and policy makers should be eligible to community support for RRI institutional changes. Consideration could be given to a 'seal of excellence' for SWAFS which could help influence and support other local institutions to change towards more RRI-aware operations. The development of Key Performance Indicators should be suggested to help institutions benchmark themselves and strive for improvement.

2. **Innovation RRI:** While the European Research Area has been successful in creating spaces for European science, it is now time to become more pro-active, and not just in relation to the Grand Challenges. There is a need for a new narrative drawing on a broad-based innovation strategy encompassing both technological and non-technological innovation at all levels of European society, and with a stronger focus on communication between science, the citizen and responsible and sustainable business – a quadruple helix and place-based approach to science, research and innovation which will also encompass the role of universities within the quadruple helix. This goes further than the procedural challenge how each part of Horizon 2020 can engage citizens and civil society in its activities and it draws attention to non-traditional locations of, and spaces for innovation, such as (smart) cities and regions.

3. **Co-construction RRI**: Integrating RRI in Horizon 2020 activities includes the need to articulate the way these are connected to citizens and society (providing evidence). This goes much further than communication, however important that is. Public engagement with science (and technology), including participation of various kinds such as citizen science, is increasingly experimented with, but could become a 'citizen-participation wash' rather than serious co-construction. Learning-by-doing will be important, including occasional evaluations. Quality assurance of inputs and interactions is important, also for the inputs from scientists into the interactions (cf. the symmetrical approach formulated in the guiding vision of SWAFS AG). The mobility of researchers within the European Research Area is of crucial importance for RRI co-construction. High-risk and high-reward projects engendering disruptive ideas and novel approaches that could lead to new innovative outputs should be supported.

4. **Cross-cutting RRI:** While RRI (including gender) is increasingly visible in Horizon 2020 parts/lines, this is often ad-hoc. More effort must be put into making this cross-cutting theme visible in the work programmes of the various parts/lines in Horizon 2020. These efforts should run along parallel lines. An operational system to systematically mainstream RRI including gender in Horizon 2020 should be put in place. The spirit behind RRI can be taken up in a diagnosis[26] of what is at stake in a topic or a proposal. The lessons learned from best practice areas with longer experience of RRI such as health should be shared. Training and guidance manuals for evaluators, project coordinators and project participants should be produced[27] and criteria for success developed.

5. **Individual RRI:** Ultimately, and to a certain extent to begin with, RRI is promoted and put into practice by individuals. One aim would be that every individual in European society feels concerned by and engages with activities aiming to embed RRI in society. This would strengthen Europe as a whole, in the face of other global regions. How RRI can be communicated and brought to the individual level requires some research and better understanding, eg. within the fields of behavioural sciences and communication studies. However, every education and research institution at university level should consider having an educational programme devoted to embedding RRI in how future scientists think and do their research and contribute to society.

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[26] The CIMULACT project funded under SWAFS 2014–2015 should help in that respect (see http://www.cimulact.eu/)

[27] The RRI Training Toolkit is a good basis (see http://www.rri-tools.eu/).

5 Conclusion

The SWAFS AG vision focuses on mutual engagement between science institutions, scientists, citizens and society driving Europe towards its Europe 2020 goals of a smart, sustainable and inclusive society. While recognising that the diagnosis developed for the previous AG Report remains valid, SWAFS and RRI evolve in a rapidly changing context as illustrated in section 2 of this report.

The AG recommendations illustrate the increasing interest in open science and open innovation at the European level. More than ever an effective science, research and innovation system is seen as the mainstay of the European economy but as science, research and innovation play this economic and societal role so is there concomitant interest in the interface between science, research and innovation and society. However, this interest has to be more than academic. It is in Europe's interest to develop effective science, research and innovation ecosystems across the whole of Europe. Societal engagement in building these ecosystems, as witnessed by the rise of citizen science, will be key to their success and thus the SWAFS and RRI programmes must be integral parts of Horizon 2020 and future programmes.

On the basis of the meetings and exchange between its members, the SWAFS AG suggests adopting the following strategic priority lines for the period 2018–2020:

Recommendations for SWAFS and RRI strategy

Part V 'Science with and for Society' should:

1. SWAFS Institutions: Supporting institutional changes in research and science institutions and regional and local authorities, including the development of Key Performance Indicators.

2. SWAFS Local: The European level is relevant for a number of specific activities but some other are better tackled at local, regional and national level.

3. SWAFS Knowledge Base: Understanding the evolution of science and society: this is important for building relevant policies. SWAFS could favour the launch of large bottom-up clusters of research projects likely to shed light on SWAFS topics and background issues.

4. SWAFS Citizen Science: An important policy orientation at Commission level under the Moedas 3O's strategy is the promotion of Citizen Science. Much more attention is needed regarding meanings, mechanisms, and challenges of Citizen Science.

5. SWAFS Challenges: Substantial issues of science and technology in society are taken up in Horizon 2020 already: there is the broader discussion (and some implementation) of

Grand Challenges that require rethinking and redoing our usual ways of research and innovation.

The other parts of Horizon 2020 should:

1. Institutional RRI: Institutions specific to the Horizon 2020 fields should receive support to evolve and integrate RRI including gender in their governance settings.

2. Innovation RRI: There is a need for a new narrative for all EC research and innovation activities, in phase with the opening strategy of Carlos Moedas, drawing on a broad-based innovation strategy encompassing both technological and non-technological innovation at all levels of European society, and with a stronger focus on the citizen.

3. Co-construction RRI: Integrating RRI in Horizon 2020 activities includes the need to articulate the way these are co-constructed with citizens and society (providing evidence).

4. Cross-cutting RRI: While RRI (including gender) is increasingly visible in Horizon 2020 parts/lines, this is often ad-hoc. More attention should be paid to the implementation of an RRI approach in the support to other cross-cutting issues (e.g. sustainability) and focus areas. An operational system to systematically mainstream RRI including gender should be put in place, and training and guidance manuals produced.

5. Individual RRI: One aim should be that every individual in European society feels concerned by and engages with activities aiming to embed RRI in society. This would strengthen Europe as a whole, in the face of other global regions. Every research institution at university level should consider having an educational programme devoted to embedding RRI in how future scientists think and do their research and contribute to society.

6 Annexes

Annex I: Horizon 2020 Specific Programme:

    Part V 'Science With and For Society'

Annex II: Horizon 2020 Specific Programme:

    '2. Complementarities, Cross-cutting Issues and Support Measures'

Annex III: List of AG members

6.1 Annex I: Horizon 2020 Specific Programme – Part V 'Science With and For Society'

'The aim is to build effective cooperation between science and society, to recruit new talent for science and to pair scientific excellence with social awareness and responsibility.

The strength of the European science and technology system depends on its capacity to harness talent and ideas from wherever they exist. This can only be achieved if a fruitful and rich dialogue and active cooperation between science and society is developed to ensure a more responsible science and to enable the development of policies more relevant to citizens. Rapid advances in contemporary scientific research and innovation have led to a rise of important ethical, legal and social issues that affect the relationship between science and society.

Improving the cooperation between science and society to enable a widening of the social and political support to science and technology in all Member States is an increasingly crucial issue which the current economic crisis has greatly exacerbated. Public investment in science requires a vast social and political constituency sharing the values of science, educated and engaged in its processes and able to recognise its contributions to knowledge, society and economic progress.

The focus of activities shall be to:

(a) make scientific and technological careers attractive to young students, and foster sustainable interaction between schools, research institutions, industry and civil society organisations;

(b) promote gender equality, in particular by supporting structural changes in the organisation of research institutions and in the content and design of research activities;

(c) integrate society in science and innovation issues, policies and activities in order to integrate citizens' interests and values and to increase the quality, relevance, social acceptability and sustainability of research and innovation outcomes in various fields of activity from social innovation to areas such as biotechnology and nanotechnology;

 (d) encourage citizens to engage in science through formal and informal science education, and promote the diffusion of science-based activities, namely in science centres and through other appropriate channels;

(e) develop the accessibility and the use of the results of publicly-funded research;

(f) develop the governance for the advancement of responsible research and innovation by all stakeholders (researchers, public authorities, industry and civil society organisations), which is sensitive to society needs and demands, and promote an ethics framework for research and innovation;

(g) take due and proportional precautions in research and innovation activities by anticipating and assessing potential environmental, health and safety impacts;

(h) improve knowledge on science communication in order to improve the quality and effectiveness of interactions between scientists, general media and the public.'

6.2 Annex II: Horizon 2020 Specific Programme – '2. Complementarities, Cross-cutting Issues and Support Measures'

2. COMPLEMENTARITIES, CROSS-CUTTING ISSUES AND SUPPORT MEASURES

Horizon 2020 is structured around the objectives defined for its three priorities: "Excellent science", "Industrial leadership" and "Societal challenges". Particular attention will be paid to ensuring adequate coordination between these priorities and fully exploiting the synergies generated between all specific objectives to maximise their combined impact on the higher level policy objectives of the Union. The objectives of Horizon 2020 will therefore be addressed through a strong emphasis on finding efficient solutions, going well beyond an approach based simply on traditional scientific and technological disciplines and economic sectors.

Cross-cutting actions will be promoted across Part I 'Excellent Science', Part II 'Industrial Leadership', Part III 'Societal Challenges', Part IV 'Spreading excellence and widening participation' and Part V 'Science with and for society' to develop jointly new knowledge, future and emerging technologies, research infrastructures and key competences. Research infrastructures will also be leveraged for broader usage in society, for example in public services, promotion of science, civil security and culture. Furthermore, priority setting during implementation for the direct actions of the JRC and the activities of the European Institute of Innovation and Technology (EIT) will be adequately coordinated with the other parts of Horizon 2020.

Furthermore, in many cases, contributing effectively to the objectives of Europe 2020 and the flagship initiative "Innovation Union" will require solutions to be developed which are interdisciplinary in nature and therefore cut across multiple specific objectives of Horizon 2020. Horizon 2020 includes specific provisions to incentivise such cross- cutting actions, including by an efficient bundling of budgets. This includes also for instance the possibility for the priority "Societal challenges" and the specific objective "Leadership in enabling and industrial technologies" to make use of the provisions for financial instruments and the dedicated SME instrument.

Cross-cutting actions will also be vital in stimulating the interactions between the priority "Societal challenges" and the specific objective "Leadership in enabling and industrial technologies", needed to generate major technological breakthroughs. Examples of where such interactions may be developed are: the domain of e-Health, smart grids, intelligent transport systems, mainstreaming of climate actions, nanomedicine, advanced materials for lightweight vehicles or the development of bio-based industrial processes and products. Strong synergies will therefore be fostered between the priority "Societal challenges" and the development of generic enabling and industrial technologies. This will be explicitly taken into account in developing the multi-annual strategies and the priority setting for each of these specific objectives. It will require that stakeholders representing the different perspectives are fully involved in the implementation, and in many cases it will also require actions which bring together funding from the specific objective "Leadership in enabling and industrial technologies" and the relevant specific objectives of the priority "Societal challenges".

Particular attention will also be paid to the coordination of activities funded through Horizon 2020 with those supported under other Union funding programmes, such as the Common Agricultural Policy, the Common Fisheries Policy, the Life Programme, the Erasmus+ programme or the Health for Growth Programme and the Union's external and development funding programmes. This includes an appropriate articulation with the cohesion policy in the context of national and regional R&I strategies

for smart specialisation, where support to capacity-building for research and innovation at regional level may act as a 'stairway to excellence', the establishment of regional centres of excellence may help close the innovation divide in Europe, or support to large-scale demonstration and pilot line projects may aid in achieving the objective of generating industrial leadership in Europe.

B. Science and society

The relationship and interaction between science and society as well as the promotion of responsible research and innovation, science education, science communication and culture shall be deepened and public confidence in science and innovation reinforced by activities of Horizon 2020 favouring the informed engagement of and a dialogue with citizens and civil society in research and innovation.

C. Gender

Promoting gender equality in science and innovation is a commitment of the Union. In Horizon 2020, gender will be addressed as a cross-cutting issue in order to rectify imbalances between women and men and to integrate a gender dimension in research and innovation programming and content.

6.3 Annex III: List of AG members

Surname, first name, gender and nationality

CAHILL, Jean	F	IE
FERNANDEZ PEÑA, Maria Teresa	F	ES
FLORIN, Marie-Valentine	F	FR
GODDARD, John	M	UK
GUIBAULT, Lucie	F	NL
HELMAN, Ana	F	HR
JERMOL, Mitja	M	SI
KALTSCHMITT, Martin	M	DE
LEONE, Cristina	F	IT
LINDHOLM, Maria	F	SE
LINDHULT, Erik	M	SE
LIPINSKY, Anke	F	DE
MANGALAGIU, Diana	F	RO
MANGO, Carlo	M	IT
ORESIC, Matej	M	SI
PALMROTH, Minna	F	FI
PORTIER, Philippe	M	FR
PRENNINGER, Peter	M	AT
RANGUS, Vanja	F	SI
RIP, Arie	M	NL
SERREAULT, Brigitte	F	FR
STILGOE, Jack	M	UK
STRES, Spela	F	SI
TUFFS, Richard	M	UK
VAN DEN HOVE, Sybille	F	BE
VILYS, Mantas	M	LT
ZADROZNY, Thomas	M	BE/PL
ZOLYOMI, Agnes	F	HU