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Science with and for Society in Horizon 2020

Achievements and Recommendations for Horizon Europe

Research and Innovation

Science with and for Society in Horizon 2020 - Achievements and Recommendations for Horizon Europe

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Science with and for Society in Horizon 2020

Achievements and Recommendations for Horizon Europe

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Science with and for society

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EXECUTIVE SUMMARY

Research and innovation are essential to finding solutions to the pressing challenges we face. It requires opening up the research and innovation system to the participation and collective intelligence of society, embedding high integrity and ethics standards, raising interest in science, and supporting Europe's brightest minds engage in scientific careers. Put simply, Europe cannot thrive without ensuring the best possible match between the immense potential achievements science has to offer and the needs, values and aspirations of citizens.

The objective of this report is to convey the achievements of the Science with and for Society (hereinafter SwafS) part of Horizon 2020, stemming from funded projects and key activities. Its purpose is to serve as input for the preparation of the Horizon Europe programme implementation.

This executive summary takes a glimpse at some of the elements addressed in each chapter corresponding to the thematic areas of SwafS.

Overview of SwafS Implementation in Horizon 2020

A budget of EUR 462 million was earmarked for SwafS in Horizon 2020. Close to 2,000 proposals submitted in response to the annual calls for proposals, conveys strong interest in SwafS matters.

The annual evaluations are deemed to be highly robust. So far, they resulted in 150 funded projects and close to 50 more projects are expected to stem from the final calls under Horizon 2020. Since the start of this Framework Programme, REA Unit B.5 manages the projects. SwafS projects are typically composed of large consortia with an average of 11 partners and tend to run for around 3 years.

Research ethics and research integrity

For all research activities funded by the European Union, adhering to the highest standards of research ethics and integrity is pivotal to achieving research excellence in all domains. To this end, the SwafS projects produced a broad array of tools to promote and support compliance including education material, guidelines, toolkits and Standard Operating Procedures frameworks.

To tackle the complex ethical challenges of new emerging technologies with high socio-economic impact (genomics, human enhancement and human–machine interaction, artificial intelligence and big data), a cluster of projects are working on enhancing the existing legal and normative framework of such fields and contribute to the ongoing policy discussions on their governance and regulatory aspects.

To develop research integrity educational materials and innovative resources, dedicated projects are working in synergy to develop tailored curricula and educational tools to promote a culture of research integrity.

To strengthen the EU capacity to uphold the highest ethical standards for research carried out in Europe and worldwide, a dedicated European Network of research ethics committees and research integrity offices (ENERI) has been set up to strengthen exchanges of good practice and increase collaboration among the main national research integrity and ethics actors.

In 2019, at the 5th World Conference on Research Integrity in Hong Kong, the Embassy of Good Science platform was launched as a 'one stop shop' for all ethics and research integrity reference materials and trainings, with its outreach extending beyond Europe.

Science education

Creative and innovative science teaching and learning help young people make the best use of their capacities to become a force of innovation. The main goals of science education include boosting the participation rates of young people in STEM[1] with a view to encouraging long-term careers in these fields. More broadly speaking, science education seeks to equip citizens with the skills required to partake actively in science.

Science education projects produced a range of ready-to-use material for students (online lessons, an online encyclopaedia and a range of apps) and teachers (repositories and tool-kits encompassing practical tips to support their teaching). With schools at the heart of science education, a number of projects are developing an open schooling model to facilitate outreach to the local community.

The European Union Contest for Young Scientists (EUCYS) is the flagship competition for science education and has proven to be an excellent way to engage and showcase the work of students and young scientists.

Scientix, the community for science education in Europe, promotes and supports a European-wide collaboration among STEM education professionals. Looking to the future, Scientix is well placed to facilitate exploitation of the vast array of material produced and ensure project outcomes are fully harvested.

Science careers

The European Research Area (ERA) priorities underline the importance of an open labour market for researchers, entailing the removal of barriers to researchers' mobility as well as enhancing their training and career opportunities. The EURAXESS – Researchers in Motion initiative strives to become the global support and career development tool for researchers, both in terms of their mobility within and beyond Europe as well as networking with researchers from all over the world.

Enhancement of EURAXESS services included expanding its services centres geographically as well as offering researchers a suite of tools for their career development to equip them for an international career. On-campus events in a number of countries complemented this effort.

The challenge of migration flows led to the Science4Refugees initiative directed towards enabling refugee researchers or scientists (granted asylum in a host country) to pursue their educational path or enter the labour market. Finally, with the advent of the Open Science Agenda, attention has shifted to developing the open science skills of researchers with new projects recently embarking in this area.

Gender equality

Since the Commission's ERA Communication of 2012, gender equality as a priority has strengthened progressively. Three objectives were identified: gender equality in careers at all levels; gender equality in decision making; integration of the gender dimension into Research and Innovation (R&I) content. To achieve these objectives the EC has devised a comprehensive strategy to support national reforms and foster an institutional change[2] within research funding and research-performing organisations, including universities, through the implementation of gender equality plans (GEP), supported under SwafS.

[1] Science, Technology, Engineering and Mathematics

[2] An institutional change is a change (with meaningful impact) in terms of how a beneficiary governs or structures itself in relation to any of the RRI dimensions (public engagement, open access, gender, ethics, science education), and lasts beyond the lifetime of project funding. See more on the explanation of the notion here.

The ERA Communication of 2012 outlined minimum requirements for a GEP. Along with these, and building on lessons learned from EU-funded GEP projects, the GEAR tool (developed by the European Institute for Gender Equality in collaboration with DG R&I) offers step-by-step guidance with concrete examples to develop GEPs in Research Performing Organisations (RPOs). GEP projects produced a wealth of resources useful for organisations seeking to develop such plans, including a glossary of gender equality-related terms, handbooks on the recruitment and promotion processes, indicators etc., as well as a suite of trainings.

In addition, policy-related projects support a coherent framework of activities including trans-national policy networks, communities of practice on GEPs, a gender equality academy for GEPs, tackling gender bias in allocation of funds, integrating a gender perspective in international cooperation as well as pan-European data collection and analysis on gender in R&I within the She Figures publications.

GEPs are a pioneering tool in terms of structural institutional change and a key instrument for gender equality in R&I policy. The European Commission's new Gender Equality Strategy 2020-2025 indicates that Horizon Europe will introduce new measures to strengthen gender equality, such as the possibility to require a gender equality plan from applicants. Such an approach would foster a European-wide recognition of the importance of gender equality as a component for achieving excellence.

Institutional Changes towards Responsible Research and Innovation

The Responsible Research and Innovation (RRI) approach supported by the European Commission since 2011 encourages societal actors to work together during the whole research and innovation (R&I) process to better align R&I and its outcomes with the values, needs and expectations of society. RRI topics have been geared towards establishing institutional changes in higher education institutes, research funding and performing organisations, industry, SMEs, as well as local and regional authorities, opening them up to closer co-operation with citizens and civil society. After analysing where organisations stand in terms of existing RRI practices, projects drafted action plans to support the implementation of institutional changes intended to last beyond the lifetime of project funding.

Projects focused on implementing institutional changes in research funding and performing organisations, higher education institutions, as well as research and technology organisations in terms of their governance systems related, for instance, to ethics, open science, citizen engagement and gender equality. Industry-focused projects produced practical tools and highlighted promising practices to enable the development of innovative products and services that directly address societal needs while contributing to environmental and economic sustainability. The territorial portfolio of projects supports around 10 per cent of all EU regions to develop more open and collaborative approaches to society by taking a Responsible Research and Innovation approach. Many of the projects from across this portfolio have taken disciplinary or sectoral approaches (e.g. focused on marine research institutes, the biosciences, or de-industrialising regions), suggesting that drawing on common links can foster productive environments for conceptualisation and implementation of institutional changes.

Furthermore, RRI projects produced an array of invaluable resources for organisations intending to implement RRI practices. Embedding RRI and implementing structural changes in the European R&I landscape requires building a strong evidence base, disseminating tools and practices, supporting networks of practitioners, and effectively monitoring progress towards goals. For instance, FP7's MoRRI project implemented the first RRI monitoring system in Europe and its successor Supper MoRRI, supported by SwafS, builds on this work. The portfolio of RRI projects as a whole is marked by a high level of global collaboration, helping influence the development of policies at national

level and raising the EU's profile as a global R&I actor. The 'Pathways declaration' emerging from one of the projects, signed by more than 13 projects, called for RRI to remain a central objective in EU R&I and for the EU to continue to pursue its leading role in this effort.

Citizen science and citizen engagement

In 2015, former Commissioner Moedas identified three strategic priorities, described in Open innovation, Open science, Open to the world (the three O's strategy). One important dimension of open science is citizen science and in 2016, the Council[3] recognised citizen science as an open science priority. Citizen science can make science more socially relevant, accelerate and enable production of new scientific knowledge, increase public awareness about science and ownership of policy making, as well as increase the prevalence of evidence-based policy making.[4]

The 22 projects funded under this part of the SwafS portfolio are categorised as 'deepening the evidence base, practice and training on co-design and co-creation' (6 projects) and 'doing citizen science' (16 projects). In terms of the former, projects produced a range of resources including practical guidance on running co-design and co-creation activities, representing the state-of-the-art in the field. Moreover, several projects developed sustainable networks. Notably, the EU-Citizen.Science Platform will serve as a repository for citizen science resources and become a pan-European hub. The 'doing citizen science' project portfolio reached an impressive number of citizens, often in innovative ways and engaging groups typically excluded from R&I processes. Importantly, the diverse projects highlight the fact that citizen science approaches and methodologies can apply across all areas of science from physics and technology development to health and the social sciences and humanities.

Citizen science and science engagement more generally, is an ideal means to democratise science, build trust in science, and leverage the vast societal intelligence and capabilities to conduct excellent research and innovation. To fully reap these benefits, important challenges need to be tackled: design and adoption of indicators to measure outcomes; development of infrastructures and platforms to support cross-European activities; training and capacity building; international mutual learning activities; and finally, promotion of career and incentive systems embedding these approaches within institutions so that they become a complementary part of the EU's R&I landscape.

Open access

It is widely recognised that making more research outputs openly accessible contributes to better science and innovation[5]. Under Horizon 2020, any peer-reviewed scientific publication, stemming from a funded project must be accessible online and free of charge to any user. Furthermore, beneficiaries are encouraged to open up the underlying data to maximise its re-use.

In support of the European Commission's open access policy, SwafS projects focused on text and data mining, innovative approaches to release and disseminate research results and measure their impact, as well as training on open access and re-use of research data. The lessons learned from the four open access projects point towards the need for continued efforts in terms of improving the knowledge and skills of researchers on open access matters.

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[3] Council conclusions on the transition towards an Open Science system, adopted by the Council at its 3470th meeting held on 27 May 2016

[4] SwafS work programme 2018-2020

[5] European Commission website for Open Science

Science Communication

Science communication informs citizens about science and innovation, opens up R&I to society and facilitates citizens' participation in activities and debate. In order for the public to be on board for solutions to the challenges our society faces, there is a need to build trust through clear and effective communication. With the science communication topics running from 2018 to 2020, the European Commission wishes to build a knowledge base in communicating science and improve science communication across the EU's Research and Innovation programme.

Projects are exploring the European landscape from various perspectives including a mapping of training opportunities in science communication, analysing the actors involved and content produced, as well as examining citizens' information sources and how these influence their perceptions. We expect to see guidelines on improving the quality of science communication, indicators, as well as new ways of training those who engage in science communication, including bloggers and social media commentators. Citizens are central to science communication and to this end, we expect a better understanding of what drives public trust in science communication as well as tools for citizens to judge the soundness of scientific information.

Concluding remarks

Since 2014, the projects funded under 'Science *with and for* Society' contributed to its primary aims set out in the EU Regulation establishing Horizon 2020, notably to effectively build cooperation between science and society, recruit new talent for science and pair scientific excellence with social awareness and responsibility.[6] One of the key ways of working towards these three SwafS objectives, and ensuring impact, is the implementation of institutional changes[7] in beneficiaries reflected in the SwafS Key Performance Indicator: *'Percentage of research organisations funded implementing actions to promote Responsible Research and Innovation, and number of institutional change measures adopted as a result'*.[8]

The results of a sample of twelve RRI projects revealed that almost 250 individual institutional change actions are implemented or in the process of being implemented by this part of the SwafS portfolio[9]. Added to this, is the pioneer of institutional changes, the Gender Equality Plans (GEPs), with 130 institutions (78%) having implemented or in the process of implementing a GEP.

SwafS will well and truly surpass its target of 100 institutional changes in beneficiaries by the end of Horizon 2020.

Consequently, SwafS stakeholders are in an excellent position to take a leading role in supporting other entities envisaging institutional transformation. In conclusion, inclusiveness on all levels underpins SwafS. RRI dimensions (gender, open access, science education, ethics and public engagement), must be part of how research and innovation is realised in all domains as well as its implications for governance. Horizon Europe needs to leverage SwafS know-how and tap into the vast potential citizens and society have to offer and continue to ensure effective cooperation between science and society.

[6] Regulation (EU) No 1291/2013 of the European Parliament and of the Council establishing Horizon 2020
[7] An institutional change is a change (with meaningful impact) in terms of how a beneficiary governs or structures itself in relation to any of the RRI dimensions (public engagement, open access, gender, ethics, science education), and lasts beyond the lifetime of project funding.
[8] Horizon 2020 indicators
[9] This data collection exercise did not cover projects dedicated to gender equality, ethics, or open access/open data, which, to various degrees, focus also on institutional changes.

INTRODUCTION

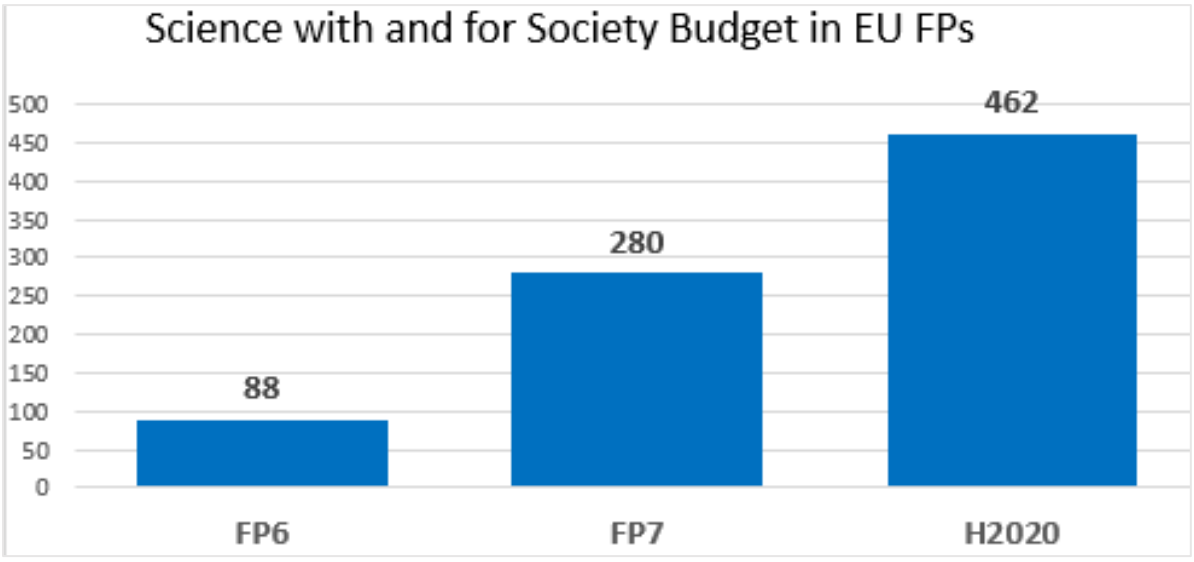
The Commission working paper in November 2000 'Science, Society and the Citizen in Europe' established the basis for the debate on the relationship of science and technology with society. On 26 June 2001, European research ministers adopted a resolution on 'science and society and on women in science' inviting both EU Member States and the European Commission to become more active in bringing science and society closer. As a response to the June 2001 invitation, in December 2001 the 'Science and Society' Action Plan was launched to set out a common strategy to make a better connection between science and European citizens.

The 'Science and Society' theme under 'Structuring the ERA' in the Sixth Framework Programme (FP6) became the first ever initiative of its kind on a European scale. With a budget of EUR 88 million, its goal was to increase society's acceptance of and engagement with science and to rectify gender imbalances in research. The Science and Society projects supported a wide range of studies and participatory events in areas including gender, ethics, young people and scientific participation.[10]

In 2007, under the 7th Framework Programme for Research and Technological Development (FP7), 'Science and Society' became 'Science in Society (SiS)' with the main objective to foster public engagement and a sustained two-way dialogue between science and civil society. Its budget almost tripled to 280 million euros. 183 projects were funded with an average EC contribution of 1.6 million euros. SiS demonstrated a clear European added value addressing science and society-relevant issues such as governance, ethics, public participation, awareness raising, gender equality, science education, open access to data, as well as dissemination of research and innovation.[11]

In 2012, the Communication on a reinforced ERA, included gender equality and gender mainstreaming in R&I as one of its five core priorities[12].

Fig. 1: Evolution of budget allocated to 'Science with and for Society' in EU FPs



[10] Report of the Expert Group: Evaluation of the Sixth Framework Programmes for research and technological development 2002-2006
[11] Study 'Commitment and coherence: Ex-post-evaluation of the 7th EU Framework Programme (2007-2013)'
[12] COM(2012) 392 final 'A Reinforced European Research Area Partnership for Excellence and Growth'

In parallel, SiS led to the development of a concept reconciling the aspirations and ambitions of European citizens and other Research and Innovation actors and towards the end of FP7, lessons learnt gave birth to an approach known as Responsible Research and Innovation (RRI), which was, on 21 November 2014, enshrined in the Rome Declaration.

Under such a framework, all societal actors (researchers, citizens, policy makers, businesses, civil society organisations, etc.) work together during the whole Research and Innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society[13]. In practice, RRI[14] is implemented as a package, aiming to better engage society in Research and Innovation activities, enabling easier access to scientific results, favouring a better uptake of the gender and ethics dimensions in Research and Innovation content, and spreading good practices in formal and informal education in science.

This concept of Responsible Research and Innovation (RRI) was tested and promoted during the last years of FP7. While RRI activities are concentrated in the 'Science and/in Society' parts, the intention was for the principles of RRI to be integrated into the overall research strategy across the Framework Programme.

The ex-post evaluation of FP7 found that future Framework Programmes should involve citizens and civil society organisations more substantially. They should engage citizens and stakeholders in a dialogue about the purpose and benefits of research and the way it is conducted, create incentives for science communication and support more strategic measures of communication addressing different audiences, foster the linkages between researchers, citizens and policy makers.

It recognised that citizen involvement in European research projects aims at increasing trust, acceptance, and ownership of research, a positive perception of science, better adoption of new knowledge and innovations, and improving relevance and creativity of research outcomes.[15]

Following on from this, Horizon 2020 includes a dedicated part on 'Science with and for Society'. Its overall 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.[16] SwafS has grown substantially to reach EUR 462 million (see Fig. 1: Evolution of budget allocated to 'Science with and for Society' in EU FPs), giving leverage to put RRI and all its dimensions into practice in Europe, notably through 'institutional changes' (a concept which was first piloted with Gender Equality Plans under FP7) in research and innovation organisations. In parallel, gender, RRI, and social sciences and humanities became cross-cutting issues promoted throughout the Horizon 2020 programme.[17]

New innovations are essential to Europe's international competitiveness. Europe cannot thrive without including citizens in the process of ensuring the best match possible between the immense potential achievements of science, and the needs and aspirations of society.

It is essential to realise societally robust science and innovation policy in the context of the European Research Area (ERA) and Innovation Union. The interim evaluation of Horizon 2020 conveys that 'Science with and for Society' is highly relevant to the

[13] Brochure 'Responsible Research and Innovation: Europe's ability to respond to societal challenges'
[14] The five dimensions of Responsible Research and Innovation are gender equality, science education, open access/open data, public engagement, and ethics.
[15] Study 'Commitment and coherence: Ex-post-evaluation of the 7th EU Framework Programme (2007-2013)'
[16] Regulation (EU) No 1291/2013 of the European Parliament and of the Council establishing Horizon 2020
[17] European Commission website for SwafS

overarching challenges facing Europe and calls for greater support for citizen science and user-led innovation.[18]

In response to this, Horizon Europe places citizens at its core. Like for FP6, where the programme was embedded in 'Structuring the ERA', 'Science with and for Society' will be embedded in the 'Strengthening the European Research Area - Reforming and Enhancing the European R&I system'. According to the legal basis establishing the framework for Horizon Europe, *'this part will also include activities on: […] modernising European universities; supporting enhanced international cooperation; and science, society and citizens'*.[19]

The Horizon Europe Impact Assessment report states that the SwafS part on 'Accelerating and catalysing processes of institutional change' contributes to implementing the RRI keys (public engagement, science education, ethics including research integrity, gender equality, and open access) through institutional governance changes in Research Funding and Performing Organisations (RFPOs) in an integrated way.

Results contribute to the implementation of ERA priorities, a greater involvement of all stakeholders in R&I, and a better and more sustainable engagement with society. Under Horizon 2020, the key performance indicator for SwafS is the number of institutional change actions which are analysed notably under the RRI chapter. This will be a key bridge for SwafS as it moves into Horizon Europe.

The Horizon Europe legal basis sets out the aim of deepening the relationship between science and society, maximising benefits of their interactions through gender equality plans, diversity and inclusion strategies, and comprehensive approaches to institutional changes. It calls on the future Framework Programme to engage and involve citizens and civil society organisations in co-designing and co-creating responsible research and innovation agendas and content, promoting science education, making scientific knowledge publicly accessible, facilitating participation by citizens and civil society organisations in its activities and promoting gender equality and strengthening the gender dimension. It should do so both across the programme and through dedicated activities under the 'Strengthening the European Research Area' part.

The engagement of citizens and civil society in research and innovation should be coupled with public outreach activities to generate and sustain public support for Horizon Europe. The programme should also seek to remove barriers and boost synergies between science, technology, culture and the arts to obtain a new quality of sustainable innovation, as well as support an inclusive approach to gender equality in research and innovation[20].

Further enriching the debate in the run-up to the start of Horizon Europe are two reports on mission-oriented R&I, authored by Mariana Mazzucato, which provide directions for how co-design, co-creation, and citizen involvement in implementation can play key roles in responding to the challenges of our times[21,22].

The ERA cannot grow in a sound manner without citizens at its core embracing science education for all, promoting gender equality in our organisations, integrating ethical aspects in the research design phase and further developing a coherent EU ethics and integrity framework, opening up research and innovation to collective intelligence and

[18] Interim evaluation of H2020
[19] COM/2018/435 final 'Proposal for a regulation of the European Parliament and of the Council establishing Horizon Europe'
[20] See supra note 19
[21] 'Mission-oriented Research & Innovation in the European Union', by Mariana Mazzucato
[22] Governing Missions in the European Union, by Mariana Mazzucato

capabilities, building trust in science through targeted communication and ultimately ensuring citizens are an integral part of the process to ensure better R&I.

The objective of this report is to convey the achievements of SwafS in Horizon 2020 to serve as input for DG Research and Innovation to integrate society and citizens in science under Horizon Europe, both across the future Framework Programme and in the first work programmes falling under the 'Strengthening the European Research Area' part.

The report commences with an outline of the methodological aspects of the analysis (the frame for the analysis, data sources, the analytical approach and its limitations) followed by nine thematic chapters. The first of these presents an overview of SwafS implementation in Horizon 2020 in terms of both the evaluation process and project implementation. In the eight following chapters, for each thematic domain, the policy objectives and achievements are analysed and recommendations for the future Framework Programme are conveyed. The final chapter presents concluding remarks as a complement to the highlights outlined in the executive summary.

At the time of writing this report, the COVID-19 pandemic, came to the fore with Member States going into lockdown, resulting in citizens across the EU being obliged to stay at home. There was an imminent need for effective online tools and many SwafS projects adopted contingency measures notably moving from physical to an online format for project activities in order to sustain the bridge between science and society.

METHODOLOGICAL NOTE

Data sources

Calls for proposal: From the start of Horizon 2020 in 2014 until 2019, projects funded under the calls foreseen in the respective SwafS work programmes are included in the analysis (note that the calls dedicated to National Contact Points and those managed by DG R&I, featuring under the 'other actions' section of the work programmes are excluded):

Year	Call
2014	SEAC[23] (3 topics), ISSI (3 topics), GERI (3 topics), GARRI (4 topics)
2015	SEAC (2 topics), ISSI (4 topics), GERI (2 topics), GARRI (4 topics)
2016	SwafS-25 (1 topic), Single call (12 topics)[24]
2017	Single call (15 topics)
2018	Two-stage call (2 topics), Single call (14 topics)[25]
2019	Two-stage call (2 topics)[26], Single call (11 topics)
2020	Two-stage call (2 topics), Single call (12 topics)[27]

Projects: The projects included are those funded under the calls listed in Table 1: Number of SwafS projects in Horizon 2020, as of 15/05/2020. For the purposes of this analysis, projects are grouped by theme in line with the report structure. In terms of data sources, the Grant Agreement notably the Description of Action, project deliverables, review reports, project web sites, project policy briefs as well as input from REA Project Officers over-seeing the implementation of the projects have been the basis of the analysis.

Cluster events: REA-led events organised in collaboration with DG R&I, bringing together projects funded under the same theme, pointed to some recommendations which are taken up in this report. At the time of report writing, five such events were held.

Year	Thematic area
2018	Gender Equality Plan projects
2018	Ethics and research integrity
2019	Science education
2019	Citizen science
2020	Gender Equality Plan projects

[23] Includes SEAC.03.2014 EURXASS topic managed by DG R&I
[24] Includes SwafS-02-2016 ERA-NET Cofund topic managed by DG R&I
[25] Includes SwafS-22-2018 topic on Outermost Regions managed by DG R&I
[26] Grant Agreement Preparation on-going at the time of writing this report so these projects have not been included in the report.
[27] Evaluation still to be carried out at the time of writing this report.

Reports: Horizon 2020 legal basis, annual work programmes, Interim evaluation of Horizon 2020, Impact Assessment for Horizon Europe are the primary references. Other relevant documents for the thematic chapters are referenced in the respective chapters.

Feedback from the evaluation: Some recommendations made by experts during the panel meetings and the independent observers in their reports are also included.

DG R&I policy officers provided input in terms of key reference documents as well as the objectives of the respective themes and gave feedback on the draft chapters.

Table 1: Number of SwafS projects in Horizon 2020, as of 15/05/2020

SwafS theme / # of projects	Res. ethics & integrity	Science educ.	Science careers	Gender equality	RRI	Citizen science	Open access	Science comm.	**TOTAL**
Finished	4	13	14	8	12	5	3	-	**59**
Running (at least 1 review held)	7	2	4	9	8	5	1	-	**36**
Running (1st review to be completed)	3	4	-	6	7	5	-	3	**28**
Just started (Q4 2019 / Q1 2020)	1	-	2	5	8	7	-	3	**26**
TOTAL GAs signed, as of 15/05/2020	15	19	20	28	35	22	4	6	**149**
Forecast of 2019 stage-2[28] & 2020 calls	3	9	9	6	12	7	-	2	**48**
TOTAL SWAFS H2020	**18**	**28**	**29**	**34**	**47**	**29**	**4**	**9**	**197**

Analytical approach

The approach to the analysis is qualitative in view of the breadth and complexity of the themes of SwafS. Whenever possible, quantitative data has been included.

The analysis is primarily based on first-hand data on the currently running or completed projects under the Horizon 2020 Framework Programme. Each project was systematically assessed including the website, review reports and key deliverables. Deliverables singled out in the report are those deemed to be particularly pertinent by the project consortia (highlighted in project website) and/or by the independent expert involved in the project review and responsible REA Project Officer (highlighted in the review report). Policy and other pertinent reports have been consulted in order to integrate this analysis in a broader perspective.

In the project portfolio table and maps, a distinction is made between the coordinator (i.e. the entity coordinating the project consortium) and other partners. Note that 'other

[28] Grant agreement preparation is on-going for eight projects selected for funding for both of the SwafS-2019 stage-2 topics which are not included in this report.

partners' includes project beneficiaries that are signatory to the grant agreement and does not include other entities e.g. third parties, that may be involved in project activities.

Finally, note that the project budget corresponds to the requested EU contribution.

Limits of the analysis

The main limitation of this study lies in the lack of complete data as many projects have not yet concluded. The analysis was carried out prior to the 2020 evaluation, projects resulting from the 2019 call commenced close to the time of drafting this report and those funded following the 2018 call had not yet been subject to their first review.

1. OVERVIEW OF SWAFS IMPLEMENTATION IN HORIZON 2020

1.1. Evaluation process

Since the start of Horizon 2020, SwafS has organised calls for proposal on an annual basis.

As indicated in the introduction, the underlying objective of all these calls is to build effective co-operation between science and society; Foster the recruitment of new talent for science; Pair scientific excellence with social awareness and responsibility[29].

The Horizon 2020 specific programme[30] outlines eight activity lines for SwafS:

- Attractiveness of scientific careers;
- Gender equality;
- Integration of citizens' interests and values in research and innovation (R&I);
- Formal and informal science education;
- Accessibility and use of research results;
- Governance for the advancement of responsible research and innovation and promotion of an ethics framework for research and innovation;
- Anticipation of potential environmental, health and safety impacts;
- Improved knowledge on science communication

For the SwafS WP 2014-2015, four separate calls for proposal were organised each year, with a common call deadline, and focused on:

- Making science education and careers attractive for young people (SEAC);
- Promoting gender equality in research and innovation (GERI);
- Integrating society in science and innovation (ISSI);
- Developing governance for the advancement of responsible research and innovation (GARRI)

As of 2016, the structure of the SwafS work programme moved from four distinct calls to individual topics under a single call. Under this new approach, the SwafS WP 2016-2017, focused on the following main orientations:

- Institutional Change to Support Responsible Research and Innovation in Research Performing and Funding Organisations
- Embedding Responsible Research and Innovation in Horizon 2020 Research & Innovation
- Strengthening the Science with and for Society Knowledge-Base
- Developing Inclusive, Anticipatory Governance for Research & Innovation

The SwafS WP 2018-2020 focused on the following five strategic orientations: Accelerating and catalysing processes of institutional change;

- Accelerating and catalysing processes of institutional change;
- Stepping up the support to Gender Equality in Research & Innovation policy;
- Building the territorial dimension of SwafS partnerships;

[29] Regulation (EU) No 1291/2013 of the European Parliament and of the Council establishing Horizon 2020
[30] See supra note 29

- Exploring and supporting citizen science, and
- Building the knowledge base for SwafS.

Table 2: SwafS proposals data in Horizon 2020shows the number of proposals submitted, evaluated and funded as well as the corresponding EC grant amount and the volume of evaluation review requests. From the outset, it is clear that there is a strong interest in the SwafS fields peaking in the final year of Horizon 2020 with 407 proposals submitted.

Over the course of Horizon 2020, the pattern tends to be lower submission rates in the first year of the work programme compared to the following year. Furthermore, submission rates were lower overall for the 2016-2017 work programme topics

Table 2: SwafS proposals data in Horizon 2020

Year	Title of Call	Number of proposals			EC grant amount for retained proposals	Success rate	Evaluation review	
		Submitted	Evaluated	Retained for funding			Requests	Upheld but not re-evaluated
2014	SEAC-2014-1	140	140	8	14.719.360 €	5,7%	1	0
	GERI-2014-1	47	44	5	10.275.490 €	11,4%	1	0
	GARRI-2014-1	28	28	5	8.710.636 €	17,9%	0	0
	ISSI-2014-1	35	33	3	10.792.173 €	9,1%	0	0
2014 TOTAL		250	245	21	44.497.659 €	8,6%	2	0
2015	SEAC-2015-1	207	204	6	11.934.183 €	2,9%	1	0
	GERI-2015-1	46	46	4	8.359.319 €	8,7%	1	0
	GARRI-2015-1	31	31	6	9.174.322 €	19,4%	0	0
	ISSI-2015-1	109	99	7	23.315.000 €	7,1%	2	1
2015 TOTAL		393	380	23	52.782.823 €	6,1%	4	1
2016	SwafS-25-2016	9	8	1	497.626 €	12,5%	0	0
	SwafS-2016-1	132	129	22	44.285.828 €	17,1%	1	0
2016 TOTAL		141	137	23	44.783.454 €	16,8%	1	0
2017 TOTAL	SwafS-2017-1	221	216	24	61.167.321 €	11,1%	2	0
2018	SwafS-2018-1	121	114	26	55.674.892 €	22,8%	2	1
	SwafS-2018-2-stage-1	76	76	*16*	-	21,1%	0	0
	SwafS-2018-2-stage-2	16	16	5	7.049.141 €	31,3%	0	0
2018 TOTAL		197	190	31	62.724.033 €	16,3%	2	1
2019	SwafS-2019-1	194	193	27	52.272.299 €	14,0%	0	0
	SwafS-2019-2-stage-1	114	113	*22*	-	19,5%	1	0
	SwafS-2019-2-stage-2	22	21	8	10.804.446 €	38,1%	0	0
2019 TOTAL		308	306	35	63.076.746 €	11,4%	1	*0*
2020	SwafS-2020-1	262	-	-	-	-	-	-
	SwafS-2020-2-stage-1	145	-	-	-	-	-	-
2020 TOTAL		407						
GRAND TOTAL		**1917**	**1474**	**157**	**329.032.036 €**	**10,7%**	12	2

compared to the first (2014-2015) and final (2018-2020) work programmes in Horizon 2020. In 2020, the number of proposals submitted peaked with over 400 consortia putting forward proposals and bringing the total number of proposals submitted under Horizon 2020 up to almost 2,000.

Looking more closely at the 2019 call, for which the evaluation is completed, compared to the previous year, the number of proposals increased by 56%. This call includes 13 topics, two of which are subject to a two-stage evaluation (see 1.1.2).

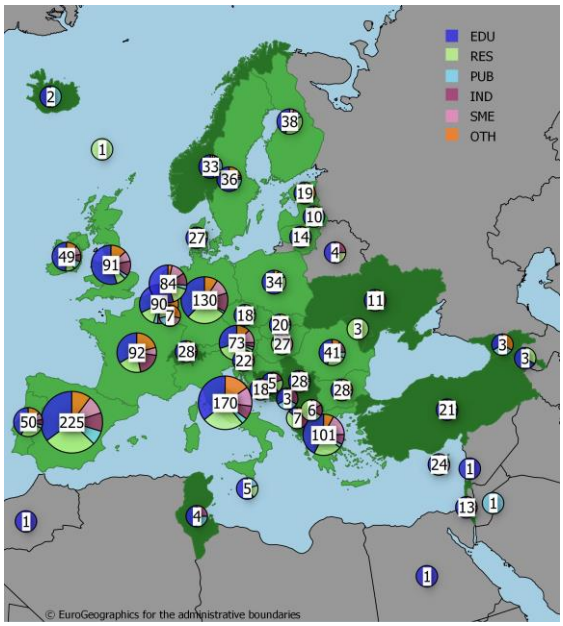
Science Education remains the most popular topic with the highest number of proposals (93). Meanwhile, Citizen Science is the topic with the biggest growth in terms of proposals (78), which more than doubled compared to 2018 (33).

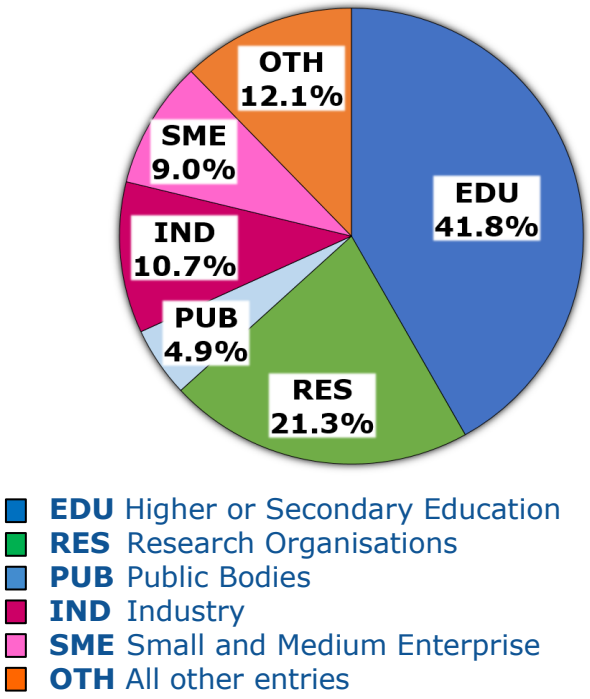
In the 2019 call, approximately one third of the topics identified international cooperation as particularly pertinent including one of the gender topics, dedicated to

dialogue with third countries. With applicants from 85 different countries from continents across the globe including Asia, Australia, Africa, South and North America, Science with and for Society follows the spirit of 'open to the world'. Looking at Europe in particular, the map below shows, applicants come from right across the continent.

Applicants represent stakeholders from all parts of the quadruple helix model[31], including Civil Society Organisations (falling under the 'other' category in pie chart above) with the relative majority being educational institutes.

Fig. 2: Applicants for SwafS-2019 single call for proposals





EDU Higher or Secondary Education
RES Research Organisations
PUB Public Bodies
IND Industry
SME Small and Medium Enterprise
OTH All other entries

[31] The quadruple helix model considers particular services, products and solutions as being co-identified, co-developed and co-created through co-operation between industry, government (e.g. policy makers and institutions), universities and society (e.g. citizens and Civil Society Organisations (CSOs).

After the 2014 evaluation, DG R&I delegated the management of SwafS to REA Unit B5. Since 2015, REA Unit B5 manages the evaluation and implementation of SwafS projects and to this end, continues to work in close cooperation with DG R&I responsible for the policy making and drafting of the work programmes.

In line with Horizon 2020 practices, three independent evaluators evaluate each proposal, selected for their expertise while the overall panel is well-balanced in terms of gender (i.e. at least 40% of males and females), geography and sector of activity.

With regard to the quality of the evaluation process, independent observers examine the fairness of the evaluation procedure. In the 2019 SwafS evaluation, the observer reported, 'that the design, planning and execution of the evaluation process was very robust and entirely consistent with peer review principles of transparency, equality of treatment and absence of conflicts of interest.' The evaluators themselves echoed this observation in the panel meetings in their invitation to EC services to better publicise the robustness of the evaluation procedure.

A quantitative indicator of the quality of the evaluation is the number of evaluation review requests filed. Applicants may file a complaint on the evaluation of their proposal from a procedural point-of-view. Over the course of the last 5 years, 0.8% of applicants (12) filed such a complaint.

An independent Evaluation Review Committee, consisting of REA staff (not involved in the evaluation) and DG R&I staff, assesses each evaluation review request.

The outcome shows that for 10 out of the 12 evaluation review requests, the respective Evaluation Review Committees found no grounds for the complaint. For the remaining two (0.1%), the Committees found some grounds for the complaint. However, this did not have an impact in terms of the proposal's possibility for funding and hence a re-evaluation of the proposal was not required.

1.1.1. Cross-cutting issues

The legislative basis for Horizon 2020 Framework Programme, article 14, lays out fifteen 'cross-cutting issues' for which linkages and interfaces shall be implemented across and within the priorities of Horizon 2020. For many challenges, solutions rely on element(s) from this indicative list, and cut across the multiple specific objectives of Horizon 2020[32], hence the term cross-cutting issues.

Since the start of Horizon 2020, cross-cutting issues have featured in all SwafS topics. To this end, the corresponding work programme topic incorporates the cross-cutting issue in its description and 'cross-cutting priorities' are listed in the topic page published on the Funding and Tenders Portal.

In terms of the practical implementation, the way in which each cross-cutting issue features in Horizon 2020 varies. For example, *'widening participation across the Union in research and innovation and helping to close the research and innovation divide in Europe'* has its own dedicated programme with targeted actions. Other cross-cutting issues, for example *'social and economic sciences and humanities', 'cooperation with third countries', 'responsible research and innovation including gender',* are identified in the work programme text.

The particularities of the cross-cutting issues relevant for SwafS and how these are implemented in the evaluation process are highlighted below:

[32] Regulation (EU) No 1291/2013 of the European Parliament and of the Council establishing Horizon 2020

- Gender equality concerns all parts of Horizon 2020, firstly, human resources i.e. balance between women and men in research teams and secondly, content i.e. applicants are required to describe, where relevant, how sex and/or gender analysis is taken into account in the project's content. 'Gender-flagged' topics refer to the later i.e. those with an explicit **gender dimension**. Gender dimension appears in the proposal template for Research and Innovation Actions (RIAs)/Innovation Actions (IAs)/Coordination and Support Actions (CSAs) *('Where relevant, describe how the gender dimension, i.e. sex and/or gender analysis is taken into account in the project's content.')* and is part of the evaluation sub-criterion for RIAs/IAs (*'where relevant, use of … gender dimension in research and innovation content')* although not for CSAs*;*

- **Responsible Research and Innovation (RRI)** as a concept in itself does not feature in the proposal template or in the evaluation sub-criterion. If one of the five dimensions of RRI (public engagement, gender, ethics, open access, science education) is pertinent, then the topic is flagged for RRI. The FAQ published on the Portal points to the need for applicants to consider how to involve societal actors in the activities or in the overall approach in one or more of the five RRI dimensions;

- Regarding **cooperation with third countries**, while not featuring in the proposal template or evaluation criteria, there is a standard sentence on 'international cooperation' which should appear in the work programme text for topics flagged for this aspect: *'In line with the strategy for EU international cooperation in research and innovation (COM (2012)479), international cooperation is encouraged'*;

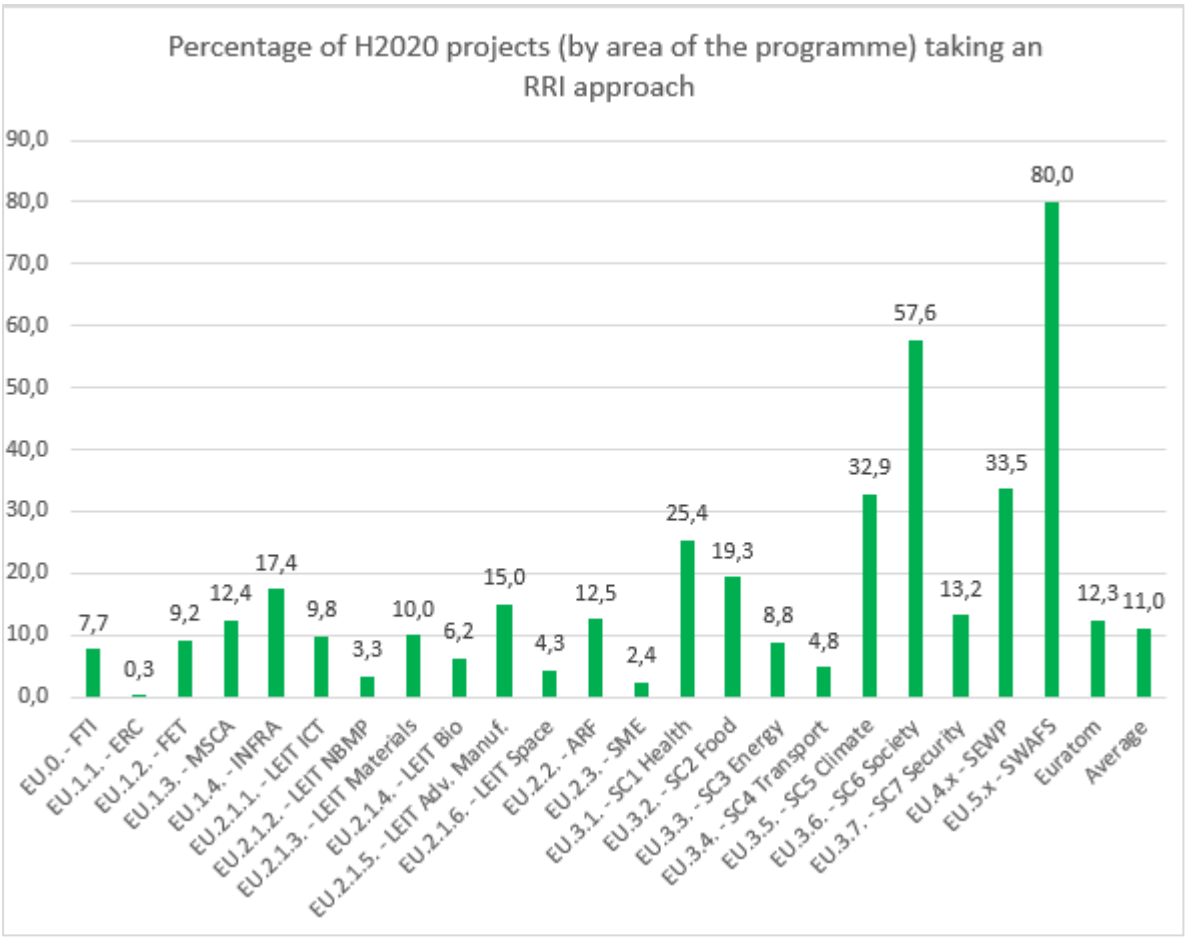
- **Social and economic sciences and humanities** are not referred to explicitly in the proposal template or evaluation sub-criterion. Regardless of whether or not the topic is flagged for 'social and economic sciences and humanities, applicants for RIAs/IAs are invited to consider the implicitly related 'inter-disciplinary considerations' in the proposal template (*'Identify any inter-disciplinary considerations and, where relevant, use of stakeholder knowledge')* and this aspect is part of the evaluation sub-criterion for these action types: *'Appropriate consideration of interdisciplinary approaches'*;

- **Open science** includes open access to scientific publications and to research data, and features in the proposal template, and implicitly in the evaluation sub-criterion in relation to management of research data and subsequently as a contractual obligation (Article 29 of the Grant Agreement). In addition, 'open science' includes opening the R&I system towards society as a whole which is neither referred to explicitly in the proposal template nor the evaluation sub-criterion yet should be addressed by applicants for topics flagged for 'open science'.

For each cross-cutting issue identified as pertinent for a given topic, a corresponding reference or sentence is included in the work programme description.

The standard briefing slides for experts indicate, *'If cross-cutting issues are explicitly mentioned in the scope of the call or topic, and not properly addressed, you must reflect this in the assessment of the relevant criterion and the corresponding score. A successful proposal is expected to address them, or convincingly explain why not relevant in a particular case.'* Consequently, cross-cutting issues are attributed a certain, although undefined, weight in the evaluation process which is left to the remit of the evaluators.

Fig. 3: RRI flagging across Horizon 2020 projects



(Source: DG R&I Unit G.4 'Open Science' internal analysis)

While the implementation of the cross-cutting issues in the evaluation process presented its challenges, the result has nonetheless been very positive in terms of ensuring greater take-up of these matters right across the Horizon 2020 programme.

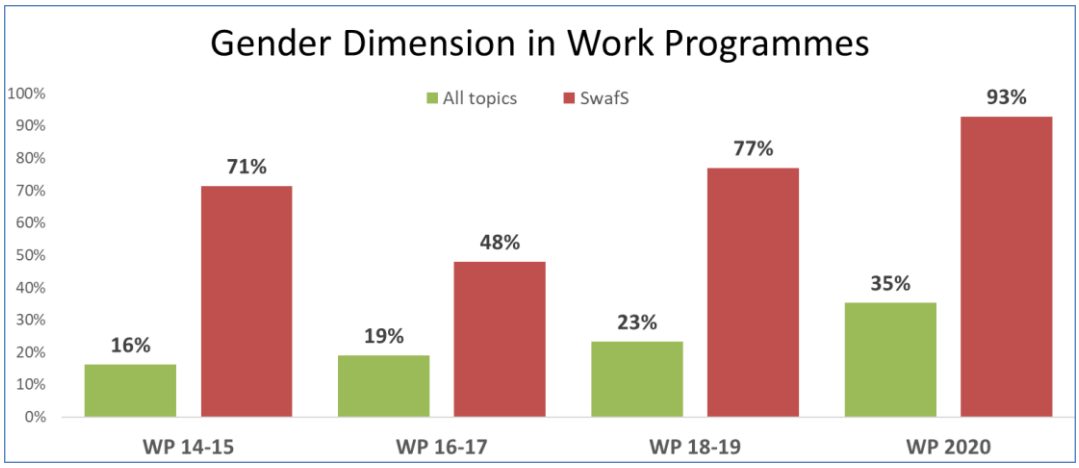
In Fig. 3: RRI flagging across Horizon 2020 projects we can see that across the Horizon 2020 programme, projects are following an RRI approach i.e. involving the relevant stakeholders in their activities or approach in order to better align R&I to the values, needs and expectations of society.

SwafS stands out with 80% of its projects integrating RRI. Looking at other programmes, Mobility 4 EU is an example from Societal Challenge 4 dealing with transport which seeks to draw out a vision for Europe's transport system in 2030 along with recommendations for R&I through a participatory and multi-stakeholder approach. Another example is HackAIR (Leadership in Enabling and Industrial Technologies - LEIT) which creates and tests an open platform to enable citizens to generate and publish outdoor air pollution data.

Fig. 4: Gender flagging in Horizon 2020 shows that over the course of Horizon 2020, the prevalence of topics for which the gender dimension is deemed relevant increased from 16% in the first work programme 2014-2015 to 35% in the last year of Horizon 2020 compared to 71% in the first SwafS work programme to 93% in 2020.

While Horizon 2020 is open to the world, for some topics there is a clear interest and benefit in engaging in **international cooperation**. In those topics, international cooperation is encouraged.

Fig. 4: Gender flagging in Horizon 2020



SwafS projects have embraced international cooperation and involve partners from around the world including for example South Africa (7), the US (6), Brazil (5), China (5), Argentina (4), Canada (4), India (3) and Japan (1). In many cases, the examples are more telling than the numbers.

As highlighted in the Research Ethics and Research Integrity chapter, the TRUST team supported the development of the first code of ethics by one of the world's oldest indigenous populations, the San of southern Africa who now have their own rules for researchers intending to study their community and people: the SAN Code for Research Ethics.

Furthermore, NUCLEUS offered the Institute of Wetland Research in China the opportunity to test RRI practices with the intention of these becoming established practices for its researchers. Furthermore, thanks to NUCLEUS, the South African Institute for Aquatic Biodiversity's integrated RRI across many areas of its business including in its strategic planning to encourage a sustained culture of RRI.

1.1.2. Two-stage evaluation process

The aim of the two-stage process is to ease the burden for applicants in the initial stage of the proposal preparation although the overall period for the evaluation extends by approximately eight months. In stage 1 of the two-stage procedure, applicants submit a short proposal (maximum 10 pages) and, like the evaluation criteria, focuses only on 'excellence' and part of 'impact', notably in relation to the expected impact statement in the work programme.

Successful stage-1 proposals passing the thresholds (see Annex H of the General Annexes to the work programme), receive general common feedback and are invited to stage-2, which is the same as the single proposal procedure albeit that the full proposal must be consistent with the short proposal submitted in stage-1.

2018 saw the introduction of the two-stage evaluation process for SwafS in view of the traditionally over-subscribed topic, science education (3% success rate in 2015).

For science education, 67 applicants submitted a proposal to stage-1 (call deadline April 2018) of which 15 were invited to submit a full proposal in stage-2 (call deadline November 2018), 4 proposals were finally selected for funding (informed March 2019) and projects commenced in summer 2019.

A new bottom-up topic on 'building the SwafS knowledge base' was also included in the two-stage call as it was expected that such an open topic would result in a large volume of proposals which as it transpired was not the case.

1.1.3. Recommendations

Expand the 'Impact' section of the proposal template in order to give more guidance to applicants in the design of the impact strategy in terms of describing the long path from outcome to the desired impact.

Like most other programmes, an indication of the project duration for the SwafS topics would be useful for applicants and would facilitate implementation in terms of planning for example joint cluster reviews to facilitate feedback to DG R&I with respect to policy work.

1.1.3.1. Cross-cutting issues

In terms of the proposal evaluation process, there is a need to better clarify for applicants that cross-cutting issues or their equivalent in Horizon Europe are an integral part of the evaluation process and ensure a harmonised approach in terms of their implementation. For any elements which the Commission wishes to address across the Horizon Europe Framework Programme, a standard sentence should feature in the corresponding work programme text (like for international cooperation), clearly explaining the meaning together with a footnote referencing the FAQ guidance for applicants and experts.

The cross-cutting issues are not part of the work programme published and are listed in the Funding and Tenders Portal at the end of the topic description with no direct link to the corresponding sentence(s) in the work programme topic/call description. Furthermore, it is possible to add or remove cross-cutting issues right up to the call deadline without any automatic notification to applicants. For 'cross-cutting priorities' or their equivalent in Horizon Europe, there should be coherence between the official published work programme and the topic page in the Funding and Tenders Portal (currently 'cross-cutting priorities' only appear in the Portal).

Furthermore, as appropriate, in order to reinforce the importance of a particular element, for example citizen science, explicit reference in the proposal template and in the evaluation sub-criterion is necessary as is the case already for the gender dimension.

1.1.3.2. Two-stage evaluation process

The volume of submissions in past calls should be a basis for determining whether to opt for the 2-stage evaluation procedure.

The work programme General Annexes (eligibility section) should reflect the provision that confirmed substantial changes between stages 1 and 2 will result in the proposal's ineligibility. The modalities for determining what constitutes a substantial difference between stage-1 and stage-2 proposals should be integrated in the online guidance for applicants when completing this section of the proposal form.

Given that in stage-1 impact is partially evaluated, a weight should be applied for the excellence criterion for which all elements are evaluated.

The stage-1 evaluation procedure should only take place if the volume of proposals submitted in stage-1 is sufficiently high with respect to the thresholds set (see Annex H

of the General Annexes to the work programme) to justify this additional evaluation phase.

Applicants invited to stage-2 receive the Evaluation Summary Report from stage-1 at the same time as they receive that for stage-2. Applicants should only receive the Evaluation Summary Report for the full proposal (stage-2) to avoid possible contradictions given that both stages are independent.

1.2. Project implementation

SwafS counts a total budget of EUR 462 million in Horizon 2020. Since the start of Horizon 2020, 150 projects have been funded amounting to a total budget of EUR 319 million, all are managed by REA Unit B.5 except for three which are managed by DG R&I.

SwafS projects are typically composed of large consortia with an average of approximately 11 partners per project. The duration tends to vary with the shortest project duration being 2 years and the longest project extending to 5 years while the average project duration is 3 years.

In terms of their nature, 30% are Research and Innovation Actions (RIA) focused on generating new knowledge while approximately 70% of funded projects are Coordination and Support Actions (CSA) tending to focus on 'accompanying measures' including for example networking, mutual learning exercises and awareness-raising type activities. The exception is GENDER-NET Plus, an ERA-NET COFUND action, managed by DG Research and Innovation which aims at funding research projects promoting the integration of sex and gender analysis into research at an international level.

The REA Unit B.5 signs grants with consortia within the legal deadline of 8 months from the call deadline. Project officers partake in kick-off meetings and closely follow the project during the lifetime. Each project has defined reporting periods that conclude with a review meeting, the formal approval of the deliverables and the payment for the activities carried out. The REA calls upon the support of an independent expert to review the deliverables and reports. The quality of deliverables is closely monitored notably those that are public and are automatically published once approved.

The REA works closely with DG Research and Innovation to ensure policy makers are kept abreast of any feedback from the project relevant for their policy monitoring or future policy making activities.

DG Research and Innovation and the REA promote networking between projects to encourage sharing of best practices and to encourage projects to build on the available know-how. The REA and DG R&I have developed this practice by organising thematic one-day cluster events in Brussels. These cluster events are organised in co-creation mode with the projects and since 2018 five such events were organised including for ethics, gender, science education and citizen science projects.

Liaising with other SwafS projects was formally encouraged in the 2018-2020 work programme which foresees the inclusion of 'additional dissemination obligations' in Article 29.1 of the grant agreement for certain topics. This provision requires consortia to share their strategies and methodologies from the outset with a view to reaping the full benefits of synergies. Project co-ordinators have demonstrated strong willingness to work together in organising joint communication channels, events, meetings, and co-ordinating content-related activities. This grant condition was a key element in terms of aiming to build a knowledge and collaboration ecosystem. The results have been positive in the territorial and citizen portfolios for example where projects are pro-actively liaising with each other. The Super_MoRRI project gathered 14 other SwafS projects together at

its annual event in Leiden in January 2020.[33] This 'additional dissemination obligation' condition should be used more extensively in the future.

1.2.1. Recommendations

The legal basis for Horizon 2020, Article 31, includes an obligation to carry out an annual monitoring of Horizon 2020.[34] The scope of the monitoring includes information and data on progress towards the cross-cutting issues.

Progress is measured through a number of policy indicators, including the cross-cutting issues. Some projects are already flagged for the indicator or cross-cutting issue in question from the call definition stage while for others, Project Officers report on these during the grant agreement preparation phase in accordance with the project specifics. These indicators should be verified and if needed updated during the project lifetime, notably at the review stage.

As stated in the introduction, the key performance indicator for SwafS is the number of institutional change actions: *'Percentage of research organisations funded implementing actions to promote Responsible Research and Innovation, and number of institutional change measures adopted as a result'*.[35] At present, the IT Grant Management system does not align with EC policy in that a number of elements mentioned in the 'Science for Society' tab do not fit under the definition of an institutional change.

Furthermore, guidance in the IT system is lacking for project coordinators in terms of how to complete this section. REA B5 unit launched an exercise to gather this data for a large part of the SwafS portfolio, in close co-operation with DG R&I unit 'Open Science' (analysed in chapter 6 'Institutional changes towards responsible research and innovation').

This is an example of how REA Unit B5 monitors the implementation of projects and their impact in order to provide DG R&I with the necessary input for designing future policies.

For Horizon Europe, the Grant Management IT system should be adapted in order to provide guidance to coordinators on the meaning of future indicators and guide them through the steps to ensure that the data collected is reliable for the Commission's monitoring and reporting purposes.

[33] Super MoRRI annual event, January 2020
[34] Regulation (EU) No 1291/2013 of the European Parliament and of the Council establishing Horizon 2020
[35] Horizon 2020 indicators

2. RESEARCH ETHICS AND RESEARCH INTEGRITY

Ethics is an integral part of all research activities funded by the European Union, and ethical compliance is essential to guarantee research excellence[36,37,38]. All projects carried out under Horizon 2020 must comply with ethical principles and relevant national, EU and international legislation, for example the Charter of Fundamental Rights of the European Union and the European Convention on Human Rights.

Furthermore, the European Commission promotes adherence to the highest standards of research integrity across Europe.

In December 2015, in its Conclusions on Research Integrity, the Council of the European Union acknowledged that research integrity is key to achieving research excellence and that measures should be taken to prevent research misconduct and invited the Commission and all stakeholders to define and implement policies to this effect. As a result, the revised provisions in the Horizon 2020 Model Grant Agreement explicitly call for beneficiaries to respect the principles and practices included in the European Code of Conduct for Research Integrity (EcoC). The Commission played a key role in the revision of this Code in 2017 and the process was led by All European Academies (ALLEA) in cooperation with stakeholders including industry, academia and research funders.

SwafS has financed a number of projects aimed at fostering and promoting a better understanding of ethics and research integrity issues and supporting the research community in this area. The funding of SwafS projects and the ethics appraisal process in Horizon 2020 are helping to raise awareness among researchers in academia and industry as well as relevant actors on the importance of ethics and research integrity as a means of promoting excellence in research.

These projects constitute a range of initiatives focused on strengthening the capacity of research organisations, researchers, ethics committees, research integrity offices and funding bodies.

Furthermore, these projects contributed to building a governance framework for research ethics (RE) and research integrity (RI). A community of RE and RI actors was set up to facilitate exchange of knowledge and experience and to leverage improvements in the existing mechanisms in place to ensure RE and RI (see 2.3.1).

Currently, interesting developments concern the definition of new guidelines and codes in areas dealing with new technologies with potentially high social and economic impact and potentially affecting human rights.

Artificial intelligence, robotics, human genomics and human enhancement offer benefits for both individuals and society. However, they also raise complex ethical issues that need to be addressed at EU level.

There is a pressing need to provide ethical responses and practical options which support innovation, the research community, facilitate the work of ethics committees and take into consideration the expectations of society.

Guidelines are currently being developed taking into account the ethical implications of these domains with the active involvement of relevant stakeholders. A number of these guidelines are expected to be published during the course of 2020.

[36] H2020 Rules for Participation, Art. 14 (Ethics Reviews)
[37] H2020 Regulation of Establishment, Art. 19 (Ethical principles)
[38] H2020 Model Grant Agreement, Art. 34 (Ethics and Research Integrity)

2.1. Policy objectives

According to Annex I – Part V of the Specific Programme Council Decision of 3/12/2013[39], the policy objective on Research Ethics and Research Integrity in Horizon 2020 is twofold:

- 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;

- 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's needs and demands, and promote an ethics framework for research and innovation.

More specific policy objectives have been identified in the various topics in the work programmes:

- Examine research integrity and research misconduct and enhance existing codes of conduct;
- Strengthen the EU's capacity to uphold the highest ethical standards, promote research integrity and minimise misconduct by promoting best practices;
- Reinforce synergies between European networks active in research integrity and research ethics;
- Promote innovative methods for teaching ethics and research integrity;
- Map the ethics and research integrity normative frameworks;
- Analyse the ethics of technologies with high socio-economic impact and human rights relevance and elaborate appropriate guidance documents and area-specific codes which will allow ethics to be perceived as a driver of excellent research and innovation and not a red tape measure;
- Examine methods to reduce the risk of exporting unethical practices to third countries.

2.2. Project portfolio

Research Ethics & Research Integrity were the main themes in topics throughout Horizon 2020's three work programmes, resulting in 15 funded projects with a combined budget of EUR 40.7[40] million (2020 call not included in which three projects are expected to be funded in the area of organoids, ethics of technologies with high socio-economic impact, and responsible open science in relation to ethics and integrity).

[39] Regulation (EU) No 1291/2013 of the European Parliament and of the Council establishing Horizon 2020
[40] The slight difference in the total figure calculated on basis of budget allocated to each project in table 3 is due to rounding

Fig. 5: Number of coordinators in Member State (MS)

Fig. 6: Number of other partners in Member States (MS) and Associated Countries (AC)

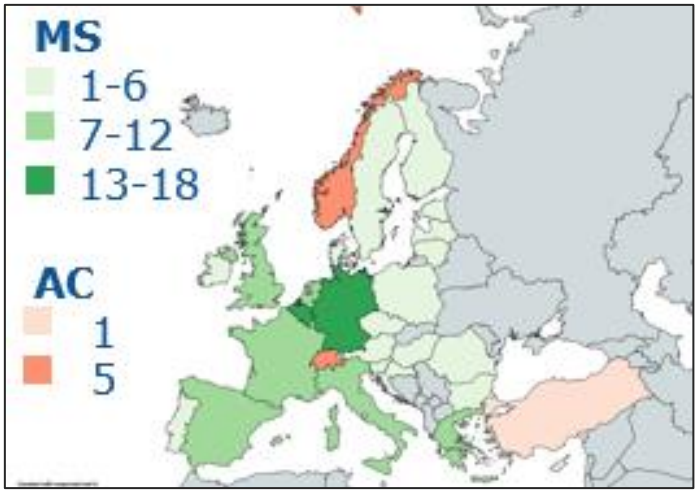
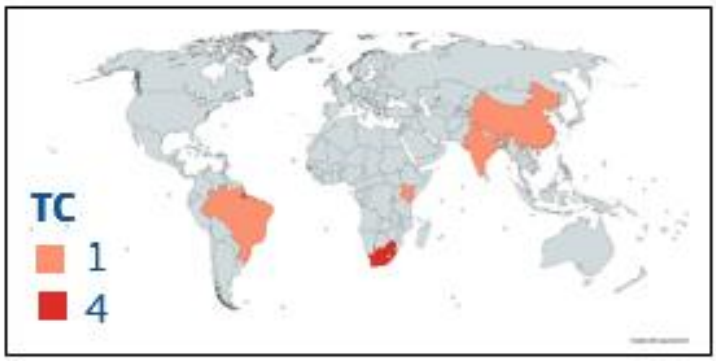


Fig. 7: Number of partners in Third Countries (TC)



All the topics are Coordination and Support Actions (CSA) by nature, which, in Horizon 2020 terms implies that they are not research projects *per se*, but in the case of ethics focus rather on the institutional framework, awareness raising, training and capacity building in general.

Table 3: Research Ethics and Research Integrity project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
GARRI-5-2014 Ethics in research: promoting Integrity (CSA)						
PRINTEGER	2.0 M€	01-09-2015 31-08-2018	STICHTING KATHOLIEKE UNIVERSITEIT	NL	**EU:** EE, BE, DE, UK, IT, NL **AC:** NO	printeger.eu
GARRI-6-2014 Reducing the risk of exporting non ethical practices to third countries (CSA)						
TRUST	2.1 M€	01-10-2015 31-12-2018	UNIVERSITY OF CENTRAL LANCASHIRE	UK	**EU:** FR(3), BE, NL **AC:** CH(2) **TC:** IN, ZA(3), KE	trust-project.eu/
GARRI-9-2015 Estimating the costs of research misconduct and the socio-economic benefit of research integrity (CSA)						
DEFORM	1.0 M€	01-06-2016 31-07-2018	INSTITUT DES HAUTES ETUDES ECONOMIQUES ET COMMERCIALES	FR	**EU:** EL	cordis.europa.eu/project/id/710246
GARRI-10-2015 European Ethics and Research Integrity Network in Horizon 2020 (CSA)						
ENERI	1.5 M€	01-09-2016 31-10-2019	RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAT BONN	DE	**EU:** AT(2), DE(2), NL, LT, FI, EL, DK **AC:** NO	eneri.eu
SwafS-16-2016 Mapping the Ethics and Research Integrity Normative Framework (CSA)						
EnTIRE	3.8 M€	01-05-2017 30-04-2021	STICHTING VUMC	NL	**EU:** DE(2), BE, HR, IE, ES, HU(2), UK **AC:** NO	embassy.science
SwafS-17-2016 The Ethics of informed consent in novel treatment including a gender perspective (CSA)						
I-CONSENT	3.1 M€	01-05-2017 31-03-2021	FUNDACION PARA EL FOMENTO DE LA INVESTIGACION SANITARIA Y BIOMEDICA DE LA COMUNITAT VALENCIANA	ES	**EU:** ES(2), IT(3), UK (2), FR(1), BE	i-consentproject.eu
SwafS-18-2016 The Ethics of technologies with high socio-economic impact and Human Rights relevance (CSA)						
SIENNA	4.0 M€	01-10-2017 31-03-2021	UNIVERSITEIT TWENTE	NL	**EU:** UK, SE, PL, DE, ES, EL, FR **TC:** BR, CN, ZA	sienna-project.eu
SwafS-21-2017 Promoting integrity in the use of research results in evidence based policy: a focus on non-medical research (CSA)						
PRO-RES	2.8 M€	01-05-2018 30-04-2021	FONDATION EUROPEENNE DE LA SCIENCE	FR	**EU:** UK, EL(2), EE, HR, BE(2), FR(2), IT(2), DE, IE	prores-project.eu
SwafS-22-2017 The Ethical dimensions of IT technologies: a European perspective focusing on security and human rights (CSA)						
SHERPA	2.9 M€	01-05-2018 31-10-2021	DE MONTFORT UNIVERSITY	UK	**EU:** UK(2), NL(3), DE, CY(2), BE, FI	project-sherpa.eu
PANELFIT	2.8 M€	01-11-2018 31-10-2021	UNIVERSIDAD DEL PAIS VASCO/ EUSKAL HERRIKO UNIBERTSITATEA	ES	**EU:** ES(3), DK, BE, AT, DE(4), IT **AC:** CH	panelfit.eu
SwafS-27-2017 Implementing a European Train-the-trainers initiative with regard to Ethics and Research Integrity (CSA)						
VIRT2UE	2.8 M€	01-06-2018 31-05-2021	STICHTING VUMC	NL	**EU:** BE, HR, AT, DE, EL, FI, LV, PT, IT, NL **AC:** NO, TR	embassy.science
SwafS-02-2018 Innovative methods for teaching ethics and research integrity (CSA)						
Path2Integrity	2.5 M€	01-01-2019 31-12-2021	FACHHOCHSCHULE COBURG	DE	**EU:** DK, ES(2), BG, DE(3), PL	path2integrity.eu
INTEGRITY	2.5 M€	01-01-2019 31-12-2021	UNIVERSITEIT UTRECHT	NL	**EU:** IE, DK, PT, HU, LT, SI, NL, SE **AC:** CH(2)	h2020integrity.eu
SwafS-03-2018 Developing Research Integrity standard operating procedures (CSA)						
SOPs4RI	4.0 M€	01-01-2019 31-12-2022	AARHUS UNIVERSITET	DK	**EU:** NL(2), HR, UK(2), AT, EL, IE, BE(2), IT, PL	sops4ri.eu
SwafS-16-2019 Ethics of Innovation: the challenge of new interaction modes (CSA)						
PRO-ETHICS	3.0 M€	01-01-2020 31-12-2023	ZENTRUM FUR SOZIALE INNOVATION GMBH	AT	**EU:** DK, NL, FR, UK, BE(2), DE(2), ES, CZ, AT, RO, LT **AC:** NO	cordis.europa.eu/project/id/872441

2.3. Achievements

The main achievements and ongoing developments of the Research Ethics (RE) and Research Integrity (RI) projects can be clustered around the following four categories:

- RE/RI community building;
- Capacity building and awareness raising;
- Development of frameworks and Standard Operating Procedures ;
- Policy drive for ethics in technologies with high socio-economic impact (such as Artificial Intelligence (AI), genomics etc.)

Projects' outcomes have been achieved based on an inclusive approach in line with Responsible Research and Innovation principles by involving societal actors, ethics committees, research integrity offices and relevant stakeholders throughout the entire process.

The European Commission identified so far two projects as particular success stories in relation to the quality and quantity of exploitable material, their dissemination activities and their impact on the research communities in Europe and beyond: TRUST and PRINTEGER while projects such as SIENNA, SHERPA and PANELFIT lead the way in research cooperation in emerging technologies and data protection.

2.3.1. RE/RI community building

2.3.1.1. Building a RI/RI community at European level

In the work programme 2014-2015, the topic 'European Ethics and Research Integrity Network in Horizon 2020' resulted in the funding of ENERI**.** ENERI carried out a series of activities to support research ethics committees (RECs) and research integrity offices (RIOs) active in all Member States and Horizon 2020 Associated Countries.

The aim of ENERI was to strengthen the existing networks, namely the European Network of Ethics Committees (EUREC) and the European Network of Research Integrity Offices (ENRIO), while at the same time enhancing their collaboration. EUREC, ENRIO, the All European Academies (ALLEA) and other SwafS RE and RI projects, joined forces to form strong ties between RE and RI and set up a unique European Network of Research Ethics and Research Integrity, also called ENERI.

This network resulted in improving its competences, enhancing interactions, promoting harmonisation and synergies as well as raising awareness. An array of activities have been carried-out including joint workshops, joint events and collaborative work resulting in tools of common interest in education and training such as the RE and RI e-Manual and the RI decision tree (presented in 2.3.2.2 below).

Moreover, an e-Community of 165 RE/RI experts has been set up to encourage sharing of best practices and a set of indicators identified to assess the competences required for qualified expert membership. This database is currently integrated in the Commission's SINAPSE portal, to ensure its sustainability after the project's conclusion.

With a view to further strengthening the RE and RI community, the REA and DG R&I organised a cluster event in Brussels on 1 June 2018 grouping 11 SwafS Research Ethics and Research Integrity projects. The aim of this event to establish project synergies and develop project-specific cooperation plans was realised.

Following up on this initiative, DG R&I encouraged SHERPA, PANELFIT and SIENNA to join forces in relation to the new technologies domain. A video produced bears witness to this collaboration and explores the ethical, legal and human rights questions surrounding information and communication technologies, big data, artificial intelligence and smart information systems.

Jointly with DG R&I, SIENNA and SHERPA organised a workshop for EC policy makers and REA project officers dedicated to ethics and artificial intelligence: Foreseeing the Impact and Shaping the Future.

Path2Integrity, INTEGRITY, VIRT2UE and ENTIRE collaborate on a regular basis with a view to jointly producing RE and RI education material and development of training curricula.

2.3.1.2. Building a RE/RI community open to the world

Taking into account the progressive globalisation of research activities, international collaboration was encouraged by the European Commission, and was explicitly mentioned in the most recent SwafS work programme 2018-2020 in line with former Commissioner Moedas three strategic priorities, Open innovation, Open science, Open to the world (the three O's strategy). As a result, international partners have been involved in projects to a certain extent (see Fig. 7) (e.g. UNESCO's involvement in TRUST).

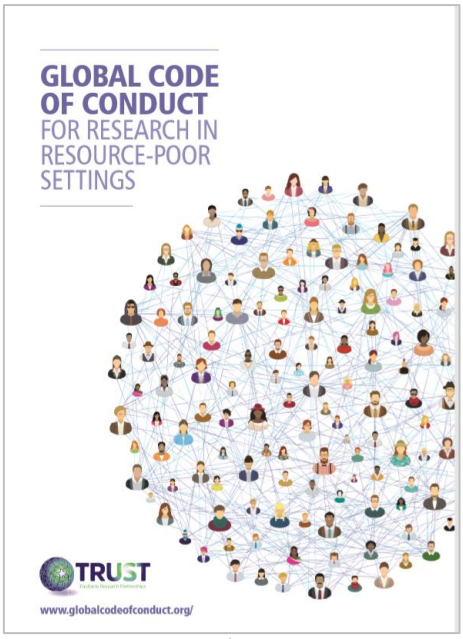
The progressive globalisation of research brought with it new ethical challenges linked to the existence of varying ethics review practices across countries and an increased risk that research with sensitive ethical issues is conducted by European organisations outside the EU in a way that would not be accepted in Europe from an ethical point of view. The European Commission refers to such practices as '*ethics dumping*'[41].

The 2014 work programme, topic 'Reducing the risk of exporting non ethical practices to third countries' focused on addressing the risk of '*ethics dumping*' and identifying mechanisms to minimise such practices.

The TRUST project, funded under this topic, developed tools and a comprehensive global code of conduct to guide researchers from high-income countries when undertaking work in low- and middle-income settings.

In collaboration with UNESCO, researchers from the EU, Africa and India, industry (pharmaceutical companies) and local communities the Global Code of Conduct for Research in Resource – Poor Settings (referred to as Global Code of Conduct) was also developed.

[41] European Commission website for Ethics



This innovative Global Code of Conduct is structured around four values and has the ambition of moving from 'procedural-based ethics' (e.g. checklist exercise) to 'ethics in practice' and 'ethics by design'. The Code proposes guiding principles centred on values and ethical considerations that researchers must take into account from the design-stage of their research and throughout its implementation. The Code has been translated into nine languages and was launched globally at a meeting of the Leadership Council of the Sustainable Development Solutions Network in Stockholm in May 2017 and presented to the European Parliament in a dedicated event organised in June 2018.

The TRUST team supported as well the development of the first code of ethics by one of the world's oldest indigenous populations, the San of southern Africa who now have their own rules for researchers intending to study their community and people: the SAN Code for Research Ethics.

This Code has brought to an end more than a century of the San population being measured, photographed, scrutinised and often exploited by researchers with no means of having their rights recognized and little benefit to the people themselves.

After its launch, the San Code of Research Ethics received widespread media coverage. A list of articles was published on the TRUST website. The following are amongst the most renowned news sites that includes coverage on the San Code and TRUST project: NATURE, Science, The Guardian, the Mail&Guardian, National Geographic, The Scientist, Scientific American and The New Economy. Additionally a wide range of TRUST materials was used by the Al-Jazeera English programme 'The Stream': 'Is there an ethical way to research indigenous communities?'
The project also produced A History of the San Code of Research Ethics, and two books (both open access) edited by Springer: Ethics Dumping: Case Studies from North-South Research Collaborations (downloaded 55,000 times in the first year) and Equitable Research Partnership. The Global Code of Conduct for Research in Resource-Poor Settings was adopted by the European Commission as a reference document for research funded projects under H2020 and by the European & Developing Countries Clinical Trials (EDCT) Partnership.

With reference to research integrity, the work carried out through SwafS projects contributed significantly not only in developing and promoting the research integrity culture in Europe but also in establishing a European position in the world. The PRINTEGER and DEFORM projects for instance sought to enhance research integrity by promoting a research culture in which integrity is part of research itself, and not just an external add-on or restrictive control system.

In 2017, the European Commission collaborated in the revision of the European Code of Conduct for Research Integrity, a Code originally developed in 1990 by the European Science Foundation (ESF) and All European Academies (ALLEA) to promote research integrity. While research integrity is relatively new to Europe, the European Commission and certain Member States such as the Netherlands and Scandinavian countries have contributed significantly to granting Europe a leading position in the domain.

The Commission is holding discussions on research ethics and integrity with the Chinese Ministry of Science and Technology with the aim to increase understanding and cooperation in this area.

Furthermore, a dialogue is ongoing with supranational networks such as the American, African and Asian Integrity networks. At the end of 2019, a new global partner with a strong interest in ethics and integrity, South Korea, came on board. In 2020, the basis of cooperation will be discussed and appropriate actions will be designed.

At the 5th World Conference on Research Integrity held in Amsterdam in 2017, all SwafS RE/RI projects were represented and in the 2019 World Conference, held in Hong Kong, the European Commission presented a dedicated session on RE/RI training involving SwafS projects ENERI, Path2Integrity, INTEGRITY and VIRT2UE.

2.3.2. Capacity building and awareness raising

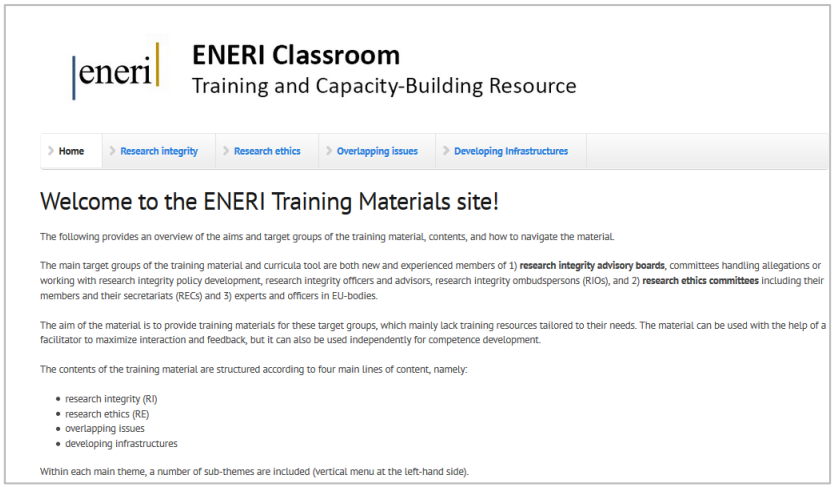
2.3.2.1. Training

RE/RI training courses and material have been designed primarily by the projects ENERI, Path2Integrity, INTEGRITY and VIRT2UE. The projects mapped the training needs of various target groups, such as: high school students, junior and senior researchers, members of Research Integrity Offices (RIOs) and Research Ethics Committees (RECs),

ethics and research integrity experts and trainers. Tailored educational material is being developed.

In the early years of Horizon 2020, the priority for training activities has been enhancing the competences of research ethics committees and research integrity officers in Member States and Associated Countries, and improving the knowledge of experts involved in the evaluation of proposals (ethics review process). Subsequently, there was a move towards developing innovative methods to those who teach RE/RI (train-the-trainer modules) and to engage with all who are directly or indirectly involved in research (training the researchers themselves). Efforts are currently ongoing in developing innovative RE/RI training material for secondary school students, undergraduate students, graduate students and young researchers in relevant fields.

ENERI set up the ENERI Classroom, a website where researchers, research integrity officers and research ethics committee members and experts can find training material.



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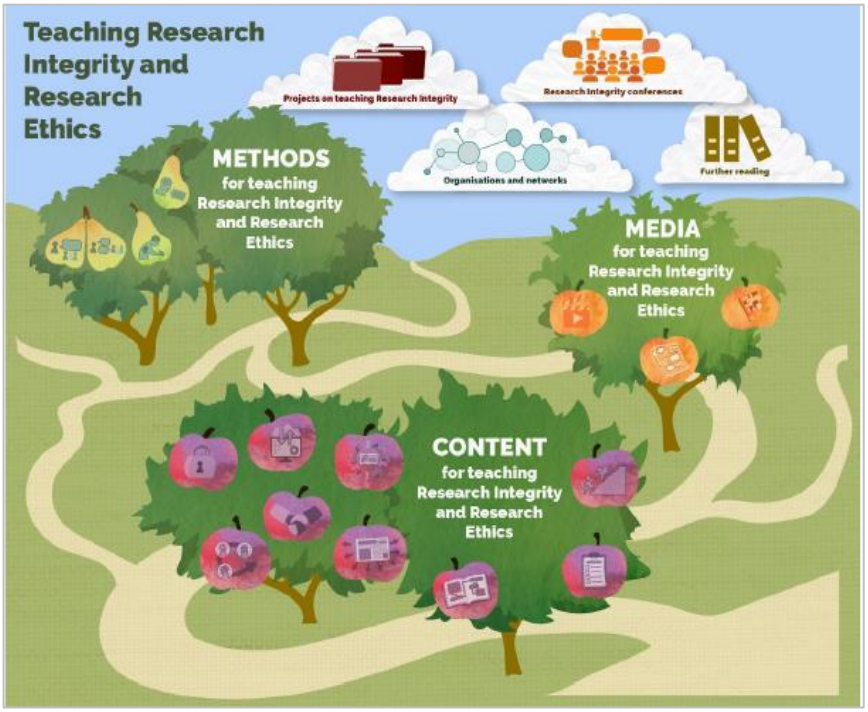
VIRT2UE is developing an innovative training programme for trainers, with novel tools to enable researchers to reflect on the principles outlined in the ECoC and apply these in their daily work. Rather than focusing on compliance, the training is being designed to stimulate researchers' virtues.

© Embassy of Good Science, 2020.

All training material produced by the ENERI and VIRT2UE projects is being transferred to the Embassy of Good Science platform (expected to be completed by 2021).

Path2Integrity is developing learning material on research integrity for students from secondary school to young researchers based on learning paths using research integrity role-models and role-play.



©Julia Prieß-Buchheit

A research integrity course for young researchers has also been developed by PRINTEGER and is available online: Upright.

All the training material produced contributed to the promotion of a consistent application of the principles listed in the European Code of Conduct for Research Integrity (EcoC).

2.3.2.2. Tools

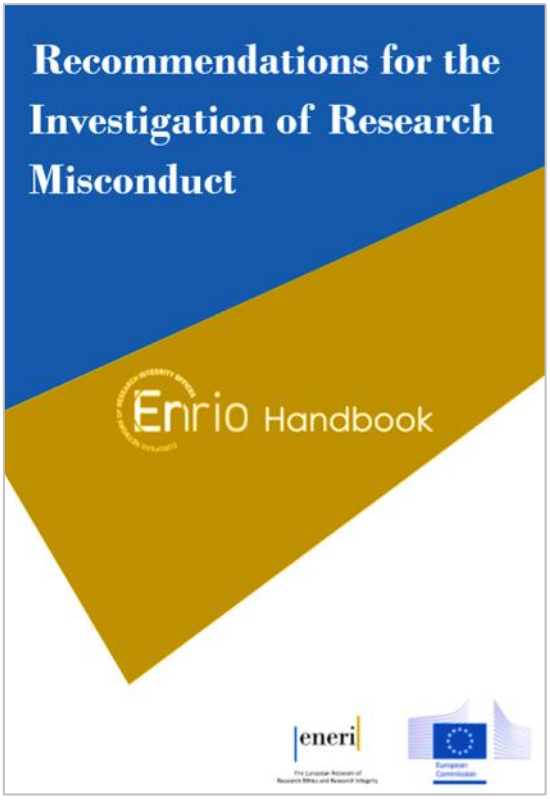
SwafS supported the development of a broad array of tools to build the capacity of the research community to conduct ethically compliant research in Europe and worldwide and guide researchers in terms of designing and carrying-out research respecting research integrity standards.

PRINTEGER and DEFORM carried out an analysis of policies, procedures, codes, guidelines and organisational structures addressing misconduct and promoting integrity in science governance in universities and other research organisations and the results are available on the PRINTEGER website.

Given the need for more concrete guidance, PRINTEGER developed a consensus statement on how research performing organisations should work with research integrity in practice. The focus was on operationalising institutional responsibilities in terms of training, monitoring, etc. The project's final conference held in Bonn in 2018 resulted in the Bonn PRINTEGER Statement that was signed and adopted by a number of universities.

Another set of operational recommendations for the investigation of research misconduct is elaborated by ENRIO within the framework of the project ENERI: the Handbook on Research Integrity.

Such recommendations are particularly relevant for countries struggling with setting up a uniform and robust research integrity system, and can serve as a reference for countries with established RI structures.



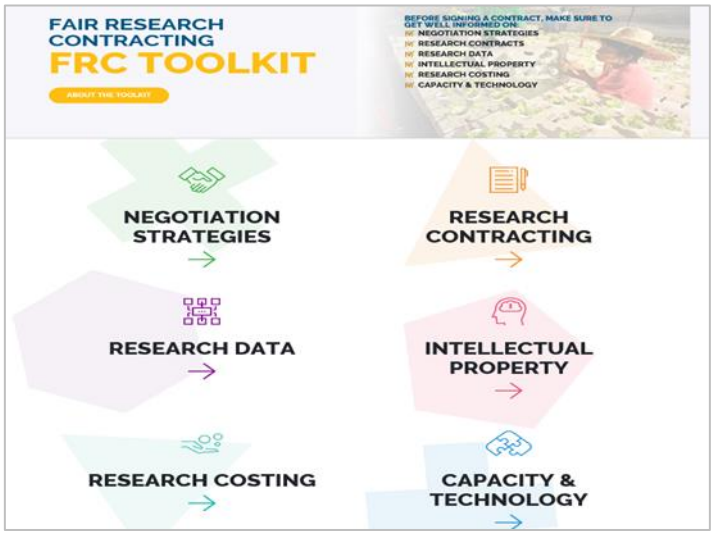
An e-Manual on research ethics and research integrity was developed by ENERI, for guiding researchers in the design phase of their research and for those evaluating research. It's a living document and seeks to instil discussion on research ethics (RE) and research integrity (RI) related matters.

In terms of ethics compliance in research, ENERI developed the ENERI Decision Tree to help researchers, REC and RIO members think about ethical questions and challenges that might arise during a planned research project.

As a complement to the Global Code of Conduct, TRUST developed tools aimed at tackling ethics dumping: the Fair Research Contracts (FRC) toolkit and the forthcoming Compliance and Ethics follow-up tool.

The Fair Research Contract (FRC) toolkit helps administrators, researchers and legal advisors in low- and middle-income settings to achieve equitable research contracts in collaboration with research teams from high-income settings offering freely accessible up-to-date information, links and references to help users understand the factors underpinning an equitable and transparent research partnership.

The Compliance and Ethics follow-up tool, complementary to the global code and the FRC toolkit, will be a self-appraisal tool designed primarily for use by ethics committees and funders as a means of monitoring researcher compliance with ethical requirements over the course of a research study.



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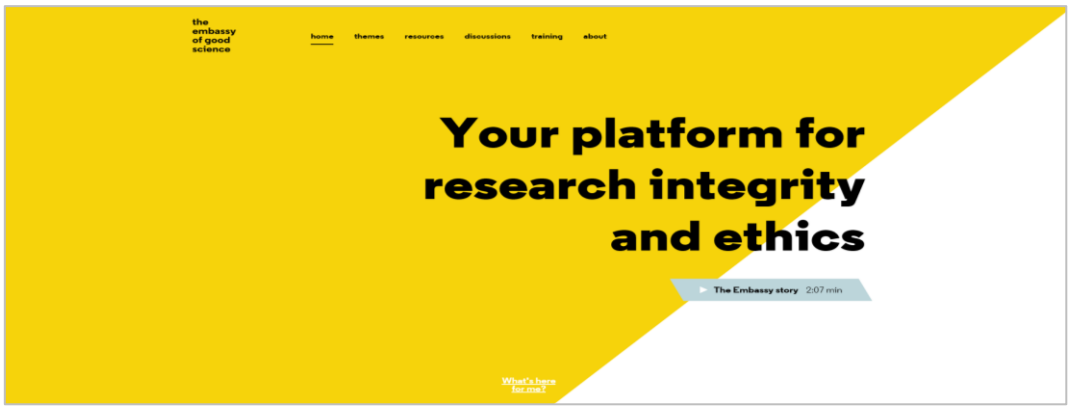
In response to the 2016 work programme topic, 'Mapping the Ethics and Research Integrity Normative Framework', ENTIRE was funded with the aim of developing a wiki-based online platform to make available the identified ethics/integrity normative framework and material.

In 2019, at the 5th World Conference on Research Integrity in Hong Kong, the platform Embassy of Good Science was launched as a 'one stop shop' for all reference materials and training modules. Currently, the platform provides access to the material produced by ENTIRE and VIRT2UE. It will serve as a European Commission portal for all outputs of the Framework Programme funded projects. Its ambition is to become the reference platform of the RE/RI community, which will ensure it is kept up-to-date and sustainable in the long term.



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2.3.3. Development of frameworks and Standard Operating Procedures (SOP)

With the SwafS work programme 2016-2017, the focus was put on 'Ethical dimensions of IT technologies', 'ethics of technologies with high socio-economic impact and human rights relevance' and on 'promoting integrity in the use of research results in evidence-based policy'.

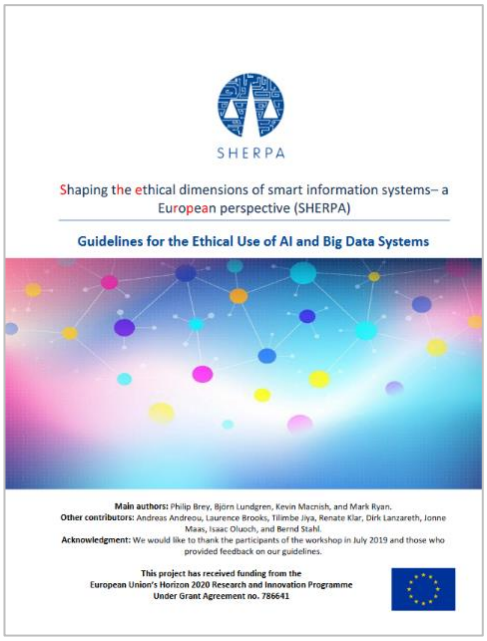
In response to the work programme topic 'The ethics of technologies with high socio-economic impact and human rights relevance', SIENNA is working on integrating the ethical perspectives of emerging technologies, focusing on genomics, human enhancement and human–machine interaction including the creation of intelligent environments. For each of the three areas, operational guidelines for research ethics committees and a code for responsible conduct for researchers will be produced.

The development of new technologies dramatically increased the capability for collection, analysis and further processing of vast amounts of personal data. While such developments have the potential of bringing enormous benefits in all spheres of social life and science, they also created ethics tensions and challenged the application of certain fundamental rights. This prompted a call for proposals under the topic 'The ethical dimensions of IT technologies: a European perspective focusing on security and human rights', under which the SHERPA project is funded.

SHERPA identified future scenarios on the use of Artificial Intelligence (AI) and big data analytics in various domains, to assess assumptions about the future social conditions that might drive the use of AI and the ethical implications society may face as a result. In addition, SHERPA is working on ten case studies seeking to provide the first large-scale empirically-grounded analysis of what is actually happening across a number of sectors in Europe, including government, health care, cybersecurity, telecommunications and insurance.

SHERPA produced so far two guidelines:

- Guidelines for the Ethical Use of AI and Big Data Systems, to answer the question: 'What is an ethical use of AI or a big data system?'



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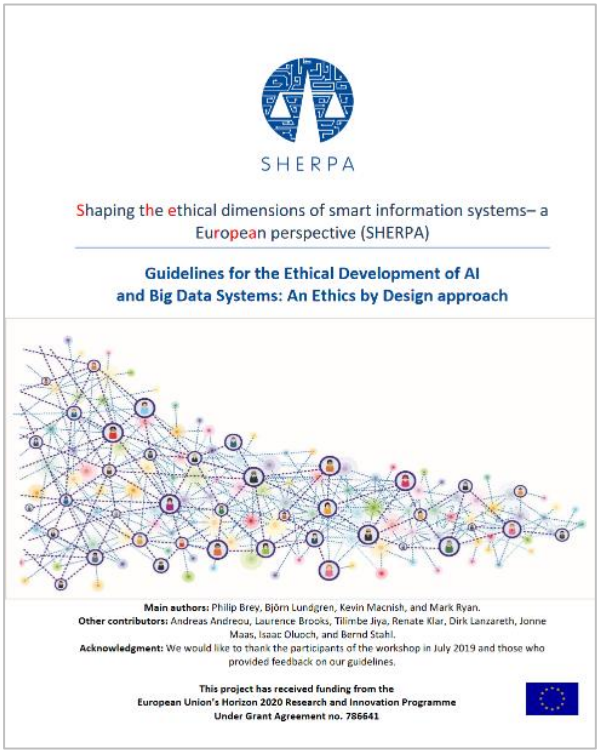
- Guidelines for the Ethical Development of AI and Big Data Systems: An Ethics by Design approach, intended to answer the question: 'How can we construct an ethical AI or big data system?'



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Under the same topic, PANELFIT aims to produce a set of outcomes that should serve as practical guidelines and operational standards to reduce the ethical and legal issues posed by ICT technologies, whilst ensuring high levels of privacy and security/cybersecurity.

An additional topic in 2017, 'Promoting integrity in the use of research results in evidence based policy: a focus on non-medical research' under which the project PRO-RES is funded and is working on the definition of an Oviedo/Helsinki type framework for non-medical research.

The topic 'The ethics of informed consent in novel treatment including a gender perspective' aimed at helping clinicians find practical answers to ensure full compliance with clinical ethics.

In this regard, I-Consent is working on guidelines to improve the information that patients obtain from clinical studies on novel treatments. During the informed consent process, patients learn about the study and decide whether or not to partake. At present, many informed consent documents are complex, difficult to understand and drafted without fully considering the patients' perspectives.

I-Consent aims to improve the existing informed consent process through the implementation of innovative proposals adapted to patients' needs. This new perspective seeks to empower patients in their decision as to whether to participate in clinical trials and to increase their decision-making autonomy.

Concerning Standard Operating Procedures (SOPs), the European Commission emphasised the important role played by Research Performing Organisations (RPOs), including Higher Education Institutions, and Research Funding Organisations (RFOs) in shaping the culture of scientific research.

The first Council conclusions on Research Integrity, indicated the need to 'define and implement policies to promote research integrity and to prevent and address research misconduct'. The implementation of these policies requires the development of standard operating procedures (SOPs) and guidelines related to research integrity and the prevention of research misconduct' [42]

Under this framework, SOPs4RI aims to produce a toolbox for RPOs and RFOs including Standard Operating Procedures (SOPs) and guidelines.

2.3.4. Policy drive for ethics in technologies with high socio-economic impact

SIENNA, PANELFIT and SHERPA provided input in the public consultation of the EU High Level Group on Artificial Intelligence 'Ethics Guidelines for Trustworthy Artificial Intelligence'[43] and continue to work further on operationalising these recommendations in practical, operational guidelines for Framework Programme applicants.

2.4. Recommendations

2.4.1. Policy recommendations

Future calls and work programmes should support projects that continue to focus on elevating Research Integrity to a level equal to that of Ethics (Art. 15 of the Proposal for a Regulation establishing Horizon Europe), and making the European Code of Conduct for Research Integrity a legal responsibility for all researchers.

Research Integrity is relatively recent in the EU and given the cultural differences between Member States, further effort is needed to harmonise processes and procedures regarding research misconduct and research integrity, as attested by members of the Research Integrity Offices (conclusion of ENERI's final review meeting).

The European Commission should continue facilitating collaboration among projects. The RE/RI community, currently rather small and mostly involving Northern European countries, should be further enlarged to facilitate a more active role of countries that are typically less represented in the European research ethics and integrity domain. Efforts should continue in strengthening the RI/RE community and facilitate the exchange of best practices to ultimately allow common approaches and practices spread across Europe.

Considering the differences across the EU, there is a need for continued efforts in RE/RI education and training. Future calls and work programmes should continue working on building the capacity of researchers and relevant actors to ensure that ethics and research integrity guide all research and innovation activities.

In addition, dedicated training for National Contact Points for dissemination to applicants is also needed.

[42] SwafS Work Programme 2018-2020, SwafS-03-2018: Developing research integrity standard operating procedures
[43] Ethics guidelines for trustworthy AI

Collaboration with other relevant DGs should be further developed. For example:

- On-going dialogue with DG GROW (soon to be transferred to DG DEFIS) on developing defence-specific guidelines related to ethics in the areas of robotics, information systems security and human enhancement;
- Co-operation with DG JUST, the EDPS and DG SANCO (for health data) will continue in the area of data protection and privacy;
- Co-operation with DG Home (security) and DG CNECT (ICT) will intensify due in particular to the emergence of AI and its socio-economic impact;
- Co-operation with DG ENV will continue on the use of animals in research;
- Co-operation with DGs involved in the implementation of the Green Deal will be established in the framework of the future work on Environmental Ethics.

Given the globalisation of research activities, the European Commission should further encourage collaboration with international partners in SwafS-funded projects, with the aim of defining accepted processes and mechanisms to allow harmonisation in the way ethical and research integrity issues are tackled at a global level. Current examples of collaboration includes countries such as China and South Korea as well as the American, African and Asian research integrity networks.

2.4.2. Recommendations for Horizon Europe

In Horizon Europe the objective is to promote the 'ethics by design' principle in order to stimulate reflection on ethical aspects while preparing the concept and methodology of the research, and consequently embed ethical considerations in the research from the outset. This would counteract the risk of ethics being considered as an ex-post add-on to simply meet administrative requirements.

In Horizon Europe, the trust-based approach will be maintained and the ethics appraisal scheme will focus on the severe and complex cases.

There is a need for General Data Protection Regulation (GDPR) training and events for researchers at national level, to raise awareness on GDPR requirements and national derogations in order to embed these principles directly in the design of research projects. Further cooperation between the national/institutional ethics committees and the respective Data Protection Officers should be encouraged to ensure that the rights and freedoms of research participants are adequately safeguarded.

Free online courses for researchers on research ethics and research integrity should become more widespread. It may be worth considering synergies with topics under the 'Science Careers' theme focusing on 'Research innovation needs & skills training in PhD programmes', where an additional module on 'Research Ethics and Research Integrity' could be envisaged.

Greater efforts are needed in the communication of project results to the general public to allow citizens to have a clear view on the European Commission's effort to strengthen research integrity and research ethics in European funded research. TRUST is an example of a project which excelled in its communication. The importance of communication should be emphasised in the work programme topics.

Finally, another aspect that deserves attention is the development of a common entry point, gateway/platform, for the existing RI/RE material developed by the various projects. This will be extremely beneficial for the whole community and allow researchers, trainers, experts, REC and RIO representatives to have a single access point to the most recently developed tools, guidelines, ethics frameworks, regulations and

relevant RE/ RI material. This common entry point will encourage collaboration among projects and facilitate access for newcomers to the community.

In parallel, this would serve as an incentive for projects to produce high quality reference documents. Such a platform will ultimately ensure the sustainability of projects' outcomes and strengthen considerably the impact of projects.

The Embassy of Good Science platform described in 2.3.2.2 will play that role and should be fully embraced in Horizon Europe and beyond.

3. SCIENCE EDUCATION

Science Education forms the basis for the full achievement of the Innovation Union and the European Research Area. Creative and innovative formal, non-formal and informal[44] science teaching and learning help young people make the best use of their capacities to become a force of innovation.

Encouraging formal, non-formal and informal science education is one of the dimensions of Responsible Research and Innovation that cuts across Horizon 2020.

In this respect, institutional changes were promoted concerning the introduction of new methods of teaching the curricula and new means of systematically fostering informal learning in non-educational settings.

In addition, science education topics show a close link to the science communication aspects of the programme, contributing to an informed and scientifically literate society.

3.1. Policy objectives

According to Annex I – Part V of the Specific Programme Council Decision of 3/12/2013, the policy objective for Science Education in Horizon 2020 is to:

'*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.*'

More specifically, the main goals of Science Education actions are:

- Greater participation of young people (up to age 20) in STEM;
- Encourage long-term careers in STEM;
- Equip citizens with the skills they need for active participation in science;
- Increase the number of countries participating at EUCYS;
- Increase the uptake of Scientix.

3.2. Project portfolio

Science Education was the focus of four particular domains (see Table 4) throughout Horizon 2020's work programmes, resulting in 19 funded projects (2019 and 2020 calls not included) with a combined budget of EUR 37.4[45] million.

[44] 'European Guidelines for Validating non-Formal and Informal Learning'
Formal learning: occurs in an organised and structured environment (e.g. in an education or training institution or on-the-job) and is explicitly designated as learning (i.e. in terms of objectives, time or resources). Formal learning is intentional from the learner's point of view. It typically leads to validation and certification.
Non-formal learning: embedded in planned activities which are not always explicitly designated as learning (in terms of learning objectives, learning time or learning support), but which do contain an important learning element. Non-formal learning is intentional from the learner's point of view. It can take place in museums, science camps, clubs, etc.
Informal learning: results from daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support. Informal learning is mostly unintentional from the learner's perspective.
[45] The slight difference in the total figure calculated on basis of budget allocated to each project in table 4 is due to rounding.

Fig. 8: Number of coordinators in Member States (MS) and Associated Countries (AC)

Fig. 9: Number of other partners in Member States (MS) and Associated Countries (AC)

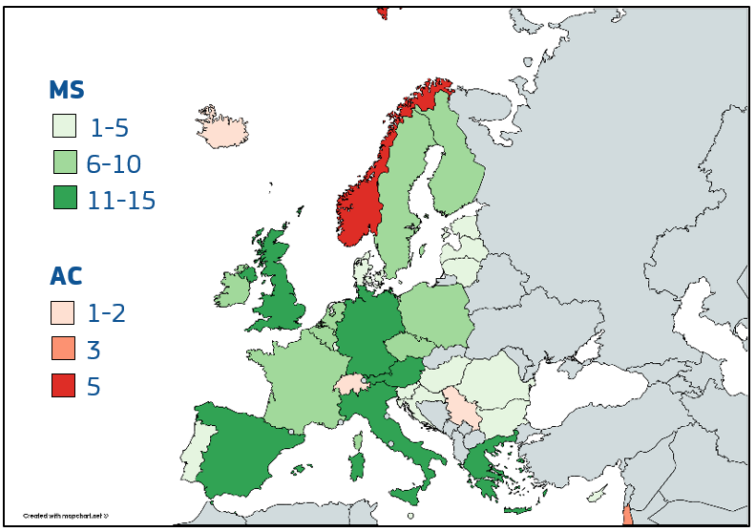


Fig. 10: Number of partners in Third Countries (TC)

A total of four third countries are involved: Australia, Belarus, Colombia and the United States of America.

Table 4: Science Education project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
SEAC-1-2014-2015 Innovative ways to make science education and scientific careers attractive to young people (RIA, CSA)						
MultiCO	1.4 M	01-08-2015 30-11-2018	ITA-SUOMEN YLIOPISTO	FI	**EU:** EE, DE, UK, CY	multico-project.eu
PERFORM	2.0 M	01-11-2015 31-10-2018	FUNDACIÓ PER A LA UNIVERSITAT OBERTA DE CATALUNYA	ES	**EU:** ES(2), UK(3), FR(3), AT	perform-research.eu
SciChallenge	1.3 M	01-09-2015 31-08-2017	SYNYO GmbH	AT	**EU:** CZ, SE, CY, SI, HU, AT, BE, UK	scichallenge.eu/
CREATIONS	1.8 M	01-10-2015 30-11-2018	UNIVERSITAET BAYREUTH	DE	**EU:** UK(3), EL(3), FI, DE, MT, ES, SE, FR **AC:** CH, NO, RS	creations-project.eu
ER4STEM	1.6 M	01-10-2015 30-09-2018	TECHNISCHE UNIVERSITAET WIEN	AT	**EU:** BG, AT, EL, MT, UK, CZ	er4stem.eu/
STIMEY	4.0 M	01-09-2016 30-11-2019	UNIVERSIDAD DE CADIZ	ES	**EU:** DE(2), EL(2), FI, ES **TC:** BY	stimey.eu/home
EDU-ARCTIC	1.8 M	01-05-2016 31-07-2019	INSTYTUT GEOFIZYKI POLSKIEJ AKADEMII NAUK	PL	**EU:** PL, FR **AC**: IS, NO, FO	edu-arctic.eu
STEM4youth	1.8 M	01-05-2016 31-10-2018	POLITECHNIKA WARSZAWSKA	PL	**EU:** EL(2), SI(2), IT, CZ, ES(3)	stem4youth.eu
UMI-Sci-Ed	1.8 M	01-06-2016 31-05-2019	INSTITOUTO TECHNOLOGIAS YPOLOGISTONK AI EKDOSEON DIOFANTOS	EL	**EU:** IE, IT(2), FI, BE **AC:** NO	umi-sci-ed.eu
Marine Mammals	1.8 M	01-09-2016 31-08-2019	CHRISTIAN-ALBRECHTS-UNIVERSITAET ZU KIEL	DE	**EU:** BE, PL(2), DK, DE(3), SE	marine-mammals.com
SEAC-2-2014 Responsible Research and Innovation in Higher Education Curricula (CSA)						
EnRRICH	1.5 M	01-07-2015 31-03-2018	VRIJE UNIVERSITEIT BRUSSEL	BE	**EU:** UK(2), IE(2), IT, DE(2), HU, NL, ES, FR, LT	livingknowledge.org/projects/enrrich/
HEIRRI	1.5 M	01-09-2015 31-08-2018	UNIVERSIDAD POMPEU FABRA	ES	**EU:** ES(3), DK, AT, HR, BE **AC:** NO	heirri.eu
SwafS-15-2016, SwafS-01-2018-2019-2020 Open Schooling and collaboration on science education (CSA)						
OSOS	3.0 M	01-04-2017 31-03-2020	ELLINOGERMANIKI AGOGI SCHOLI PANAGEA SAVVA AE	EL	**EU:** NL(2), ES, IE, DE, FI, EL(2), FR(2), IT, PT(2), LU, BG, **AC**: IL(2) **TC**: AU, USA (special agreement[46])	openschools.eu
SEAS	1.6 M	01-09-2019 31-08-2022	UNIVERSITETET I OSLO	NO	**EU:** AT(2), SE(2), BE(2), IT(2), EE, UK	seas.uio.no
PULCHRA	1.5 M	01-09-2019 31-08-2022	ETHNIKO KAI KAPODISTRIAKO PANEPISTIMIO ATHINON	EL	**EU:** DE, PL, CZ(2), RO, IT, LV, EL, SE, CY, IE	pulchra-schools.eu/
OSHub	1.5 M	01-10-2019 30-09-2022	UNIVERSITEIT LEIDEN	NL	**EU:** IE, IT, AT, FR, CZ, PT, EL **AC**: CH	oshub.network/

[46] European Commission website for the EU-US Cooperation in Research and Innovation

PHEREC LOS	1.5 M	01-10-2019 30-09-2022	KINDERBURO UNIVERSITAT WIEN GMBH	AT	**EU:** AT(3), PL(2), NL(2), DK, FI, PT, IT, RO, UK **TC:** CO	phereclos.eu
SwafS-11-2017 Science education outside the classroom (RIA)						
SySTEM 2020	3.0 M	01-05-2018 30-04-2021	TRINITY COLLEGE DUBLIN	IE	**EU:** NL, BE, FI, AT(2), SI, IT, EL, DK **AC:** IL, RS	system2020.education
CoM_n_Play-Science	3.1 M	01-06-2018 31-05-2021	NORGES TEKNISK-NATURVITENS KAPELIGE UNIVERSITET	NO	**EU:** FI, EL, NL, SE, DE, MT, ES, AT, UK (2) **TC**: USA (special agreement)	comnplayscience.eu

3.3. Achievements

The Science Education topics tend to attract the highest number of proposal submissions in SwafS, showing a great interest and need for dedicated funding in this area. The high number of applications led to a low success rate however ensured excellent projects were selected for funding.

The European Commission flagged many Science Education projects as success stories in relation to the quantity and quality of exploitable learning material, the engagement of students and the project's impact on teaching: PERFORM, SciChallenge, EDU-ARCTIC, STEM4Youth and Marine Mammals.

ER4STEM was selected to participate in the Science is Wonderful exhibition at the European R&I Days in Brussels in September 2019, and was a finalist at the European Digital Skills Awards.

In addition to specific projects managed by the REA, the Science Education policy area in Horizon 2020 included other actions. In particular, it is worth mentioning the EUCYS contest and the Scientix portal.

The annual European Union Contest for Young Scientists (EUCYS) is one of Europe's premier events for showcasing young scientific talent. It brings together winners of national science competitions (young people between 14 and 20 years of age) to compete with their European counterparts. The host country receives a grant to an identified beneficiary for EUR 800,000. In 2019, Commissioner Mariya Gabriel attended the Opening Ceremony and Deputy DG Signe Ratso attended the award ceremony in Sofia. The contest in 2021 will be in Salamanca.

Scientix, the community for science education in Europe, was developed to ensure a wide uptake and dissemination of STEM education practices. Scientix promotes and supports a European-wide collaboration among STEM teachers, education researchers, policy makers and other STEM education professionals.

This activity is funded by Horizon 2020 under SwafS 'other actions'. This European Commission initiative, since its inception in 2009, has been coordinated by European Schoolnet. Scientix has been selected as one of the world's top 100 innovations in education.[47]

[47] Article 'Scientix is one of the world's top 100 innovations!', January 2017

3.3.1. Ready-to-use content for students

Projects produced a high number of quality, ready-to-use material for students. Even after its official ending, the EDU Arctic project continues to provide the public with online lessons given by Arctic researchers.

The Arctic Explorer Game App is an example of an innovative educational tool targeting school pupils. It is based on the idea of 13-year-old EDU-ARCTIC Competition finalist from the Faroe Islands (2nd edition) Yngva Sigursdottir Lamhauge. She had the idea of creating a virtual journey through the Arctic, which, thanks to the form of a quiz, allows participants to broaden their knowledge of this region. The idea was then further developed by the project team and subsequently launched in the Google app store.

Finally, EDU Arctic developed Polarpedia, a free online encyclopaedia on polar research and established an extensive knowledge base on the Arctic, with more than 500 terms translated into 16 national European languages. 'Polarpedia' promotes the idea of co-creation and contains photos, graphics and animations, videos as well as games and quizzes.

STEM4youth produced freely available educational content for high school students aimed at encouraging them to study STEM and to pursue STEM-careers (not only academic). To this end, the project aimed at presenting students with tangible arguments on why it is worthwhile studying STEM subjects and the career perspectives in store for STEM graduates.

COM n PLAY Science developed the COMnPLAYer app to encourage children to discover and learn about science, and have their say on what it means to them.

3.3.2. Toolkits for teachers

Educators are essential in delivering any knowledge and results coming from the projects to students. Several projects included teacher training, and some produced deliverables designed specifically for teachers.

ER4STEM, a project that explored robotics education, developed a generic curriculum linking subject domains, technologies, use cases and powerful ideas. An educational robotics repository was created for use and improvement by teachers, academics, researchers and practitioners in the field of educational robotics.

Stem4youth researched citizen science at schools and provided a toolkit for teachers on how to design and carry out such experiments.

SySTEM 2020 created a toolkit of design principles and methods to help educators and pedagogical coordinators facilitate and reflect on the science learning activities offered in non-formal learning environments. The toolkit also includes examples of best practices and practical tips to support educators adapt the design principles to their particular context.

In terms of capacity building, EnRRICH produced good practices and case studies that demonstrate the embedding of RRI in modules and courses at 11 higher education institutions. Similarly, the EnRRICH tool for educators in higher education provides valuable insights in developing teaching modules and assisting in the design of teaching and learning methods.

HEIRRI created formative training materials designed for different educational levels and produced a booklet teaching and learning RRI presenting teaching resources in an endeavour to teach RRI in universities and higher education institutions.

3.3.3. Open schooling

Schools are of course the nexus where Science Education mostly takes place. The OSOS project promotes the open school model and supports adhering schools to hub together.

The OSOS Portal brings together 1000 schools from different European countries. These schools have been introduced to the open schooling culture and are already involved in numerous related activities promoting the use of open content and open pedagogies, while establishing open cooperation schemes with local stakeholders, industries and research organisations.

In order to continue promoting the open schooling approach, a new batch of projects started at the end of 2019: SEAS, PULCHRA, OSHub and PHERECLOS.

3.3.4. Competitions

Competitions are a great way to engage and showcase the work of students and young scientists. The aforementioned European Union Contest for Young Scientists (EUCYS) is a prime example of a successful event of this type promoted by the European Commission through SwafS. Individual projects also set up smaller-scale competitions.

Stem4Youth organised an open international student competition, along with a report including conclusions and suggestions on how to organise similar events.

As mentioned above, EDU Arctic developed and maintains the Arctic competition for teams of one or two pupils aged 13 to 20 and their teacher. In addition they created the engaging EDU-Arctic App, to collect meteorological data and through which students can collect points as part of the competition.

ER4STEM organised the annual European Conference on Educational Robotics (ECER) which centred on the 'botball' competition. High-school students submitted papers and if successful presented these at the conference and showcased their robotic developments.

3.3.5. Knowledge base

SySTEM 2020 started in 2018 and has already produced a mapping of over 1000 European STEAM (Science, Technology, Engineering, Art and Mathematics) organisations, programmes, events, online projects and bottom-up initiatives across a number of parameters. This has generated valuable insights and comparable data. The collected data from these STEAM organisations contains vast information on different targets groups, scientific topics, the methods used, outreach and communication strategies, activities, collaboration, governance and more.

3.3.6. Dissemination

Most projects engaged with many students, teachers, the general public, schools, civil society organisations and policy makers.

To give a sense of the amplitude of the outreach of the Science Education projects, we have outlined the number of stakeholders reached from a few projects.

ER4STEM (a completed 3-year project) reported to have used a total of 571 robots to engage with 4,459 students, well above the original target. An additional 510 people

were addressed in conferences, and more than 50 teachers were trained through workshops. More than 80 teachers and Scientix ambassadors were present at the repository webinars organised by the partners.

While initially aiming at reaching 10 EU countries, EDU-ARCTIC (also a completed 3-year project) reached pupils in 60 countries across five continents and established a network of over 1200 educators from over 800 schools. They estimate that the programme reached at least 30,000 students, who participated in more than 500 online lessons dedicated to the Arctic and polar research.

SySTEM 2020 (an on-going 3-year project) claim that their communication and dissemination activities reached about 500,000 people in the following categories:

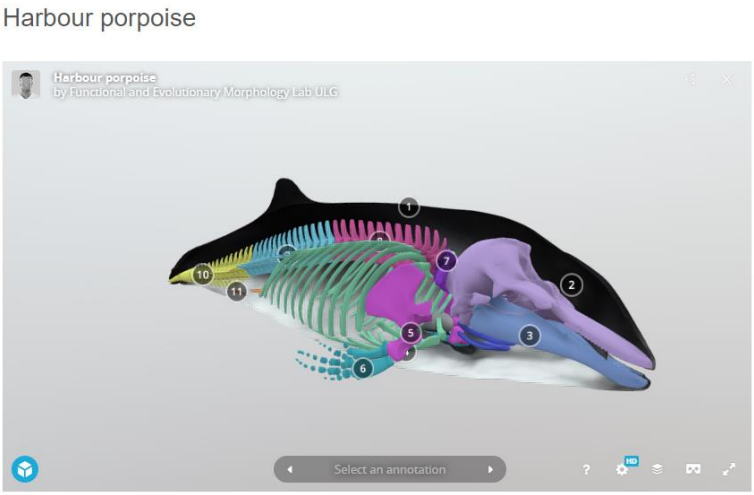
Table 5: SYSTEM 2020 dissemination

Category	People reached by SySTEM 2020 dissemination
Scientific Community	2,137
Industry	759
Civil Society	5,428
General Public	195,922
Policy Makers	118
Media	1,937
Investors	25
Customers	2,240
Other	271,132
TOTAL	**479,698**

EU success story example: Marine Mammals

The project is exemplar in utilising a specific topic like marine mammals to engage citizens with science, technology and environmental awareness.

Significant exploitable results include novel educational resources relevant to school curricula and attractive to students, teachers and the general public: 3D models, "expedition boxes", interactive digital posters, a book, practical activities and display materials. These are available through the project website, project partner events and exhibitions at consortium venues and other marine science centres.



© Marine Mammals, 2020.

These tangible outputs contribute considerably to ensuring a lasting legacy of the project. They also make an excellent contribution to the current state-of-the-art in marine science education and outreach.

Considerable impact has been achieved by directly involving over 400 teachers and almost 1,500 students from 14 different countries in more than 50 events between training sessions, summer schools and symposia. The public outreach activities have reached an estimated 50,000 people in the partner countries.

© Marine Mammals, 2020.

Sustainability of the project has been ensured through the production of physical and digital resources which project partners will continue to utilise in various ways in the future.

The additional, unforeseen, opportunity to publish a book with a well-respected academic publisher is an added positive.

This project contributes towards EU policy and strategy in the areas of environment and education. In particular it demonstrates the successful approach of using hands-on learning inside and outside of the school curriculum and direct contact with scientists to raise interest in and understanding of science careers and environmental issues.

3.4. Recommendations

3.4.1. Policy recommendations

In line with the von der Leyen Commission's priorities, the Science Education community recommends the systematic integration of climate change and energy issues into schools' curricula.

More than 50 educational systems exist across the EU Member States, sharing common challenges and offering many different solutions. This variety of experiences could be better exploited with a view to identifying best practices for promoting Science Education.

Science Education policy is closely connected with the first article[48] of the European Pillar of Social Rights. The implementation of the life-long learning principle, involving people outside of the formal education sphere, would benefit from better integration with citizen science, citizen engagement and science communication policy areas.

A possible vehicle to this interconnection could be the extension of the open schooling approach to open universities, whereby universities become community spaces, hosting events and co-creation activities open to the public at large.

Other public spaces like museums or local municipalities could also be exploited. Science communication professionals may use issues of particular public interest to help people connect to science through everyday experiences. Such activities can help combat anti-scientific attitudes.

Furthermore, a clear Science Education component could be integrated and supported in each Citizen Science project.

Adults could also be more involved in their children's educational activities and promoting inter-generational learning. Accompanying carers should be kept in mind when organising activities primarily targeting children.

3.4.2. Recommendations for Horizon Europe

Horizon Europe should foresee standalone Science Education topics.

In terms of possible topics, one area of exploration could be calls dedicated to facilitating interactions between secondary and tertiary education.

The full potential of the business world is yet to be explored and Science Education topics could for example aim to identify mutual benefits and create the means for such interactions.

Reinforced collaboration with Scientix would increase projects' impact. This should be added as a specific requirement in the work programme topic descriptions.

Furthermore, Scientix should assess the extensive material produced by Horizon 2020 Science Education projects and consider a 'one-stop-shop' solution for teaching practitioners who do not have the time to look into individual projects.

[48] 'Everyone has the right to quality and inclusive education, training and life-long learning in order to maintain and acquire skills that enable them to participate fully in society and manage successfully transitions in the labour market.'

Scientix could ensure teaching material is readily identifiable and accessible. Scientix is well placed to facilitate the exploitation of the material produced and ensure the outcomes of projects are fully harvested.

The article on 'additional dissemination obligations', which applies for a number of SwafS topics since 2018, should also be foreseen for Science Education projects in order to share best practices, identify synergies and ensure sustainability.

It is advisable that project duration in relation to the budget foreseen is indicated in the work programme topics. In terms of implementation, this would facilitate clustering activities with the timing of periodic reviews for similar projects coinciding.

Aside from the standalone topics on Science Education, Horizon Europe could also foresee mainstreaming of Science Education in other parts of the programme. Coordination and support actions for science education, citizen science and science communication could be aimed at facilitating these specific SwafS-related elements in projects across the future framework programme.

Science Education policies should seek links beyond Horizon Europe, for example by engaging with publicly recognised European scientific programmes like European Space Agency (ESA)'s Copernicus.

Synergies should be explored between funding schemes with similar goals in Europe. Notably, DG EAC has initiatives tying in directly with the goals of Science Education, for example the European Key Competences Framework.

An example of successful synergies with other funding programmes is the Horizon 2020 project EDU Arctic, which secured additional European Economic Area (EEA) funding for its Arctic exploration programme.

4. SCIENCE CAREERS

The European Research Area (ERA) priorities underline the importance of an open labour market for researchers. This includes the removal of barriers to researchers' mobility as well as enhancing their training and career opportunities. As stated in the SwafS 2016 work programme, Europe will need around 1 million more researchers in the coming years. Students and young researchers need to be better informed about European opportunities for the pursuit of their career.[49]

One of the main challenges across the EU is to ensure transparent, open and merit-based recruitment where this is still not the case. A lack of open recruitment not only does injustice to individuals but also prevents universities from putting together the best possible research teams.

Member States have signed up to removing any outstanding barriers to mobility and stakeholder organisations are committed to filling their research positions according to open recruitment procedures and to advertise all vacancies on EURAXESS. This will make research careers more attractive and foster mobility and ultimately research quality.

The European Research Area (ERA) launched 'EURAXESS – Researchers in Motion' initiative to address barriers to researcher mobility. The initiative strives to become the global support and career development tool for European and international researchers, both in terms of their mobility within and beyond Europe as well as networking with researchers from all over the world. Designed as a comprehensive tool-set, it provides access to information and support services structured around the following five pillars:

- EURAXESS SERVICES is a network of more than 600 centres in 40 European countries providing relocation assistance to ensure a smooth transition of Europe-bound international or expatriate European researchers. This free service helps with logistical matters including accommodation, visa and work permits, language courses, schools for the researcher's children, social security and medical care as well as facilitating integration into the culture of the new host country. Today the centres deal with about 450,000 mobility related issues per year.

- EURAXESS PORTAL is a recruitment tool for research personnel. The portal lists research job vacancies, funding and hosting opportunities.

- EURAXESS NATIONAL PORTALS amounting to 40 national websites complement the main EURAXESS Portal with country specific information on living and working conditions for researchers.

- EURAXESS RIGHTS aims at better employment and working conditions for researchers throughout Europe through the implementation of the 'European Charter for Researchers' and the 'Code of Conduct for the Recruitment of Researchers'. Together both documents set out the rights and obligations of researchers, research institutions and funding providers, with the aim of ensuring equitable treatment of all researchers in Europe and increasing transparency in their selection and recruitment. The 'HR Excellence in Research' is awarded to research institutions or funders actively implementing the Charter & Code[50]. EURAXESS hosts the Human Resources Strategy for Researchers (HRS4R) e-tool, the entry point for entities to apply for the 'HR Excellence in Research' award.

[49] SwafS work programme 2016-2017, SwafS-20-2016
[50] European Commission website for HRS4R

- EURAXESS WORLDWIDE is the international arm of the EURAXESS initiative with a mandate to promote Europe as a research destination and bridge research communities to facilitate scientific collaboration.

- EURAXESS Worldwide has dedicated teams in eight international hubs: ASEAN (focus on Singapore, Thailand, Indonesia, Malaysia, and Vietnam), Latin America and the Caribbean (focus on Brazil, Argentina, Chile, Mexico, and Colombia), China, India, Japan, Korea, North America (the US and Canada) and Australia/New Zealand.

- All EURAXESS pillars aim at achieving a truly open and excellence-driven ERA in which highly skilled and qualified people can move seamlessly across borders, sectors (e.g. academia and industry) and disciplines to where their talents can be best employed, in order to advance the frontiers of knowledge and support innovation throughout Europe and beyond.

4.1. Policy objectives

In the first SwafS work programme under Horizon 2020, the policy objective set in relation to careers was to '*ease access to scientific careers'* by increasing the services offered by the EURAXESS Services Network[51].

During the course of Horizon 2020, a number of topics in the SwafS work programmes were dedicated to expanding the services offered by EURAXESS and raising awareness among researchers about career opportunities beyond their country.

In parallel to enhancing EURAXESS services, the open nature of SwafS allowed for flexible adaptation as needs arose including responding to the emerging challenge of migration flows through the 'Science4Refugees' initiative (featuring in the 2017 and 2018 work programmes) aimed at welcoming refugee researchers in all career stages. Projects funded aimed at integrating refugee researchers within the research labour market of their host country.

Towards the end of Horizon 2020, a new area of focus emerged with the Open Science Agenda coming to the fore. The Open Science Policy Platform (OSPP) adopted in April 2018 a set of prioritised actionable recommendations concerning eight Open Science ambitions:

1. Rewards and Incentives
2. Research Indicators and Next-Generation Metrics
3. Future of Scholarly Communication
4. European Open Science Cloud
5. Findable, Accessible, Interoperable, Reusable (FAIR) Data
6. Research Integrity
7. Skills and Education
8. Citizen Science

With respect to researchers' careers, the report produced by the Education and Skills Working Group highlighted the need for researchers in Europe to have appropriate skills and competences to practice Open Science and to ensure that Open Science skills become an integral component of the standard education, training and career development paths of researchers, and if possible even at earlier stages in their career in schools and universities.

[51] SwafS work programme 2014-2015

The skills necessary for Open Science include among others:

1. Open access publishing
2. Data management and open data
3. Enabling professional research conduct
4. Citizen science

Following on from this in 2019, a new topic emerged (SwafS-08-2019-2020) targeting the improvement of researchers' skills on Open Science and entrepreneurship (inter-sectoral talent).

4.2. Project portfolio

Researchers careers was addressed in various themes throughout Horizon 2020 work programmes, resulting in 20 funded projects (2020 call not included) and their combined budget is approximately EUR 12.6 million[52].

Fig. 11: Number of coordinators in Member States (MS) and Associated Countries (AC)

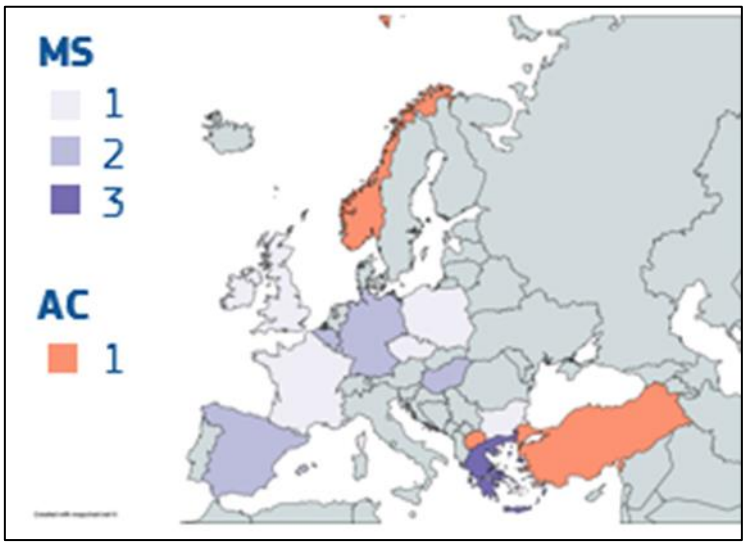
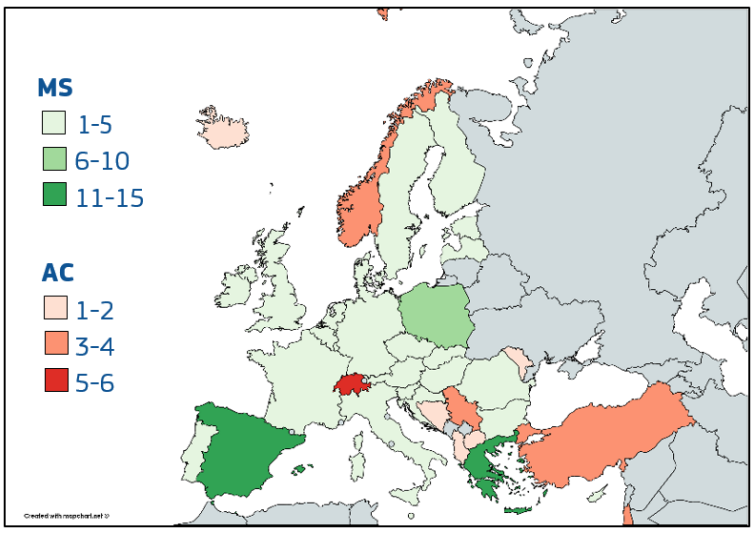


Fig. 12: Number of other partners in Member States (MS) and Associated Countries (AC)



[52] The slight difference in the total figure calculated on basis of budget allocated to each project in table 6 is due to rounding

Fig. 13: Number of partners in Third Countries (TC)

Table 6: Science Careers project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
SEAC-3-2014; SwafS-24-2017 Trans-national operation of the EURAXESS Service network (CSA)						
EURAXESS TOP III (Managed by DG R&I)	3.6 M	01-09-2015 31-08-2018	BAY ZOLTÁN ALKALMAZOTT KUTATÁSI KÖZHASZNÚ	HU	**EU:** AT, BE, BG, CY, CZ, DK, EE, EL, ES, FR, HR, IE, IT, LV, MT(2), NL, PL, PT, RO, SI, SK, UK **AC:** AL, BA, CH, IL(2), IS, MD, MK, NO, RS, TR	euraxess-top.eu/project/
EURAXESS TOP IV	3.3 M	01-09-2018 31-08-2021	CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS	EL	**EU:** AT, BE, BG, CY, CZ, DK, EE, ES, FR, HR, HU, IE, IT, LT, LV, NL, PL, PT, RO, SE, SI, SK, UK **AC:** AL, BA, CH, FO, IL, IS, MD, MK, NO, RS, TR	euraxess-top.eu/top-iv
SEAC-4-2015 EURAXESS outreach to industry (CSA)						
EURAXIND	812 k	01-05-2016 30-04-2018	CAREERS RESEARCH AND ADVISORY CENTRE LTD	UK	**EU:** AT, BG, ES, HU, NL **AC:** IL	vitae.ac.uk/researcher-careers/euraxess-uk-career-development-centre/euraxind

SwafS-20-2016 ERA Mobility and Career Day (CSA)						
ERA-MobilCar.GR	80 k	01-03-2017 28-02-2019	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	EL	**EU:** EL(4)	euraxess.gr/greece/jobs-funding/about-project
MayDay	78 k	01-04-2017 31-12-2017	STŘEDISKO SPOLEČNÝCH ČINNOSTÍ AV ČR	CZ	-	kariera.euraxess.cz
BG_CareerDays	78 k	01-02-2017 30-11-2017	SOFIISKI UNIVERSITET SVETI KLIMENT OHRIDSKI	BG	-	cordis.europa.eu/project/id/741107
MCD 2017	88 k	01-04-2017 31-07-2018	ASSOCIATION BERNARD GREGORY	FR	**EU:** DE, IT	abg.asso.fr/en/article/researchers-without-borders-eu4phd
EUESCADA	90 k	01-03-2017 28-02-2018	FUNDACIÓN ESPAÑOLA PARA LA CIENCIA Y LA TECNOLOGÍA	ES	**EU:** ES(6)	euraxess.es/spain/news/euscada-5-career-days-researchers-spain
CARERA	81 k	01-03-2017 28-02-2018	NŐK A TUDOMÁNYBAN EGYESÜLET	HU	**EU:** HU(2)	euraxess.hu/hungary/events/era-mobilitycareer-day-ceu
ENCIRCLE	80 k	01-03-2017 31-10-2017	МАКЕДОНСКА АКАДЕМИЈА НА НАУКИТЕ И УМЕТНОСТИТЕ	MK	-	
PL-ERADays	85 k	03-04-2017 02-03-2018	INSTYTUT PODSTAWOWYCH PROBLEMÓW TECHNIKI POLSKIEJ AKADEMII NAUK	PL	**EU:** PL(5)	cordis.europa.eu/project/id/741769
SwafS-25-2016 Celebrating European Science (CSA)						
ENABLE	498 k	01-07-2016 31-12-2020	FUNDACIÓ INSTITUT DE RECERCA BIOMÈDICA	ES	**EU:** DK, ES, IT, NL	enablenetwork.eu
SwafS-26-2017, SwafS-06-2018 Science4Refugees - Support to highly skilled refugee scientists (CSA)						
BRiDGE	370 k	01-04-2018 31-03-2020	UNIVERSITÄT BIELEFELD	DE	EU: BG, EL(3) AC: CH, TR	uni-bielefeld.de/International/projects/bridge/bridge.html
SCIREA	113 k	01-03-2018 29-02-2020	UNIVERSITY OF THE AEGEAN	EL	**EU:** IT	scirea.aegean.gr/
GREET	202 k	01-04-2018 30-09-2019	ASSOCIATION POUR LA COOPÉRATION ACADÉMIQUE	BE	**EU:** DE, FI	aca-secretariat.be/index.php?id=1104
WESREF-IU	67 k	01-05-2018 30-06-2019	ISTANBUL UNIVERSITESI	TR	-	cordis.europa.eu/project/id/787248/
BRiDGE II	607 k	01-10-2018 30-11-2020	UNIVERSITÄT BIELEFELD	DE	**EU:** AT, BG, EL(2), SE **AC:** CH, RS	uni-bielefeld.de/International/projects/bridge2/bridge2.html
CARe	345 k	01-01-2019 31-10-2020	ASSOCIATION POUR LA COOPÉRATION ACADÉMIQUE	BE	**EU:** DE, FI	aca-secretariat.be/index.php?id=1123
SwafS-08-2019-2020 Research innovation needs & skills in PhD programmes (CSA)						
DocEnhance	991 k	01-01-2020 31-12-2022	UNIVERSITETET I TROMSØ	NO	**EU:** BE, CZ, FI, FR(2), DE, EL, LU, NL, PT, SK, ES(2), SE **AC:** CH(2), NO **TC:** GH	cordis.europa.eu/project/id/872483
CHAMELEONS	998 k	01-03-2020 28-02-2022	UNIVERSITY COLLEGE DUBLIN	IE	**EU:** IE(3), EL, ES(2), FI, PT(2)	cordis.europa.eu/project/id/873105

4.3. Achievements

4.3.1. EURAXESS services

The SEAC.3.2014[53] and SwafS-24-2017 topics on 'Trans-national operation of the EURAXESS Service network' focused on further intensifying the services provided by the EURAXESS Service Centres. Such services include setting-up of career development and/or support for dual careers centres over a wider geographical range of the network, support to researchers and young entrepreneurs for start-ups, better integration of researchers into the culture of the host country and/or business environment as well as mentoring programmes for researchers.

In 2018, the EURAXESS Portal was improved with a new section including Career Development resources for researchers and institutions supporting research. All resources intended for use by researchers directly are accessible free of charge via the main EURAXESS website without requiring membership.

The No Limits Career Orientation Tool is designed to help researchers identify what is important for their career development, locate further information and plan accordingly.
The PIPERS Project Career Kit is a collection of external learning resources on the topics of entrepreneurial skills, information literacy, disciplinary working, IPR, leadership skills, managing a research career, professional development, public engagement, researcher self-assessment, market exploitation of research results and working with industry.
The Intercultural Assistant Tool is designed to help researchers adapt and integrate in a new cultural environment. With this tool, researchers can test and develop their intercultural competence and learn how to become part of a new community, while reaching their research goals and making the best out of their new job.

The Talent Development Suite (TDS) is a tool created within the EURAXESS TOP III project which primarily aims to assist postdocs one to three years after completing their PhD, during the period in which researchers typically tend to opt either for an academic or follow an alternative career path. The TDS is structured into four different assessment sections concluding with the 'Personal Journey Map'.

The ongoing training schemes of EURAXESS TOP IV build upon what has been developed under EURAXESS Top III.

The EURAXIND project funded under SEAC.4.2015 on EURAXESS outreach to industry aimed at equipping EURAXESS Service Centres with tools to increase the uptake/use of the EURAXESS portals and services by industry. Furthermore, EURAXESS is expanding its activities beyond internationally mobile researchers to also support inter-sectoral movement amongst researchers. The project conducted surveys[54] to shed light on researchers' experiences and expectations of inter-sectoral mobility.

In 2016, the 'ERA Mobility and Career Days' topic was introduced with a particular focus on countries where jobs and funding for researchers is scarce and hence European opportunities would be of particular interest.

A portfolio of eight projects were funded resulting in a range of on-campus events on the careers of young researchers involving employers and researchers in Greece, Czech Republic, Bulgaria, France, Spain, Hungary, North Macedonia and Poland. All projects

[53] This topic and the resulting project was managed by DG R&I.
[54] CORDIS article on EURAXIND survey

organised events with an attractive programme for researchers with respect to their career development and mobility. The number of events varied across projects ranging from two to five events per project. Attendance levels were high indicating that the expected results have been achieved with respect to raising awareness levels on European job and funding opportunities.

In 2016, an additional topic was introduced in the work programme on 'Celebrating European Science' resulting in the funding of ENABLE which seeks to promote excellence in the biomedical sciences in Europe. The project's flagship initiative is the career day during which PhD students and postdocs from all over Europe are given the opportunity to interact with professionals from different fields, to discuss career perspectives beyond the laboratory workbench[55]. These annual 3-day international congresses on biomedicine[56], organised by and for young biomedical scientists, seek to: support young researchers, strengthen scientific careers, and bring biomedicine closer to society. The career day is organised within the yearly symposium, and is the most successful part of the event. It is intended for this career day to be integrated in other large conferences once the project concludes.

4.3.2. Science4Refugees

The Science4Refugees initiative focused on refugee researchers or scientists granted asylum in a host country, to enable them to continue their educational path or enter the labour market. The action targeted existing initiatives that already supported the integration of refugees into their new employment setting and culture, to prepare for the highly competitive job market. The action sought to scale-up initiatives to the European level and make use of the EURAXESS portal to increase their visibility.

A portfolio of six projects were funded under this initiative. Activities were funded in countries which typically have high numbers of asylum seekers. Many of the projects faced challenges to carry out the planned activities, for example bureaucracy preventing access to refugees, poor living conditions, refugees preoccupation with resolving basic needs before tackling their career aspirations, reluctance to share personal data and in some cases even uprisings and riots.

Despite these challenges, projects organised the planned seminars and events to put highly skilled refugees in contact with potential employers. However, the take-up of initiatives varied across projects and countries with participation levels in many proving disappointing (see section 4.4.1).

The GREET project targeted national support structures and higher education institutions rather than refugees directly in nine European countries. GREET's main outcomes are the Peer Learning Activity to facilitate the exchange of best practices, foster mutual learning and to serve as a discussion platform for stakeholders as well as on-going work on an online repository.

The CARe project aims to produce ten country information guides on the R&D landscape and employer groups which will be made available on the EURAXESS portal.

4.3.3. Skills in PhD programmes

DocEnhance, which commenced in January 2020, aims to enhance and integrate transferable skills into existing PhD programmes and produce a curriculum and course material.

[55] ENABLE: Scientific Symposium
[56] Events in Barcelona (2017), Copenhagen (2018), Netherlands (2019), Milan (2020).

CHAMELEONS, which started in March 2020, seeks to develop a range of interdisciplinary, inter-sectoral and international modules, designed to broaden the skills of PhD graduates and improve their employability in academic and non-academic environments.

4.3.4. Dissemination

The type and number of stakeholders the projects engaged with depended of course on their scale.

With respect to EURAXESS online services, in 2019, more than 80,000 job adverts were published compared to 7,500 in 2010. In 2019, 3.9 million people from 233 countries visited the EURAXESS portal. With 1.6 million page views per month, EURAXESS is one of the most popular websites of the European Commission. More than 100,000 users created EURAXESS accounts out of which 54,200 are registered researchers. 16,500 institutions are registered and can publish vacancies. The funding database displays over 300 offers per year and the hosting section lists up to 750 job advertisements. Efforts made at the national level have also contributed, for example in Poland legislation was adopted making it mandatory for publicly funded organisations to publish on EURAXESS Jobs.

With respect to the 'ERA Mobility and Career Days' action, taking the BG Careers Day as an example, more than 600 young researchers and master students attended the events and 45 industrial organisations and HR agencies, including the Representation of the European Commission in Bulgaria participated with information stands. By the time the project ended, the Bulgarian EURAXESS Portal hits increased by 36% and 82 new open job positions were registered.

4.4. Recommendations

4.4.1. Policy recommendations

In terms of researchers' careers, in its report on career development services and centres in the EURAXESS network, the EURAXESS Top III project recommended further developing tools for researchers to evaluate and plan their professional development including mobility opportunities; better promotion of new services available for researchers; organisation of initiatives creating opportunities for researchers to link up with industry and greater clarity on the type of skills industry requires of researchers.

EURAXESS offers services for the professional career perspective of researchers' spouses (dual career centres). Regarding dual careers, future developments should encourage institutions to be fully transparent with a publicly accessible dual careers policy. Equally important is the development of communication strategies and identification of an official contact person for dual career matters.

For projects carrying out similar activities for example, for the national 'Career Days', there is an opportunity to ensure synergies by envisaging larger projects with multi-country consortia whereby partners would organise Careers Days in their respective countries.

For the 'Science4Refugees' initiative, greater emphasis on communication to ensure maximum outreach for activities organised for this vulnerable target group. More insights into the profile of refugee researchers (gender, degree level, field and origin country, but also on position prior to fleeing, and splitting the data by destination country) would help tailor the offering to support them in their career development. Furthermore, a robust risk plan with well-developed mitigation measures should be foreseen. Finally, for the 'Science4Refugees' type of action, the action should target

national support structures rather than refugees directly (similar to target of GREET cited in 4.3.2).

While the Report of the Working Group on Education and Skills under Open Science, identified the Open Science skills set, it is not sufficiently evident that Citizen Science is part of Open Science. Greater awareness raising initiatives are needed to promote this aspect of Open Science.

4.4.2. Recommendations for Horizon Europe

Researchers' engagement in Open Science will increase through encouragement and incentives from funders through assessment.[57] If Open Science skills are to be fully embraced, then the respective activities, notably citizen science, should be explicitly mentioned and assessed under the evaluation criterion of Excellence *'Appropriate consideration of interdisciplinary & intersectoral approaches and, where relevant, citizen science activities and the gender dimension'.*

A report produced by the OSPP Incentives and Rewards Working Group focused on the rewards and incentives for researchers and the ways in which researchers at all career stages should be rewarded, distinguishing between academic and non-academic settings and could be a subject to address in a future work programme topic.

[57] Report on 'Evaluation of research careers fully acknowledging Open Science practices'

5. GENDER EQUALITY

Gender equality and gender mainstreaming in research are a priority for Member States and Associated Countries of the European Research Area (ERA), since the Communication on the ERA of 7 July 2012. Horizon 2020 made significant progress in promoting gender equality in the European Research & Innovation policy (Regulation Establishing Horizon 2020) in terms of strengthening its legal basis, by enshrining gender equality as a general principle of the programme in Article 16, singling it out as one of the components of Responsible Research and Innovation in Art. 14(l) on cross-cutting issues, and featuring it as part of SwafS in Annex I - Part V, Art. 3(b). Furthermore, gender equality is also mentioned as a cross-cutting priority in Art. 2.c of Annex I to Horizon 2020's Specific Programme. Consequently, gender equality has been a strategic orientation and a line of activity in each Horizon 2020 work programme.

The ERA Communication was followed by the Council conclusions of 1 December 2015 on advancing gender equality in the European Research Area, acknowledging the contribution of gender equality to the quality of research and innovation. The need for sustainable cultural and institutional change along the three following objectives was reaffirmed:

- Removing barriers to the recruitment, retention and career progression of women researchers;
- Addressing gender imbalances in decision making processes;
- Integrating the gender dimension in research and innovation content.

In the proposal on establishing the specific programme implementing Horizon Europe, the 'Reforming and Enhancing the European R&I System' part of the 'Widening Participation and Strengthening the ERA' horizontal pillar includes: '*Supporting and monitoring gender equality as well as other forms of diversity in scientific careers and in decision making, including in advisory bodies, as well as the integration of the gender dimension in research and innovation*'. Furthermore, Article 2 includes '*strengthening the gender dimension across the Programme*' as an operational objective and Article 4.3d foresees '*gender equality, including the integration of gender dimension in the R&I content*' forming part of the multi-annual strategic plan.

5.1. Policy objectives

The gender equality (GE) policy objectives for the SwafS work programme are the three GE objectives established for the ERA and transposed into Horizon 2020:

- Gender equality in careers at all levels;
- Gender equality in decision-making;
- Integration of the gender dimension into R&I content

To achieve these goals, a systemic approach was developed to tackle gender inequalities, through institutional change. The approach chosen, already initiated under FP7 was to support the implementation of Gender Equality Plans (GEPs) in research performing organisations (RPOs), including universities and research funding organisations (RFOs).

GEPs should be developed using a coherent approach based on the minimum requirements listed in the ERA Communication of 2012:

- Conduct assessment/audit of procedures and practices with relevant data to identify gender bias within the organisation;
- Implement effective actions to be developed over time, according to the identified bias;
- Set targets and monitor progress via indicators within the organisation.

In 2015-2016, DG R&I and the European Institute for Gender Equality (EIGE) developed the Gender Equality in Academia and Research tool – the GEAR tool – as a step-by-step guide to assist institutions in developing GEPs. In the 2018-2020 work programme, reference to the GEAR tool became a requirement for all GEP projects.

Topics supporting the implementation of GEPs were present in all Horizon 2020 work programmes. In the last call in 2020, special attention is given to GEP-implementing organisations from countries for which the implementation of ERA Priority 4 ('Gender equality and gender mainstreaming in research') has shown slower progress (as shown in the ERA Progress Report 2018), i.e. mainly widening countries[58]. Particular emphasis is also placed on the sustainability of the GEPs to be implemented and on the impact at national level, with a recommendation to involve national authorities.

Further to the development and implementation of GEPs, several topics throughout the Horizon 2020 work programmes were devoted to expanding the knowledge base on the impact of initiatives regarding gender equality in research. To this end, a comprehensive strategy was designed and updated over the course of Horizon 2020 in order to support institutional changes and address gender inequalities at all levels.

Actions included establishing a network of national representatives and resource centres on gender, creating a community of practitioners, investigating potential gender biases in the allocation of grants, monitoring of initiatives, developing training and capacity building on gender equality in R&I, and more recently, addressing international cooperation.

More specifically, actions were foreseen to investigate and promote the impact of gender diversity in Research and Innovation (GERI-2-2014), evaluate initiatives to promote gender equality in research policy and research organisations (GERI-3-2014) as well as looking at gender gaps and biases in the allocation of grants (SwafS-10-2018).

Coordination of national-level stakeholders on gender in R&I was addressed by the topics SwafS-02-2016 and SwafS-19-2016. Topics were dedicated to strengthening the European community of practice of GEP-implementers, disseminating gender knowledge as well as promoting science careers for girls.

More recently, a topic was dedicated to research scenarios for an award/certification system for gender equality in research organisations and universities in Europe (SwafS-11-2019).

In the spirit of Horizon 2020's open to the world approach embraced by SwafS, in 2019 a topic was dedicated to studying the gender perspective of science, technology and innovation (STI) in dialogue with third countries.

[58] European Commission website for 'Spreading Excellence and Widening Participation'

In the 2020 call, two new complementary topics address key issues notably gender-based violence and sexual harassment in research organisations and bridging the gender gap in innovation by reaching out to the next generation of innovators.

Other actions coordinated by DG R&I, were also implemented under the SwafS work programme, including:

- Monitoring the state of gender equality in research and innovation (She Figures);
- Supporting the Finnish Presidency of the EU in organising a conference around the new challenges and opportunities for gender equality in R&I[59];
- Establishing an Expert Group to update and expand 'Gendered Innovations/ Innovation through Gender' and help support the strengthened integration of the gender dimension in R&I content across Horizon Europe;
- Running the annual editions of the EU Prize for Women Innovators.

5.2. Project portfolio

SwafS in Horizon 2020 funded a total of 28 projects (2020 call excluded) under the Gender Equality theme, with a budget of EUR 64.6[60] million.

Fig. 14: Number of coordinators in Member States (MS) and Associated Countries (AC)

[59] EU2019.FI 'Research and Innovation Excellence through gender equality: New pathways and challenges'
[60] The slight difference in the total figure calculated on basis of budget allocated to each project in tables 7 and 8 is due to rounding

Fig. 15: Number of other partners in Member States (MS) and Associated Countries (AC)

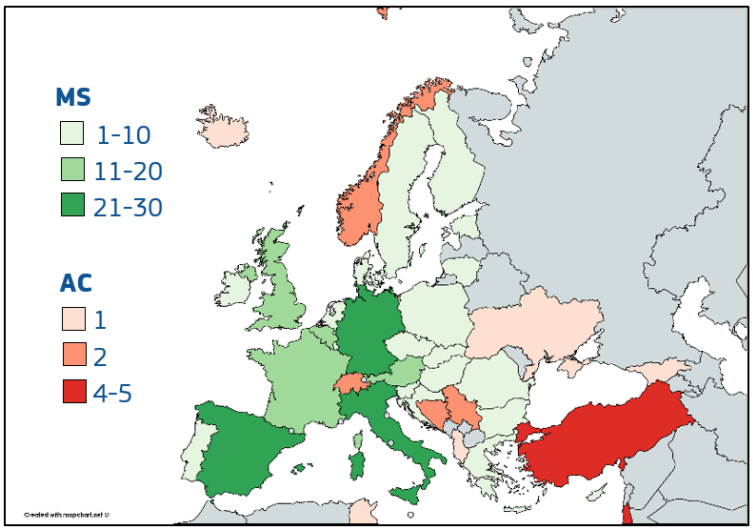


Fig. 16: Number of partners in Third Countries (TC)

Table 7: Gender Equality Plan (GEP) project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
GERI-4-2014-2015; SwafS-3-2016-2017; SwafS-9-2018-2019-2020 Support to research organisations to implement gender equality plans (CSA)						
Completed						
GENERA	3.2 M	01-09-2015 31-08-2018	STIFTUNG DEUTSCHES ELEKTRONEN-SYNCHROTRON	DE	**EU:** NL, UK, IT(2), DE(2), AT, ES, RO, PL, FR, NL **AC:** CH	genera-project.com
LIBRA	2.3 M	01-10-2015 31-03-2018	FUNDACIÓ CENTRE DE REGULACIÓ GENÓMICA	ES	**EU:** IT(2), AT, FR, UK, DK, DE, CZ, NL **AC:** CH	eu-libra.eu
PLOTINA	2.3 M	01-02-2016 31-01-2020	ALMA MATER STUDIORUM – UNIVERSITÀ DI BOLOGNA	IT	**EU:** UK, SI, PT, ES(3), AT, BE, IT **AC:** TR	plotina.eu
Baltic Gender	2.2 M	01-09-2016 31-08-2020	HELMHOLTZ ZENTRUM FÜR OZEANFORSCHUNG KIEL	DE	**EU:** EE, DE(3), LT, SE, FI	baltic-gender.eu
SAGE	2.3 M	01-09-2016 31-08-2019	TRINITY COLLEGE DUBLIN	IE	**EU:** IT, PT, FR, UK **AC:** TR, BA	sage-growingequality.eu

EQUAL-IST	1.9 M	01-06-2016 31-05-2019	VILABS OE	EL	**EU:** IT(2), DE, FI, LT, PT **AC:** UA **TC:** LI	equal-ist.eu
Running						
TARGET	2.0 M	01-05-2017 30-04-2021	INSTITUT FÜR HÖHERE STUDIEN	AT	**EU:** RO, IT(2), EL, FR, ES, CY **AC:** RS **TC:** MA	gendertarget.eu
GEECCO	2.0 M	01-05-2017 30-04-2021	TECHNISCHE UNIVERSITÄT WIEN	AT	**EU:** IT, PL, ES, CZ, AT(2), BE, DE	geecco-project.eu
R-I PEERS	2.0 M	01-05-2018 30-04-2022	UNIVERSITÀ DEGLI STUDI DI SALERNO	IT	**EU:** CY, IT(2), ES, BE, SI, EL **AC:** IL, TN	ripeers.eu
CHANGE	2.0 M	01-05-2018 30-04-2022	INTERDISZIPLINARES FORSCHUNGSZENTRUM FÜR TECHNIK, ARBEIT UND KULTUR	AT	**EU:** DE(2), PT, SK, SI **AC:** IL	change-h2020.eu
SUPERA	2.0 M	01-06-2018 31-05-2022	UNIVERSIDAD COMPLUTENSE DE MADRID	ES	**EU:** BE, FR, IT(2), HU, PT, ES	superaproject.eu
GEARING ROLES	3.0 M	01-01-2019 31-12-2022	UNIVERSIDAD DE LA IGLESIA DE DEUSTO ENTIDAD RELIGIOSA	ES	**EU:** PT, SI, UK(2), EE, BE, ES, NL **AC:** TR	gearingroles.eu
Gender-SMART	2.9 M	01-01-2019 31-12-2022	CENTRE DE COOP. INTERN. EN RECHERCHE AGRONOMIQUE POUR LE DEVELOPPEMENT	FR	**EU:** ES, IT, IE, NL, CY, BE, CZ, FR	gendersmart.eu
SPEAR	3.0 M	01-01-2019 31-12-2022	SYDDANSK UNIVERSITET	DK	**EU:** SE, DE, HU, AT, BG(2), LT(2), PT, HR	gender-spear.eu
Starting						
CALIPER	2.9 M	01-01-2020 31-12-2023	VILABS OE	EL	**EU:** IT(2), EL, HR, SK, BE, ES, RO,DE **AC:** TR, GE	caliper-project.eu/
EQUAL4EUROPE	3.0 M	01-01-2020 31-12-2023	FUNDACION ESADE	ES	**EU:** NL(2), SK, SI, DE, FR, BE	cordis.europa.eu/project/id/872499
LeTSGEPs	2.4 M	01-01-2020 31-12-2023	UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA	IT	**EU:** DE(2), IT, ES, FR **AC:** AL, RS	cordis.europa.eu/project/id/873072
TARGETED-MPI	2.5 M	01-09-2020 31-08-2024	ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS – RESEARCH CENTRE	EL	**EU:** BE, SE, UK(2) **TC:** LB	cordis.europa.eu/project/id/872260

Table 8: Other Gender Equality project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
GERI-1-2014 Innovative approach to communication encouraging girls to study science (CSA)						
Hypatia	1.5 M	01-08-2015 31-07-2018	STICHTING NATIONAAL CENTRUM VOOR WETENSCHAP EN TECHNOLOGIE	NL	**EU:** BE, DK(2), FR(2), IT, NL (2) **AC:** IL	expecteverything.eu/hypatia
GERI-2-2014 Impact of gender diversity on Research & Innovation (RIA)						
GEDII	1.0 M	01-10-2015 30-09-2018	FUNDACIÓ PER A LA UNIVERSITAT OBERTA DE CATALUNYA	ES	**EU:** DE(2), SE, UK(2)	gedii.eu
GERI-3-2015 Evaluation of initiatives to promote gender equality in research policy and research organisations (RIA)						
EFFORTI	2.0 M	01-06-2016 31-05-2019	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG	DE	**EU:** ES, AT, DK, HU, LU	efforti.eu
SwafS-19-2016 Networking of National representatives and resource centres on Gender in R&I (CSA)						
GENDERACTION	2.0 M	01-04-2017 31-03-2021	INSTITUTE OF SOCIOLOGY OF THE ACADEMY OF SCIENCES OF THE CZECH REPUBLIC	CZ	**EU:** AT(2), CY, DE, EL(2), ES, LU, MT(3), SI, SK **AC:** TR, BA	genderaction.eu
SwafS-02-2016 Promoting Gender Equality in Horizon 2020 and the ERA (ERA-NET Cofund)						

GENDER NET Plus (Managed by DG R&I)	3.8 M	15-09-2017 14-09-2022	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	FR	**EU:** AT, BE, CZ, CY, EE, ES(2), FR, IE, IT, SE **AC:** IL, NO **TC:** CA(2)	gender-net-plus.eu
SwafS-08-2017 European Community of Practice to support institutional change (CSA)						
ACT	3.0 M	01-05-2018 30-04-2021	FUNDACIÓ PER A LA UNIVERSITAT OBERTA DE CATALUNYA	ES	**EU:** UK(3), ES(2), AT, IE, DE(3), FR, PL, SI, SE **AC:** IS **TC:** CR	act-on-gender.eu
SwafS-10-2018 Analysing gender gaps and biases in the allocation of grants (RIA)						
GRANTeD	2.0 M	01-01-2019 28-02-2023	JOANNEUM RESEARCH FORSCHUNGS-GESELLSCHAFT MBH	AT	**EU:** SE, ES, DE, NL	granted-project.eu
SwafS-13-2018 Gender Equality Academy and dissemination of gender knowledge across Europe (CSA)						
GE Academy	2.0 M	01-01-2019 31-12-2021	VILABS OE	EL	**EU:** BE, IT(2), CZ, DE, ES, AT, IE, FR, HU **AC:** NO	ge-academy.eu
SwafS-11-2019 Scenarios for an award/certification system for gender equality in research organisations and universities in Europe (RIA)						
CASPER	1.5 M	01-01-2020 31-12-2021	FONDATION EUROPÉENNE DE LA SCIENCE	FR	**EU:** IT(2), UK, BE, ES, CZ, AT	cordis.europa.eu/project/id/872113
SwafS-12-2019 The gender perspective of science, technology and innovation (STI) in dialogue with third countries (RIA)						
GENDER STI (Grant Agreement Preparation on-going)	2.0 M	To be confirmed	INMARK EUROPA SA	ES	**EU:** AT, ES, FI, FR, IT, PT **TC:** AR, CA(2), CL, BR, CN, IN, KR, MX, US, ZA	

5.3. Achievements

5.3.1. Gender Equality Plans

In Horizon 2020, excluding the 2020 call, 18 GEP projects have been funded (listed in

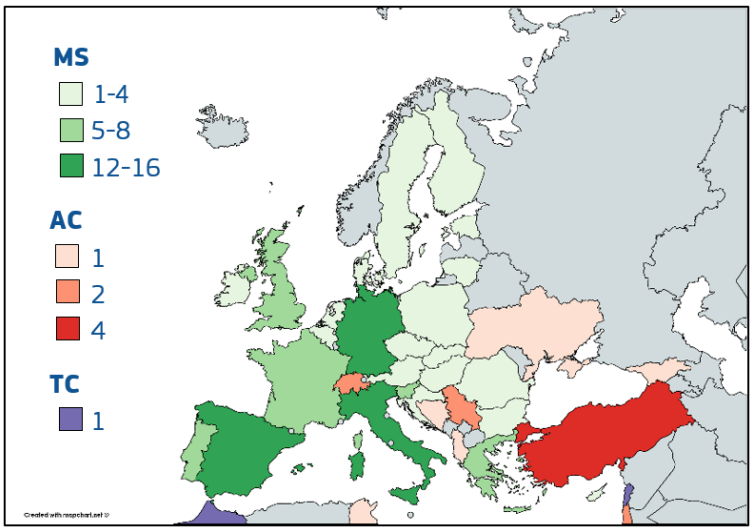
Table 7: Gender Equality Plan (GEP) project portfolio), with a total budget of EUR 43.9 million[61] (corresponding to 68% of the total budget allocated to gender equality projects in SwafS).

Out of all 168 institutions involved in GEP projects, 130 institutions (78%) are implementing GEPs, while other partners have either an independent evaluating role (a requirement for the GEP call topics) or a consultancy or technical role.

Of the total EUR 43.9 million budget allocated to GEP projects, EUR 34.2 million (78%) is ear-marked for GEP-implementing institutions.

[61] Calculated on the basis of actual budget of GEP projects (table 7 displays rounded figures)

Fig. 17: Number of GEP-implementers in Member States (MS), Associated Countries (AC) and Third Countries (TC)



Only the six completed GEPs projects are presented below: GENERA, LIBRA, PLOTINA, Baltic Gender, SAGE, and EQUAL-IST (see

Table 7: Gender Equality Plan (GEP) project portfolio).

GEP projects have been instrumental in embracing new challenges such as the need to address sexual harassment and gender-based violence in academia, and to develop an inclusive approach.

Furthermore, GEP projects have been models and catalysers for action at the national level in many countries and are prime examples of institutional changes that live well beyond the life of the project.

As an example, the SAGE Charter of Principles for Gender Equality, designed to promote stronger action on gender equality and research, supports structural, cultural and political change to eradicate sexism, bias and other forms of discrimination in research and higher education, was formally endorsed by the Irish Universities Association at the launch event in May 2019 with the intention for higher education institutions across Europe to sign up to this Charter.[62]

A comprehensive 3-phase approach to GEPs and institutional changes was developed by SAGE based on the GEAR tool, and summarised in the SAGE Wheel Model for Gender Equality Plans:

- Institutional Self-Assessment;
- Construction and implementation of GEPs;
- Embedding Gender Knowledge in Organisations

The SAGE Wheel Toolkit aims to assist organisations to effect and sustain change in cycles. At each cycle, the organisation should re-assess itself and carry out the

[62] Trinity College Dublin 'Minister Mitchell O'Connor launches gender equality charter', 15 May 2019

necessary changes towards ensuring gender equality. SAGE has been flagged by the European Commission as a Horizon 2020 success story.

GENERA produced several working papers and guidelines on the implementation of GEPs in physics research organisations. The most innovative output is the Toolbox for tailored Gender Equality plans (by and for physicists), a structured collection of

good practices to address gender inequality (measures, instruments and activities) related to structural, social, cultural, and political aspects of work environments in various (mainly physics related) research performing and funding organisations (RPFOs), as well as higher education institutions (HEIs). GENERA also addressed the need, reported by many GEP projects, to tailor GEPs to each specific institution with its Roadmap for the implementation of customised GEPs.

LIBRA focused more particularly on increasing the presence and representation of women in leadership positions in life sciences. Among the projects deliverables, the LIBRA Recruitment Handbook stands out as an invaluable resource providing research institutions with tangible instruments to carry out a more inclusive, transparent and unbiased recruitment process. LIBRA, flagged by the Commission as a success story, also produced a video to point out the main biases that may occur during a recruitment process and convey how an equality-committed panel could address these biases. This video was adopted by the European Research Council (ERC)'s Working Group on Gender Issues and is also recommended as part of the Horizon 2020 briefing for evaluators.

PLOTINA produced a curated repository listing potential actions RPOs can consider to enhance gender equality, analyses of case studies as well as a glossary of gender equality-related terms. PLOTINA's main achievements are its toolkits: step-by-step guides on how to carry out a Gender Audit, how to design a GEP, how to implement it, how to monitor the GEP's progress and ensure its upkeep. The project was also flagged by the Commission as a success story with remarkable dissemination outputs including a video to provide guidance on how to counteract unconscious gender biases in the evaluation and recruitment of professors and researchers.

The Baltic Gender consortium, formed by research institutes in the field of marine science, analysed its members' performance in terms of gender equality. Apart from the good practices listed by other GEP projects, a distinctive outcome of Baltic Gender is the 'Handbook of gender-sensitive indicators', aimed at measuring gender equality.

One of the unique contributions of EQUAL-IST to GEPs has been its Idea Crowdsourcing Platform to facilitate the co-design of tailored GEPs (EQUAL-IST partners were mostly research institutions in the field of information and computer technologies). The EQUAL-IST Toolkit, targets research organisations with a focus on ICT (Information and Communication Technology) and IST (Information System Technology) with an interest in setting up actions aimed at improving and achieving gender balance in a research field where women are still a minority, and where scientific and applied research remain male-oriented. All the GEPs implemented by EQUAL-IST partners are published on the project's website. EQUAL-IST has been flagged by the Commission as a Horizon 2020 success story.

5.3.2. Networking and community building

An additional policy objective for SwafS in Horizon 2020 was to build a network of Communities of Practice (CoPs), acting as agents to develop gender equality plans in research organisations in the ERA.

This community-building role was the task of the ACT project which is working to:

- Establish the first European network of Communities of Practice by supporting eight thematic or geographical CoPs working on gender equality in higher education and research and innovation, assess their needs, and offer opportunities to foster synergies and innovation in this field.

- Consolidate and strengthen existing infrastructure for knowledge sharing and mutual learning in the field of institutional change and gender equality across Europe (Knowledge Sharing Hub, online survey tool for gender equality audit and monitoring, and an evaluation framework for CoP collaborations and activities).
- Develop an adaptable support toolkit, training materials and audio-visual resources for adopting best practices on gender equality by R&I organisations.

A significant contribution to Gender Equality policies at the national level stems from GENDERACTION's series of position papers and policy briefings with an emphasis on networking and community building. Notably, GENDERACTION, flagged as a success story by the Commission, recommended in its policy brief to properly integrate gender equality policies in the 'Strengthening the ERA' part of the proposal for Horizon Europe and in the future of the ERA.

GENDER-NET Plus is the first ERA-NET Cofund scheme dedicated to the promotion of gender equality in research and innovation. It gathers 16 national organisations from 13 countries, committed to strengthening transnational collaborations towards a common goal: advancing gender equality in research institutions and integrating the gender dimension into research and innovation content and programmes. It succeeded in launching a co-funded joint call of approximately EUR 11 million (of which around EUR 8 million stems from consortium partners' contributions) supporting 13 innovative transnational projects. The projects integrate sex and gender based analysis in research fields addressing intersections between Sustainable Development Goal (SDG) 5 (Gender equality), Goal 3 (Good Health and Well-being), Goal 9 (Industry, Innovation and Infrastructure) and Goal 13 (Climate Action)[63].

GRANteD analyses the prevalence and causes of gender bias in research funding in Europe and how the granting processes and outcomes can influence researchers' academic careers. Based on empirical evidence, GRANteD will develop recommendations for research funding organisations (RFOs) and research performing organisations (RPOs) as well as for research policy makers.

Even though community-building was not its primary scope, the GEP project EQUAL-IST has been outstanding in creating synergies with EURAXESS and many other EU-funded projects. In the same networking spirit, in 2018, the REA and DG R&I co-organised a cluster event, involving FP7 and H2020 GEP projects, which led to synergies among the 15 participating projects. One example being PLOTINA's final conference in January 2020 to which the consortium invited other GEP projects GENERA, SAGE, GEARING ROLES, R-I Peers to partake.

Building on this momentum, in March 2020, DG R&I and REA organised a co-creative brainstorming workshop together with the Horizon 2020 GEPs projects, as well as coordinators of related projects ACT, GENDERACTION, GE Academy and EFFORTI, on 'Fostering institutional change through Gender Equality Plans'. The aim of the workshop was to assess the implementation of GEPs in Horizon 2020 in order to prepare for Horizon Europe's intensified focus on this institutional change policy approach.

5.3.3. Education and trainings

The Hypatia project, exploring innovative approaches to encourage girls to study science, has been flagged by the European Commission as a success story.

[63] United Nations Sustainable Development Goals

Hypatia produced an accessible, practical and ready-to-use digital collection of activities (modules) for teachers, informal learning organisations, researchers and industry. The modules focus on gender-inclusive ways of educating and communicating STEM (Science, Technology, Engineering and Mathematics), empowers teenagers to pursue STEM-related studies and explores the range of skills that are needed for various STEM studies and careers open to young people. Every activity contains gender and facilitation guidelines and can be used by teachers, informal learning organisations, researchers and industry. The modules are developed by science centres and tested by teenagers in different countries and are available in 15 languages to ensure international appeal.

Looking at the university-level curricula, Baltic Gender developed a 'Toolkit on Gender-Sensitive Teaching Methods in Higher Education'. This collection of online material aims at encouraging teaching staff to integrate the gender dimension into their teaching. A variety of information is provided in the form of toolboxes, best practice examples, manuals, guidelines and training tools.

SAGE developed Guidelines on integrating the gender dimension into research content and curriculum.

Finally, GE Academy developed a set of trainings aimed at individuals from RPOs and RFOs keen to learn how to design and implement a GEP or those who seek being trained as a trainer on gender equality matters. GE Academy provides in-person trainings, summer schools, webinars, online courses and workshops.

5.4. Recommendations

5.4.1. Policy recommendations

Under Horizon 2020, the integration of the gender dimension was, for the first time in a Research Framework Programme, included under the 'excellence' award criterion featuring in the proposal template and in the evaluation sub-criterion. It is important to find ways to integrate the gender dimension in research content whenever relevant, adapting to different disciplinary contexts and the specificities of each academic field and institution.

Organisations should promote the value of integrating the gender dimension in research content in terms of increasing research excellence notably by incorporating this in their GEPs. Furthermore, to this end, the creation of detailed guidance with concrete examples of gendered innovations, the introduction of incentives and/or the establishment of possible sanctions, may help overcome barriers.

Significant gaps in the uptake of gender equality in research organisations in different Member States are still present, particularly amongst those joining the EU most recently. Notwithstanding, no country can afford to be complacent on gender equality matters including countries where gender equality is historically more established.

For example, EQUAL-IST revealed a certain 'gender fatigue' in Finland: legislation introduced gender equality some time ago and as a result most entities have a general plan in place. However, while GEPs exist at the university level, not all departments have one and some resistance to consider gender issues at the level of research and teaching with a male-dominated staff (as is still common in that domain) was observed. Furthermore, EQUAL-IST's experience confirms the need for

increased focus on the gender dimension in research and teaching, on the model of projects like Baltic Gender.

Marking the 20 years of gender equality in Research and Innovation, the Finnish Presidency policy conference organised on new challenges and opportunities for gender equality in R&I in October 2019[64], through financial support from SwafS, has generated increased attention for gender equality. Furthermore, a survey on GEP implementation in academic institutions was launched by the Finnish Ministry which will be used in their dialogues with universities. Such closer involvement and endorsement by national authorities should be fostered to a greater extent.

5.4.2. Recommendations for Horizon Europe

Many RPOs and RFOs across the EU don't yet have a GEP in place. GEPs have been a pioneering tool in terms of institutional change and as the most important tool for Gender Equality policy, with Horizon Europe, the aim is to achieve sustainable impact and create a multiplier effect. The European Commission's new Gender Equality Strategy 2020-2025[65], clearly indicates that the Commission will introduce new measures to strengthen gender equality in Horizon Europe, such as the possibility to require a gender equality plan from applicants.

The GEAR tool, as a basis for the design of GEPs, needs to be updated. The EFFORTI project performed a European-wide research and case study work, generating a significant source of evidence on potential impacts of all aspects of gender equality for society, economy and science. This sound theoretical basis was then used to create a ready-to-use IT toolbox, to assist in the evaluation of the impact of certain measures, or provide recommendations towards a desired goal. Initially conceived to address national level policies, the Impact Story Knowledge Base (dynamic toolbox with step-by-step guidance for producing a roadmap) and Programme Theory Generator for creating and visualising tailored programmes, can serve as a basis to enhance the tool-set for the design of GEPs.

The Member States and regions should take into account equality between women and men and the integration of the gender perspective in the management of Structural Funds, including in support of R&I capacity building and actions in public research bodies. The different perspective and needs of SMEs are yet another example of tailoring that needs to be taken into account in designing a GEP.

In view of the increased importance given to Gender Equality in the von der Leyen Commission, the significance attached to GEPs will certainly grow considerably in the near future. Therefore, it would be of strategic importance to further develop tailored guidance, advice and support, and provide easy access to the successful tools, best practices as well as guidelines developed by the GEP projects and other gender equality related SwafS projects.

Reviews of GEP projects have shown that the long-term impact of the structural changes initiated cannot be judged right after the end of a project, and that devising effective strategies to ensure the sustainability and institutionalisation of the GEPs are crucial to achieve lasting transformation.

Several projects reported a major obstacle to institutional change due to a change in top management of the implementing institution during the project. This can be a crucial issue if the newly appointed management doesn't consider gender equality as

[64] Research and Innovation Excellence through gender equality: New pathways and challenges, Finnish Presidency conference, 23-24 October 2019, Helsinki, Finland
[65] European Commission website for 'Gender Equality Strategy'

a priority. To mitigate this risk, the most effective long-term strategy is the early push for an institutional gender equality policy with defined and binding commitments and targets. An integrated, institutionalised, policy in management structures, and a GEP that is made publicly available, make successors likewise accountable for gender equality matters.

An annual gender report should track and monitor the progress of each organisation towards gender equality and its publication is an invaluable strategy for instilling commitment while at the same time serves for dissemination purposes.

On a policy level, support emerged from the GEPs cluster event of 2018, the SwafS-supported Finnish Presidency Conference of October 2019 and the March 2020 RTD-REA workshop on 'Fostering institutional change through Gender Equality Plans: the way forward towards Horizon Europe' to consider the uptake of gender equality measures in applicant organisations to national and/or European funds as a mandatory requirement.

This could be combined with a European award/certification/ranking system, which would label RPOs according to their progress on gender equality. Furthermore, this would foster a European-wide recognition of the importance of gender equality as a factor for excellence. The project CASPER, takes a first step in this direction, in its examination of the feasibility of establishing such a European award or certification system for gender equality in research organisations.

6. INSTITUTIONAL CHANGES TOWARDS RESPONSIBLE RESEARCH AND INNOVATION

6.1. Policy objectives

'Early and continuous engagement of all stakeholders is essential for sustainable, desirable and acceptable innovation.'[66] The Responsible Research and Innovation (RRI) approach supported by the European Commission since 2011 aims to encourage societal actors to work together during the whole research and innovation (R&I) process to better align R&I and its outcomes with the values, needs and expectations of society.

In practice, RRI is implemented as a package, aiming to better engage society in research and innovation processes, enabling easier access to scientific results, favouring better uptake of the gender and ethics dimensions in research and innovation content, and spreading good practices in formal and informal science education.

The eight activity lines for SwafS in the Horizon 2020 specific programme[67] take up all these dimensions of RRI in various forms.

One of the key ways of working towards the objectives for SwafS, and ensuring impact (and therefore value for money), is the implementation of institutional changes in beneficiaries. This is evidenced by the Key Performance Indicator for SwafS being *'Percentage of research organisations funded implementing actions to promote Responsible Research and Innovation, and number of institutional change measures adopted as a result'*.[68]

What does the EC mean by an 'institutional change'? While this was put in broad terms in early work programmes, by 2018-2020 it was described more precisely. In 2019, specific guidance was developed, based on observed practices and the approach taken in the work programme 2018-2020, stating that an institutional change is a change to how a beneficiary governs or structures itself. It is expected to have meaningful impact within the institution concerned and intended to last beyond the lifetime of project funding. Moreover, institutional changes towards RRI concern one or more of the EC's five dimensions of RRI (public engagement, open access, gender, ethics, science education), or manifest as an 'RRI package' covering all of these five dimensions.

This chapter focuses on three of the constituents of the quadruple helix model (firstly, higher education institutes and research funding and performing organisations, secondly, industry and SMEs, and thirdly, regional and territorial public authorities) and how they open up to the fourth constituent of the model (citizens and civil society). A large part of these projects focus on implementing institutional changes within the beneficiaries of the project funding, but others look more widely at the systemic changes required to open up governance to society more broadly. The final part of the chapter examines projects that sought to deepen the knowledge base on RRI and enhance co-ordination between RRI actors.

[66] Rome Declaration on Responsible Research and Innovation in Europe, November 2014
[67] Regulation (EU) no 1291/2013 of the European Parliament and of the Council establishing Horizon 2020
[68] Horizon 2020 indicators

6.1.1. *Research Funding and Performing Organisations and Higher Education Institutes*[69]

Both the 2014-2015 and 2016-2017 work programmes included topics that supported 'structural change' or 'opening' research funding and performing organisations to society. The work programme 2016-2017 pointed to a need to overcome obstacles to engagement with society, for example due to lack of knowledge or behaviour types and to focus on spreading good RRI practices in Research Funding Organisations (RFOs) and Research Performing Organisations (RPOs). This aim was pursued in two topics that ran in the work programme 2018-2020, and in 2020 the focus narrowed somewhat from RRI to citizen science.

6.1.2. *Industry*

The work programme 2014-2015, addressed Responsible Research and Innovation in an industrial context with a view to building the evidence base on how RRI can improve development processes and the quality of the research and innovation outcomes.

The work programme 2016-2017 sought to progress further in integrating RRI in industrial contexts through two dedicated topics. Moreover, the work programme for 2020 includes a sub-topic focused on frugal innovation, bridging citizen science approaches to industry/SMEs.

6.1.3. *Territorial governance*

While one project was funded from the 2014-2015 work programme on opening up territorial governance to society, it was not until the work programme 2018- 2020 that specific focus was put on this area. The goal was to work towards the establishment of self-sustaining R&I ecosystems, characterised by a high degree of openness and responsiveness to local needs. This required relevant quadruple helix R&I actors to work together. This inclusive approach ensures the buy-in of stakeholders and results in greater sustainability on all levels. In particular, projects focused on opening up territories through RRI and regional partners are expected to update their smart specialisation strategies based on the broad input of society.

6.1.4. *Knowledge base*

Evidence from the Sixth Framework Programme Science and Society (S&S) and Seventh Framework Programme Science in Society (SiS) programmes shows that more consistent policy development in Science and Technology requires systematic cooperation and a shared knowledge base on which European, national and sub-national research and innovation policy decisions can be drawn from. In the work programme 2014-2015, a topic was dedicated to fostering the sharing of 'Science with and for Society' experience and know-how in Europe, and beyond, notably by building a Knowledge Sharing Platform (KSP).

Several other topics in SwafS have focused on specific areas of interest, such as monitoring the evolution and benefits of RRI, and global governance towards RRI. Moreover, the work programme 2018-2020 included topics that encouraged applicants to come up with areas of research that they thought were most needed and to 'connect the dots' between disparate initiatives and knowledge bases

[69] RFPOs should be understood broadly as organisations developing or funding activities in the field of R&I as one of their objectives, including civil society organisations engaged in R&I.

6.2. Project portfolio

RRI is addressed in various SwafS work programmes, resulting in 35 funded projects (2019 2-stage and 2020 calls not included) which for the purposes of this analysis are categorised into four groups:

- Research Funding and Performing Organisations and Higher Education Institutes (12 projects – EUR 29.4 million);
- Industry (6 projects – EUR 12.6 million);
- Territorial governance (10 projects – EUR 24.3 million)
- Knowledge base (7 projects – EUR 23.7 million).

Their combined budget is approximately EUR 90 million.

Fig. 18: Number of coordinators in Member States (MS) and Associated Countries (AC)

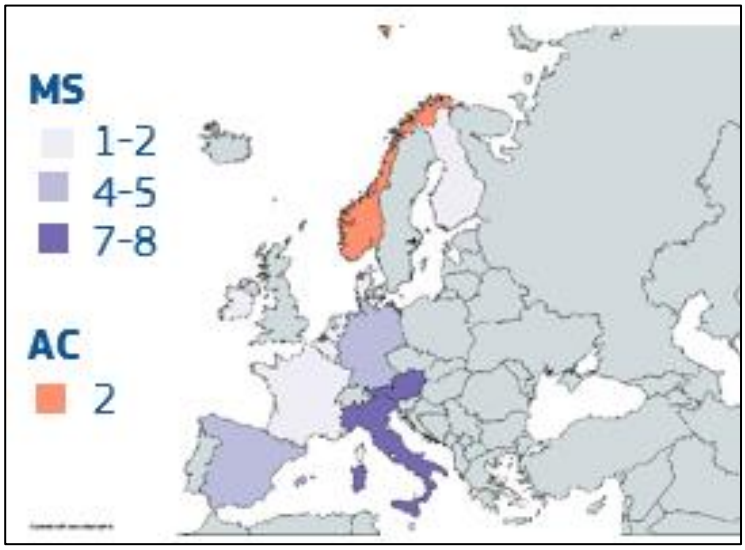


Fig. 19: Number of other partners in Member States (MS) and Associated Countries (AC)

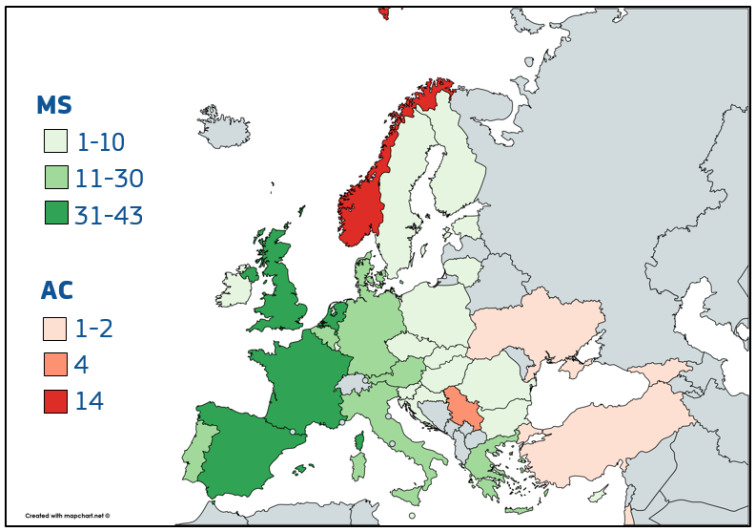


Fig. 20: Number of partners in Third Countries (TC)

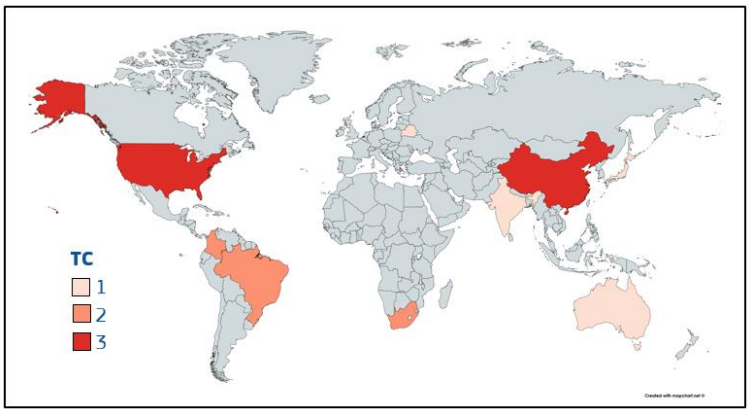


Table 9: Institutional changes in Research Funding and Performing Organisations and Higher Education Institutes RRI project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
ISSI-5-2014-2015 Supporting structural change in research organisations to promote Responsible Research and Innovation (CSA)						
NUCLEUS	4.0 M	01-09-2015 31-08-2019	RHINE-WAAL UNIVERSITY OF APPLIED SCIENCES	DE	**EU:** AT, DE(5), EL, FR(2), IE, IT, MT, NL(2), UK(5) **AC:** GE, RS **TC:** CN(2), ZA	nucleus-project.eu
STARBIOS 2	3.5 M	01-05-2016 31-07-2020	UNIVERSITÀ DEGLI STUDI DI ROMA TOR VERGATA	IT	**EU:** BG, DE, DK, FR, IT(2), PL, SE, SI, UK **TC:** BR, US	starbios2.eu
JERRI	2.4 M	01-06-2016 31-05-2019	FRAUNHOFER GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG	DE	**EU:** AT, NL, UK(2)	jerri-project.eu
RRI-PRACTICE	3.6 M	01-09-2016 31-08-2019	OSLOMET - STORBYUNIVERSITETET	NO	**EU:** BG, DE, FR, IT, NL(2), UK(2) **AC:** NO **TC:** AU, BR, CN, IN, US	rri-practice.eu
GARRI-1-2014 Fostering RRI uptake in current research and innovation systems (CSA)						
FoTRRIS	2.0 M	01-10-2015 31-03-2018	VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK	BE	**EU:** AT, BE, ES, FR, HU, IT	fotrris-h2020.eu
SwafS-04-2016 Opening Research Organisations in the European Research Area (CSA)						
FIT4RRI	3.2 M	01-05-2017 31-10-2020	UNIVERSITÀ DEGLI STUDI DI ROMA LA SAPIENZA	IT	**EU:** DE, EL, FI, FR, IT, NL, PT(3), UK(2) **AC:** NO	fit4rri.eu
ORION	3.2 M	01-05-2017 31-10-2021	FUNDACIÓ CENTRE DE REGULACIÓ GENÒMICA	ES	**EU:** CZ(2), DE, ES(2), IT, SE, UK	orion-openscience.eu
SwafS-05-2018-2019 Grounding RRI practises in RFOs and RPOs (CSA)						
GRACE	1.5 M	01-01-2019 31-12-2021	FONDATION EUROPÉENNE DE LA SCIENCE	FR	**EU:** BE, DK, EL, ES, IT(2), NL, SE, SI	grace-rri.eu
GRRIP	1.5 M	01-01-2019 31-12-2022	UNIVERSITY COLLEGE CORK	IE	**EU:** DE, ES, IE(2), IT, FR(2), NL, PT, UK(2)	grrip.eu
RESBIOS	1.5 M	01-01-2020 31-12-2022	UNIVERSITÀ DEGLI STUDI DI ROMA TOR VERGATA	IT	**EU:** AT, BG, DE, DK, EL, ES, HR, IT, PL, SI **AC:** UA	cordis.europa.eu/project/id/872146
ETHNA System	1.5 M	01-01-2020 31-12-2022	UNIVERSITAT JAUME I DE CASTELLÓ	ES	**EU:** AT, BG, DE(2), DK, EE, ES, PT **AC:** NO	cordis.europa.eu/project/id/872360
Co-Change	1.5 M	01-02-2020 31-01-2023	AUSTRIAN INSTITUTE OF TECHNOLOGY	AT	**EU:** AT, ES, FI(2), HU, NL **AC:** RS	cordis.europa.eu/project/id/873112

Table 10: Institutional changes in industry RRI project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
GARRI-1-2014 Fostering RRI uptake in current research and innovation systems (CSA)						
PROSO	1.4 M	01-01-2016 28-02-2018	DIALOGIK GEMEINNÜTZIGE GESELLSCHAFT FÜR KOMMUNIKATIONS- UND KOOPERATIONSFORSCHUNG	DE	**EU:** AT, BE, BG, DE, UK(2), PT	proso-project.eu
GARRI-2-2015 Responsible Research and Innovation in industrial context (CSA)						
SMART-map	1.5 M	01-05-2016 31-10-2018	AARHUS UNIVERSITET	DK	**EU:** AT, DE, ES, HU, IT(2), UK(2)	projectsmartmap.eu
COMPASS	1.5 M	01-05-2016 30-04-2019	WIRTSCHAFTSUNIVERSITÄT WIEN	AT	**EU:** BE(2), CY, ES, NL, UK	innovation-compass.eu/
PRISMA	1.7 M	01-08-2016 31-07-2019	TECHNISCHE UNIVERSITEIT DELFT	NL	**EU:** DE, IT, NL, UK	rri-prisma.eu
SwafS-06-2017 Engaging industry – Champions for RRI in industrial sectors (CSA)						
LIV.IN	3.5 M	01-05-2018 30-04-2021	WIRTSCHAFTSUNIVERSITÄT WIEN	AT	**EU:** AT, BE, DE(3), ES(3), HR, IT, NL, PL, RO, UK	living-innovation.net
SwafS-12-2017 Web of Innovations Value Chains and openings for RRI (RIA)						
I AM RRI	3.0 M	01-05-2018 30-04-2021	MONTANUNIVERSITÄT LEOBEN	AT	**EU:** AT(2), DE, DK, ES, FI(2), FR, IT(2), LT, NL, SI, UK **AC:** NO	iamrri.eu

Table 11: Institutional changes in territorial governance RRI project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
ISSI-4-2015 On-line mechanisms for knowledge-based policy advice (RIA)						
ONLINE-S3	3.9 M	01-05-2016 30-06-2018	RESEARCH, TECHNOLOGY DEVELOPMENT AND INNOVATION	ES	**EU:** AT, BE, EL(3), FI, SI, SK, UK(3)	onlines3.eu
SwafS-22-2018 Mobilising Research Excellence in EU Outermost Regions (CSA)						
FORWARD (Managed by DG R&I)	4.3 M	01-01-2019 31-21-2021	GOBIERNO DE CANARIAS	ES	**EU:** FR(12), ES(6), PT(5)	forward-h2020.eu
SwafS-14-2018-2019-2020 Supporting the development of territorial Responsible Research and Innovation (CSA)						
SeeRRI	2.0 M	01-01-2019 30-06-2021	NORDLANDSFORSKNING	NO	**EU:** AT(3), ES(4), IT **AC:** IL, NO(2)	seerri.eu
TeRRIFICA	2.0 M	01-01-2019 30-06-2022	WISSENSCHAFTSLADEN BONN	DE	**EU:** DE(2), ES, FR, PL **AC:** RS **TC:** BY	terrifica.eu
TeRRItoria	2.0 M	01-02-2019 31-01-2022	FONDATION EUROPÉENNE DE LA SCIENCE	FR	**EU:** BE, BG(2), IT(2), DK(2), EL(2), RO **AC:** NO(2)	territoriaproject.eu
CHERRIES	2.0 M	01-01-2020 31-12-2022	ZENTRUM FUR SOZIALE INNOVATION GMBH	AT	**EU:** BE, CY(2), ES(4), IT, NL, SE(2)	cordis.europa.eu/project/id/872873
DigiTERRI	2.0 M	01-01-2020 31-12-2022	AUSTRIAN INSTITUTE OF TECHNOLOGY	AT	**EU:** AT(3), ES, FR(3), SE(3) **AC:** NO	cordis.europa.eu/project/id/873010
RRI2SCALE	2.0 M	01-01-2020 31-12-2022	AGENZIA PER LA PROMOZIONE DELLA RICERCA EUROPEA	IT	**EU:** AT, BE, EL(2), ES, NL(3) **AC:** NO(2)	cordis.europa.eu/project/id/872526
TRANSFORM	2.1 M	01-01-2020 31-12-2022	FONDAZIONE GIANNINO BASSETTI	IT	**EU:** BE(5), ES(3), IT(2), **AC:** NO **TC:** US	cordis.europa.eu/project/id/872687
TETRRIS	2.0 M	01-09-2020 31-08-2023	TEKNOLOGIAN TUTKIMUSKESKUS	FI	**EU:** BE, DE(2), ES(2), FI, HU, NL	cordis.europa.eu/project/id/872550

Table 12: Knowledge base RRI project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
ISSI-3-2015 Knowledge sharing platform (CSA)						
MARINA	3.0 M	01-05-2016 30-04-2019	CONSIGLIO NAZIONALE DELLE RICERCHE	IT	**EU**: BE, CY(2), DK, EE, ES, IE, FR, IT(2), PT, RO **AC:** TR	cordis.europa.eu/project/id/710566
SwafS-09-2016 Moving from constraints to openings, from red lines to new frames in Horizon 2020 (CSA)						
NewHoR RIzon	6.8 M	01-05-2017 30-04-2021	INSTITUT FÜR HÖHERE STUDIEN	AT	**EU:** AT(2), CZ, DE(2), DK, EE(2), ES, FI, FR(2), NL(5) **AC:** NO **TC:** CO, JM	newhorrizon.eu
SwafS-05-2017 New constellations of changing institutions and actors (CSA)						
MULTI-ACT	3.4 M	01-05-2018 30-04-2021	FONDAZIONE ITALIANA SCLEROSI MULTIPLA	IT	**EU:** BE(2), ES, FI, FR, IT(2), LU, PL, PT	multiact.eu
RiConfigure	3.5 M	01-05-2018 30-04-2021	FONDEN TEKNOLOGIRADET	DK	**EU:** AT(2), DE, DK, ES, HU, IT, NL(2) **TC:** CO	riconfigure.eu
SwafS-14-2017 A linked-up global world of RRI (RIA)						
RRING	3.0 M	01-05-2018 30-04-2021	UNIVERSITY COLLEGE CORK	IE	**EU:** DE(2), ES, FR(2), IE(2), IT, LT, NL(4), UK(4) **AC:** RS, UA **TC:** JP, ZA	rring.eu
SwafS-21-2018 Advancing the monitoring of the evolution and benefits of Responsible Research and Innovation (RIA)						
Super_MoRRI	3.0 M	01-01-2019 31-12-2023	FRAUNHOFER GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG	DE	**EU:** AT, DK, ES(2), NL(2), RO **AC:** NO	super-morri.eu
SwafS-20-2018-2019 Building the SwafS knowledge base (RIA)						
On-MERRIT	1.0 M	01-10-2019 31-03-2022	KNOW-CENTER GMBH RESEARCH CENTER FOR DATA-DRIVEN BUSINESS & BIG DATA ANALYTICS	AT	**EU:** AT, DE, PT, UK	cordis.europa.eu/project/id/824612

Table 13: Examples of institutional changes in the RRI dimensions

Theme	Examples of institutional changes
Ethics	Introduction of a new code of ethics Ethics and integrity training established for all personnel
Gender equality	Introducing an action plan on gender equality Establishing a 'family room' in the institution Introducing training on implicit bias for senior management
Open access/Open data	Implementation of an open access policy plan Making data management plans compulsory Inclusion of open access measures in legal documents connected with funding decisions
Public engagement	Spin-off company created to link researchers with industry Involvement of atypical stakeholders in strategy advisory councils Recruitment of a citizen science facilitator in the institution
Science education	Establishment of an action plan on science education Introduction of PhD training on communication to diverse audiences Publication of educational materials on thematic issues on an institutional website
Full RRI package	Establishment of a new information centre to engage with the public Publication of a booklet on RRI recommendations for a faculty Implementation of an RRI policy development action plan

6.3. Achievements

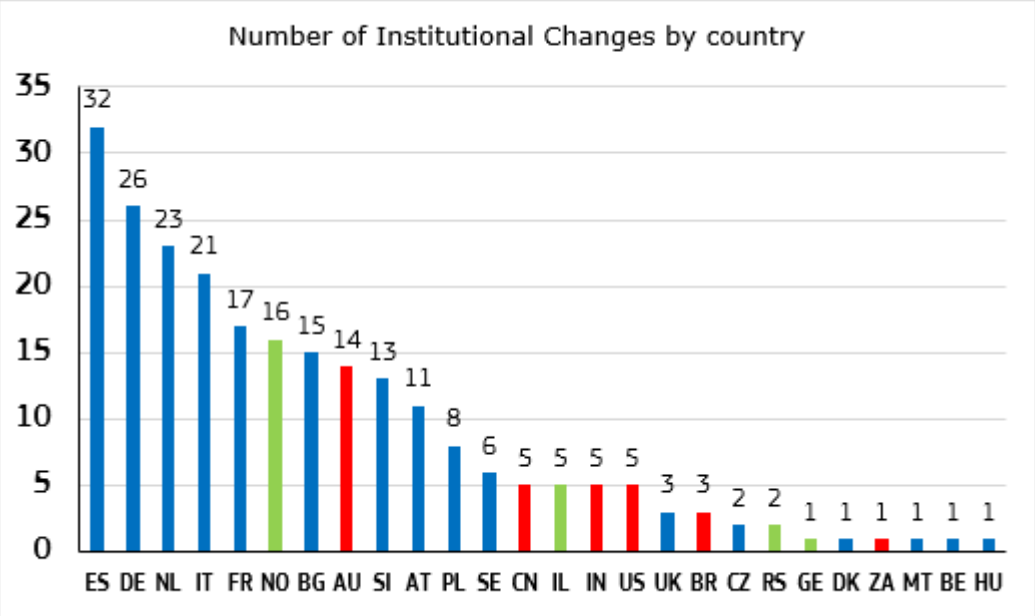
As previously stated, the key performance indicator for SwafS is the number of institutional change actions (see examples in Table *13*: Examples of institutional changes in the RRI dimensions): *'Percentage of research organisations funded implementing actions to promote Responsible Research and Innovation, and number of institutional change measures adopted as a result'*.[70]

To this end, REA.B.5 unit 'Spreading Excellence, Widening Participation, Science with and for Society' launched an exercise in 2019, in close co-operation with DG R&I unit 'Open Science', to gather data from SwafS projects focused on implementing institutional changes towards RRI in beneficiary organisations.

The results of this exercise showed that 238 individual institutional change actions had been or were being implemented by this part of the SwafS portfolio, and suggest that SwafS will well and truly surpass its target of 100 institutional changes in beneficiaries by the end of the programme[71].

Fig. 21 and Fig. 22 show the results for a sample of 12 RRI projects[72], by country and by RRI dimension.

Fig. 21: Number of institutional changes produced by 12 RRI projects in Member States (blue), Associated Countries (green) and Third Countries (red).

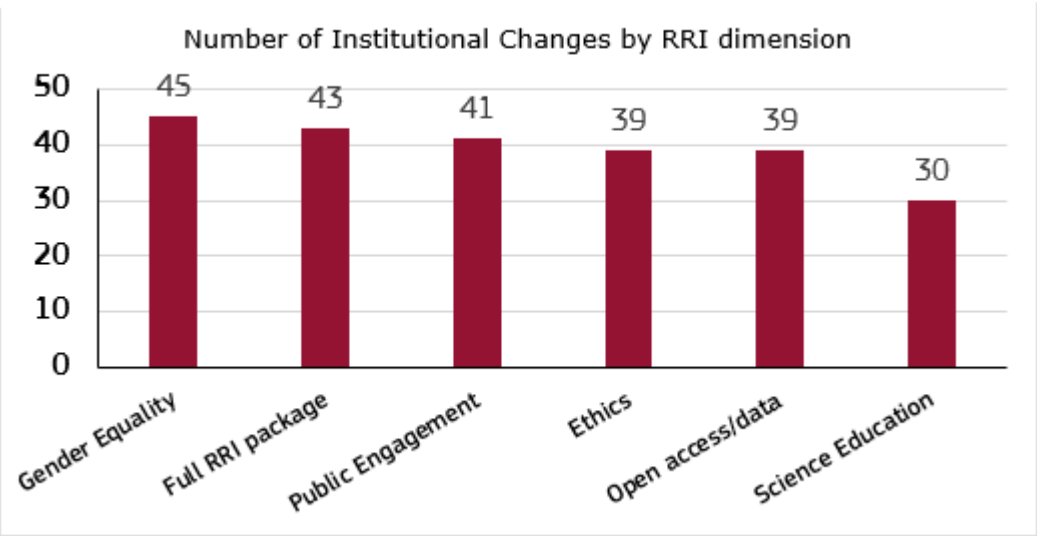


[70] Horizon 2020 indicators

[71] This data collection exercise only covered projects in the RRI portfolio focused on institutional changes, and did not cover projects dedicated to gender equality, ethics, or open access/open data, which, to various degrees, focus also on institutional changes.

[72] The 12 projects considered are: STARBIOS 2, RRI-Practice, FoTRRIS, FIT4RRI, ORION, RIConfigure, JERRI, SeeRRI, TeRRIFICA, NUCLEUS, PROSO, GRACE.

Fig. 22: Number of institutional changes produced by 12 RRI projects in the RRI dimensions.



6.3.1. Research Funding and Performing Organisations and Higher Education Institutes

Projects funded under this category aim to change the institutional practices and cultures in research funding and research performing organisations (RFPOs) with a view to fostering and embedding RRI on a sustained basis.

The projects aiming to open up RFPOs use a variety of approaches and methods in implementing institutional changes towards RRI. These include identifying best practices and analysing obstacles and barriers in successfully implementing RRI principles. As such, one of the main outcomes of the portfolio of projects is a strong evidence-based inventory of impactful practices for the uptake of RRI. They show that different changes require varying amounts of effort, that changes in some institutions are easier to implement than in another, and that all manner of changes can be impactful depending on the context. For many of the projects in SwafS, the changes introduced represent significant steps forward towards RRI for the organisations concerned.

For the purposes of the analysis of the group of projects targeting institutional changes in higher education institutes and RFPOs, the projects are grouped according to four main areas of focus: good practices in RFPOs; setting up action plans; training and education on RRI and finally those with a particularly innovative approach.

6.3.1.1. Good practices in RFPOs

NUCLEUS developed a new understanding of engagement in universities and scientific institutions. Its main goal was to implement this understanding by embedding RRI in the governance and culture of research institutions across Europe, China and South Africa. The NUCLEUS project tested the principles of RRI through experiments in ten research institutions across Europe, as well as in South Africa and China (presented in chapter 1 in the context of international outreach).

These experiments involved implementing approaches and activities that would help overcome institutional obstacles and demonstrate the benefits of RRI to each partner institution. NUCLEUS developed a web-tool for RRI implementation.

RRI Practice reviewed RRI-related work in 22 RFPOs and developed objectives, targets and indicators for each organisation. One of the main outcomes of the project is the RRI Handbook for organisations that are considering implementing policies or practices related to RRI. Together with the NUCLEUS project, they organised the 'Pathways to Transformation' conference.

The conference explored the pathways that institutions may follow towards being more socially responsive, with two main questions acting as the driving force: firstly, what can research performing organisations learn from the projects' institutional RRI experiments ('Practical Pathways')? And secondly, how can research policy incentivise stakeholders to contribute to more responsive science and innovation systems ('Policy Pathways')? The 'Pathways declaration' emerging from the conference, signed by more than 13 projects funded under SwafS, called for RRI to remain a central objective in EU R&I and for the EU to continue to pursue its leading role in this effort (section 6.4 outlines the recommendations put forward for the European Commission). This formed the basis for a 'Joint Declaration on Mainstreaming RRI across Horizon Europe' recently published in the Journal of Responsible Innovation.

JERRI orchestrated a deep RRI transition process within two major European Research and Technology Organisations: the German Fraunhofer Gesellschaft and the Netherlands Organisation for Applied Scientific Research.

Transition roadmaps were developed detailing pathways to the envisaged long-term goals of both entities to guide the process beyond the project's lifetime as well as producing best practices (Deliverable 9.1: Global RRI Goals and Practices).

6.3.1.2. Setting up action plans

After analysing where their institutions stand in terms of existing RRI practices, many of the projects drafted action plans to support their organisations in implementing structural changes.

STARBIOS 2 produced six action plans geared to putting in place structural changes in one or more of the RRI dimensions in partner institutions based in Europe and developed three action plans for non-European partners, all active in the field of the biosciences. STARBIOS 2 is in the process of developing an RRI model for the biosciences, with the potential of contributing to structural changes in bioscience institutions in Europe and beyond. Examples of institutional changes include the implementation of an open access policy at one of the RPOs, the setting up of an ethical commission at a higher education partner, and the creation of a start-up to connect the university's research to enterprises: InNutRes (Responsible Innovation in Nutrition). Finally, STARBIOS 2 organised a session on 'Epigenetics in Infection, Diets and Environment: Responsible Research and Innovation' at the American Association for the Advancement of Science (AAAS) Annual Meeting 2019 in Washington DC[73].

GRRIP focuses on embedding RRI practices through action plans in five RFPOs active in the marine and maritime sectors. GRRIP aims to contribute to the implementation of RRI in partner institutions by providing evidence of societal, democratic, economic

[73] STARBIOS2 at AAAS Annual Meeting 2019

and scientific impacts of institutional changes through a monitoring and evaluation methodology developed in co-creation mode with input from all quadruple helix stakeholders.

Actions plans are also the focus of GRACE, which involves ten RFPOS in Europe. Each institution will develop customised RRI profiles for implementing RPFOs based on their needs, expectations and specific characteristics, which they will then implement. The novelty of the GRACE project is that these action plans will lead to an 8 year RRI roadmap for each implementing RPFO. GRACE intends to co-organise a side event at the III International Triple Helix Summit in Bologna (November 2020) together with another project funded under the same topic as part of its 'additional dissemination obligations[74]', foreseen for some SwafS projects.

ETHNA System started in January 2020 and will develop and implement an Ethics Governance System for grounding good practices in RRI in Higher Education and Funding and Research Centres. The project will implement and validate a new formal organisational structure within the management structure of its six partner institutions.

6.3.1.3. Training and education on RRI

Embedding RRI in institutions and implementing structural changes along the RRI dimensions can only take place if the organisations themselves are comfortable with what RRI entails and know about the tools available in the implementation of RRI-related changes. Educating future researchers to be attuned to RRI is also important, as is grounding RRI in higher education curricula.

Many projects focus on the training aspect, not only in capacity building for staff in higher education to teach RRI but also in training the RFPOs by providing tools, guidelines etc. See EnRRICH and HEIRRI included in chapter 3: Science Education, in relation to RRI in higher education curricula.

FIT4RRI focuses on the training of RFPOs through workshops, with an online RFPO training programme to follow. Similarly, ORION is creating training content for researchers and professional staff at funding agencies on RRI and Open Science concepts, practices and tools.

To date, ORION produced case studies, checklists, factsheets, podcasts, and are planning to launch a Massive Open Online Course (MOOC).

6.3.1.4. Innovative approaches

Embedding RRI creates a need for intermediary structures, reconnecting established knowledge institutions with broader society for the co-creation of local answers to global challenges. Several projects adopted an innovative approach to the challenge of embedding RRI in RFPOs.

FoTRRIS developed and tested such an intermediary structure: a Co-RRI Competence Cell. This was prototyped in five regional case studies on various challenges, including renewable energy, refugees, and women with disabilities, local economy, sustainable food and material scarcity. FoTRRIS designed and

[74] The 2018-2020 work programme foresees additional dissemination obligations: consortia must make active efforts to freely share, in a timely manner and as appropriate, the research strategies, methodologies, and raw and analysed data deriving from their activities (including any evaluation activities), with the other projects funded by SwafS subject to these same additional dissemination obligations. Applicants must acknowledge and incorporate these obligations in their proposal, outlining the efforts they will make towards this in Annex 1 of the proposal. The respective option of Article 29.1 of the Model Grant Agreement applies.

implemented co-RRI competence cells within its partner organisations, with changes to these organisations' governance in the way research and innovation practice occurs. These have resulted in commitments from the organisations to promote and sustain their institutional changes, to varying degrees depending on the specifics of the institutional context (e.g. their business model and size). Furthermore, FoTRRIS produced a set of highly innovative materials, including a co-RRI 'cook book' to assist stakeholders in implementing RRI.

Co-change, which recently commenced, centres on the concept of change labs to generate transformative capacity for institutional change in terms of practices, procedures, rules and norms.

6.3.2. Industry

The 2015 topic dedicated to 'Responsible Research and Innovation in the industrial context'[75], resulted in the funding of PRISMA, SMART-map and COMPASS.

The goal of PRISMA was to identify lessons on implementing RRI in industry ranging from small enterprises to large corporations and universities. The structured methodology was the result of eight pilots in companies active in emerging technologies (nanotechnologies, synthetic biology, Internet of things, and autonomous vehicles). PRISMA produced a number of practical tools and promising practices for companies to include RRI in their (business) strategies, notably a roadmap consisting of a 6-step approach for defining an RRI-strategy. The PRISMA R&I toolkit is geared for SMEs aspiring to develop innovative products and services with which societal needs are addressed together with a contribution to environmental and economic sustainability. The project also designed a MOOC on 'CSR and RRI: Building tomorrow's responsible firms'.

A re-run of the course is planned in 2020. The project team were very active with close to 30 publications produced in journals and conference articles. Finally, the project aims at sustainability through the development of CEN (the European Committee for Standardisation) standards on responsible industry based on the outcomes of the project's work.

SMART-map defined and implemented concrete roadmaps for the responsible development of technologies and services in three fields: precision medicine, synthetic biology and 3D printing in biomedicine. Industrial Dialogues i.e. collaborative dialogue between industry and societal actors, resulted in the co-design of a SMART map to help companies address questions of social and environmental responsibility in their innovation processes.

COMPASS developed an interactive online platform, the Responsible Innovation Compass, deploying RRI visions and roadmaps for three innovation fields (healthcare, nanotechnology, ICT) with a particular focus on SMEs. The Responsible Innovation Self-Check Tool for SMEs is a key outcome, providing concrete inputs and examples on how to translate RRI principles into actual business practices.

Falling under the 2014 topic 'Fostering RRI uptake in current research and innovations systems'[76], PROSO aimed to foster the engagement of citizens and 'third sector organisations', notably non-governmental organisations (NGOs) and civil society organisations (CSOs), in Europe's research and innovation processes across three domains of research and innovation: nanotechnology, food and health and the bio-economy. The PROSO Support Tool outlined practices that encourage the

[75] SwafS work programme 2014-2015
[76] SwafS work programme 2014-2015

engagement of citizens and third sector actors in publicly-funded research and in research and innovation policy in the European Union.

LIV.IN launched a Virtual Community Platform to co-create new solutions that are beneficial to society and create new business opportunities in the areas of smart homes, smart health and designing responsible, sustainable solutions for future living. The platform was created on the basis of the RRI Community Building Handbook, a guide to the design, development and maintenance of a sectoral virtual community. The initiative gives citizens the chance to be involved in the design of technology that will shape their future lives while giving industry the possibility to respond directly to changes and the needs of users and expectations of society[77].

I AM RRI is investigating the additive manufacturing (AM)[78] innovation network in order to develop a dynamic model of webs of innovation value chains in AM based on open innovation considerations and stage-gate approaches to include openings for responsible research and innovation. Additive manufacturing in the automotive and medical industry will serve as pilot cases to refine and validate the model[79].

6.3.3. Territorial governance

Complementing the European Commission's guidance[80] on the methodological design of RIS3 (research and innovation strategies for smart specialisation), ONLINE-S3 developed an e-policy platform hosting a toolbox consisting of 28 tools covering the complete RIS3 process, a roadmap and a 6-phase guide to assist national and regional authorities in the EU elaborate their smart specialisation agenda. Online-S3's web services and tools to implement RIS3 methodologies were tested in four regions: Scotland (United Kingdom), Central Macedonia (Greece), Galicia (Spain), and Northern Netherlands. Over 12,000 users were involved, of which over 1,000 contributed with suggestions and conveyed high levels of satisfaction[81].

The following projects are supported by topic SwafS-14-2018-2019-2020 that will likely see around 10 per cent of all EU regions developing more open and collaborative territorial governance through institutional and governance changes by taking a Responsible Research and Innovation approach.

TeRRItoria will connect RRI to the general strategy of Smart Specialisation of regions by developing a set of transformative experiments[82] and implementing institutional changes in five European selected territories in order to embed RRI in their planning process. The territories, represented by a territorial organisation, are located in Central Macedonia (Greece), Emilia-Romagna (Italy), Trøndelag (Norway), Region of North-East Romania and the Municipality of Gabrovo (Bulgaria). So far, TeRRItoria has produced an inventory of 43 RRI Governance Innovation Practices, on the basis of good practices observed in other RRI projects in the design and implementation of five transformative experiments foreseen.

SeeRRI aims to establish a foundation for self-sustaining R&I ecosystems in Europe by developing a framework for integrating the RRI approach into regional development policies in three European territories: Nordland in Norway; B30 in Catalonia; Ecoplus from Lower Austria. The aim is to provide a set of core principles and a roadmap that regions can use to develop a sustainable research and

[77] Liv.In website
[78] AM is a key enabling technology in high value manufacturing
[79] I am RRI website
[80] Guide on Research and Innovation Strategies for Smart Specialisation
[81] Intelligence and co-creation in Smart Specialisation Strategies: Towards the next stage of RIS3
[82] TeRRItoria Project experiments

innovation ecosystem based on RRI principles[83]. SeeRRI published an article explaining how organisations can become responsible innovators and demonstrating that practicing RRI may give companies a competitive advantage[84].

In October 2019, SeeRRI and TeRRItoria partook in the European Week of Regions and Cities, in a workshop on 'In Science for Citizens: how science meets regions and cities', emphasising the importance of involving all actors in the 'quadruple helix' in transition processes.[85]

TeRRIFICA will increase competencies for climate action and climate change adaptation in six pilot cities and regions: Barcelona (Spain), Brittany, Normandy and Pays de Loire (France), South Oldenburg (Germany), Poznań Agglomeration (Poland), Minsk (Belarus) and Belgrade (Serbia). TeRRIFICA produced a guide on engagement and co-creation aimed at fostering stakeholders' engagement and co-creation within the context of climate mitigation and adaptation. In the knowledge gathering phase, it examined the local contexts in the six pilot regions[86] and identified case studies of community-academia research partnership related to climate change, highlighting common elements for the development of future climate actions[87].

The outcomes of this project should be particularly interesting to future work on a climate-focused mission in Horizon Europe and the European Green Deal.

RRI2SCALE aims to implement successful regional R&I policies that spearhead sustainable development and economic growth while advancing inclusiveness in four regions: Hordaland (Norway), Overijssel (Netherlands), Crete (Greece) and Galicia (Spain). RRI2SCALE will examine the integration of RRI principles within the regions as well as the key components of territorial R&I ecosystems. This will be followed by a large-scale citizen survey on RRI principles and their interaction with R&I ecosystems. All the project's results, together with a training compendium, will form the RRI2SCALE Toolkit which can be used for replicating the move towards RRI by other territories.

TRANSFORM will bring Lombardy (Italy), Brussels (Belgium) and Catalonia (Spain) together to design, test and disseminate participatory research agenda setting; design for social innovation; and citizen science as co-creation methodological frameworks for the implementation of Smart Specialisation Strategies (RIS3). Regional governments involved in TRANSFORM will adopt RRI approaches in their R&I policies and actions including integration into the strategic roadmaps for the implementation of RRI within RIS3.

CHERRIES will support healthcare research and innovation policy and pilot actions by interlinking RRI, demand-side policy and territorial innovation models including smart specialisation. This pilot innovation process will be implemented and tested in the territories of Murcia (Spain), Örebro (Sweden) and the Republic of Cyprus.

DigiTeRRI will develop a framework for the responsible transition of traditional industrial regions into digitised R&I ecosystems together with the impacted industries, territorial authorities and citizens affected in Värmland (Sweden), Région Grand Est (France) and Styria (Austria). DigiTeRRI will produce a strategy for

[83] SeeRRI website
[84] 'The responsible learning organization: Can Senge (1990) teach organizations how to become responsible innovators?'
[85] 18th European Week of Regions and Cities, 12-15 October 2019
[86] TeRRIFICA 'Report on institutional framework conditions, relevant local and regional processes, instruments and co-creation factors related to or adaptable for climate action'
[87] TeRRICICA 'Case studies report'

implementing resilient R&I ecosystems for digitalised industries in traditionally industrial-oriented territories.

TETRRIS, due to start later in 2020, will support four European pilot territories to integrate RRI practices into their territorial research and innovation systems and development approaches. The regions are Tampere (Finland), Karlsruhe (Germany), Cantabria (Spain) and Szeged-Timișoara (Hungary-Romania). TETRRIS will also develop tools and good practices and policy recommendations for other European territories to integrate RRI in their regional development.

Looking further afield, FORWARD (managed by DG R&I), launched as part of the EU's strategy for outermost regions, aims to foster research excellence in EU Outermost Regions (ORs). The project involves the regional governments from the nine ORs in charge of R&I regional policies together with key R&I actors.

FORWARD will perform an initial analysis of R&I ecosystems and, based on these results, will put in place tailored actions including a joint strategy and thematic action plans, capacity building and networking activities, as well as approaches for connecting research and policy making. Importantly, and in line with SwafS, emphasis is placed on the involvement of civil society organisations within these processes.

6.3.4. Knowledge base

MARINA developed a Knowledge Sharing Platform in order to facilitate the cooperation of those involved in marine issues and ensure the integration of citizens' ideas. The platform includes a section on tools and good practices for RRI implementation[88]. Now that the project is over, the project team guarantees the sustainability of the communities federated in the platform and of the platform itself.

NewHoRRIzon sets out to promote the acceptance of RRI in Horizon 2020 and beyond. It will work out the conceptual and operational basis to fully integrate RRI into European and national research and innovation (R&I) funding practices. In order to accomplish this goal, NewHoRRIzon established 19 Social Labs, each dedicated to a different part of H2020 (e.g. ERC, LEIT ICT, Societal Challenge 6)[89]. For every section of H2020, different stakeholders gather in a Social Lab to define the social challenges at stake and develop social experiments to overcome them. NewHoRRIzon also analysed the specifics of the current use and practices of RRI within the various Horizon 2020 programme lines.

One important outcome of the project is the Societal Readiness Thinking Tool, a practical online tool that can be used by research projects and funders to ensure that they have adequately taken into account different aspects of responsibility through the research and innovation process, so as to ensure that the outcomes of the research and innovation will align with the needs, values and expectations of society ('societal readiness').

MULTI-ACT aims to increase the impact of health research on people with brain diseases through patient participation. Starting with multiple sclerosis as its first case study, MULTI-ACT will create and implement a new model allowing for the effective cooperation of all relevant stakeholders in defining the scope of health research as well as new metrics for the evaluation of its results[90].

[88] Marina website
[89] New Horizon website
[90] MULTI-ACT website

So far, MULTI-ACT produced a Master Scorecard for use at the beginning or during the development of a research initiative, engaging multiple stakeholders in defining impact indicators towards a given mission through a collective bottom-up approach.

RiConfigure aims to include civil society in the innovation process in order to let innovative solutions flourish and in doing so bring different voices together in new types of collaborations to avoid blind spots and exploit the specific competences of the various actors[91]. RiConfigure produced a social lab methodology manual for designing and implementing social labs.

RRING aims to bring RRI to the global level to promote mutual learning and collaboration in RRI through a global RRING community network and a global Open Access RRI knowledge base[92]. An important part of RRING is its bottom-up approach to share and engage in learning about responsibility, aligned to the states' commitments to implement UNESCO's Recommendation on Science and Scientific Researchers (2017).

On 13 February 2020, RRING ran a workshop at the American Association for the Advancement of Science (AAAS) Annual Meeting in Seattle (USA), which brought together various stakeholders of science technology and innovation systems for learning on responsibility in research and innovation.

FP7's MoRRI project (2014-2018) conceptualised and implemented the first RRI monitoring system in Europe, consisting of more than 36 indicators for the key areas of RRI[93]. SUPER MoRRI builds on this work, ensuring sustained data collection, curation, further assessment and refinement of the MoRRI indicators.

Super_MoRRI aims to continue cross-European data collection on the evolution and benefits of RRI, enhance understanding of its societal, democratic, economic and scientific benefits and ultimately improve the monitoring system.

In addition, it will create a user-friendly, interactive dashboard[94]. The annual event in Leiden in January 2020 gathered 14 other SwafS projects, focused on institutional change, the territorial dimension of open and responsible research and innovation, and citizen science[95].

The project has been particularly active in developing an active ecosystem of sharing and learning, so as to inform and co-develop the indicator system with SwafS stakeholders.

ON-MERRIT, targets an equitable scientific system that rewards merit rather than the 'Matthew Effect'[96] of cumulative advantage.

ON-MERRIT deploys a combination of qualitative and computational methods that use stakeholder participation and co-design to engage researchers, industry, policy makers and citizens in examining the extent of the Matthew Effect in key RRI elements with the aim of providing evidence-based policy recommendations for stakeholders on mitigate these effects. ON-MERRIT was the only project to be supported from the 2018 call of SwafS-20-2018-2019.

[91] RiConfigure website
[92] RRING website
[93] 'Monitoring the evolution and benefits of responsible Research and Innovation'
[94] Super_MoRRI website
[95] Super_MoRRI events
[96] The idea that the rich get richer and the poor get poorer is a social phenomenon linked to the Matthew effect. Essentially, it refers to the concept that those who already have status can gain more, whereas those without status struggle more to gain it. In other words, it is the accumulated advantage.

6.4. Recommendations

6.4.1. Policy recommendations

NUCLEUS highlighted in its policy brief the importance of impressing upon stakeholders the meaning and principles of RRI rather than focusing on the term itself, which can create unnecessary barriers.

The Pathways Declaration, recently published in the Journal of Responsible Innovation as a 'Joint declaration on mainstreaming RRI across Horizon Europe'[97], calls for the funding of a hub on RRI to ensure quality in the mainstreaming of RRI, co-creation, public engagement and citizen science in the next Framework Programme. This hub should build on and further cultivate the RRI knowledge base. It should advise, train, consult, assess and provide quality control and serve as a resource for those who include RRI-related activities in Horizon Europe projects.

It should also provide experts for the assessment of these aspects in proposals and project activities as well as for relevant committees and boards.

RRI-Practice produced a policy brief echoing some ideas from the Pathways Declaration, notably establishing a network of train-the-trainers in all Member States to train stakeholders in RRI. The project also proposed that the European Commission launch a tender for professional marketing, dissemination and training of RRI.

It proposed for DG R&I to fund a conference with a global scope, with the goal of developing a Declaration on Research Quality and Impact (in a similar format as the Rome Declaration on RRI). Another idea proposed was setting up an annual RRI award to incentivise and promote RRI.

With respect to regional governance, the European Commission should envisage greater synergies between the SwafS calls and ESF (European Social Fund), ERDF (European Regional Development Fund) and Erasmus+. RRI practices, for example stakeholder engagement, should be part of the evaluation for Structural Funds, and RRI is a key tool towards opening up cohesion policy to the input of society. ONLINE S3's platform and other project outputs of potential interest to regional governments should be referenced on the European Commission's Smart Specialisation Platform.

While progress has made in terms of the participation of Civil Society Organisations (CSOs) in Horizon 2020 projects, efforts should continue to ensure the inclusion of this group of actors. Appropriate funding mechanisms to encourage CSOs to partake in quadruple helix collaborations should be promoted, notably the cascading grant mechanism, a useful instrument to engage such stakeholders.

Furthermore, a clearer definition of CSOs in the context of particular topics would be commendable and could help clarify the types of CSOs expected. Finally, a compendia of 'best practices' should be made available to the research community at large, including effective methodologies to support the active participation of CSOs within quadruple helix collaborations[98].

6.4.2. Recommendations for Horizon Europe

The Pathways Declaration (recently published as 'Joint declaration on mainstreaming RRI across Horizon Europe') pointed to the following specific recommendations to the European Commission in relation to strengthening RRI in Horizon Europe:

[97] Joint declaration on mainstreaming RRI across Horizon Europe

[98] RiConfigure Policy Brief

- In cases in which RRI-related concepts are included in future topics, applicants should outline how their projects relate to RRI, based on guidelines for how to embed RRI effectively and to measure societal impact.

- Clear criteria for assessing RRI-related concepts should be communicated to applicants and evaluators.

- Interdisciplinary collaboration should be encouraged. For instance, including researchers from Social Sciences and Humanities (SSH) usually increases the quality of RRI actions.

- Treat RRI components as research, for example the methods and results of RRI measures in an integrated project should be published.

- Open science, citizen science and co-creation agendas should be considered in a broader perspective with reference to RRI.

- The different advisory boards and committees in Horizon Europe, especially in relation to emerging science and technologies, as well as the mission-oriented programmes, should be well-versed in RRI.

NewHoRRIzon may potentially have a significant impact on future R&I policy in Europe. EC staff should be more involved in the pilots and an EC contact person nominated for each social lab.

NewHoRRIzon advises a shift from RRI being a general 'cross-cutting issue' to becoming an explicit policy goal, outlined in clear guidelines for action and that the European Commission should develop and actively disseminate information on RRI implementation tools[99].

Finally, NewHoRRIzon recommends including the Societal Readiness Thinking Tool in the Horizon Europe evaluation process by requiring applicants to include project-specific RRI-related questions and reflections with the support of this tool. This step would encourage researchers to reflect on their work in relation to societal needs.

With respect to regional governance specifically, in collaboration with EU services dealing with regional policy, the link between the region's design and implementation of smart specialisation strategies and projects funded under Horizon Europe geared towards developing RRI practices in RIS3 strategies should be strengthened.

A conference organised in February 2020 by the Commission's Directorate-General for Regional and Urban Policy on 'Engaging citizens for good governance in Cohesion Policy', aimed to identify new solutions and approaches to better involve citizens in the decision-making process related to the implementation of the cohesion policy[100].

However, there appeared to be little knowledge of the projects supported in SwafS that are showing how to do this in practice and this know-how should be better exploited across Commission services.

[99] Second NewHoRRIzon Policy Brief
[100] High-level conference "Engaging citizens for good governance in Cohesion Policy", Brussels, 6 February 2020

7. CITIZEN SCIENCE AND CITIZEN ENGAGEMENT

7.1. Policy objectives

The 'Integrating Society in Science and Innovation' call of the initial SwafS 2014-2015 work programme included topics on public outreach and multi-actor engagement for scenario building. The 2016-2017 work programme saw three topics focus specifically on the involvement of citizens (alongside other actors) in co-producing research content.

In parallel, wider policy developments intensified efforts in this domain. In 2015, former Commissioner Moedas identified three strategic priorities, described in Open innovation, Open science, Open to the world (the three O's strategy), which proposed *inter alia* that 'many more actors will take part (in the research process) in different ways and the traditional methods of organising and rewarding research will also see many changes'[101]. One important dimension of open science is citizen science, envisioned as being 'linked with outreach activities, science education or various forms of public engagement with science as a way to promote Responsible Research and Innovation'. In 2016, the Council[102] recognised citizen science as an open science priority and in April 2018, the Open Science Policy Platform (OSPP) included citizen science as one of eight Open Science ambitions.

Furthermore, partly in response to the interim evaluation of Horizon 2020, the SwafS work programme 2018-2020 included a strategic orientation on 'exploring and supporting citizen science', and developed a portfolio approach to work towards this orientation.

The SwafS work programme 2018-2020 focuses on the meanings, mechanisms and challenges facing citizen science from local to European and global levels, learning from on-going experiences and innovative grassroots initiatives. In addition, the aim is to explore how citizen science can act as a catalyst to develop scientific skills and competences, act as a tool for informal and formal science education of young people and adults, counteract perceived anti-intellectual attitudes in society, raise the scientific literacy of European citizens, as well as promote social inclusion and employability.

Citizen science is blooming across scientific disciplines. It has the potential to bring a wide variety of benefits to researchers, citizens, policy makers and society and across the research and innovation cycle. It can make science more socially relevant, accelerate and enable production of new scientific knowledge, help policy makers monitor regulatory implementation and compliance, increase public awareness about science and ownership of policy making, and increase prevalence of evidence-based policy making[103]. To this end, the European Commission aimed to support and showcase excellent examples of citizen science across scientific disciplines (presented in section 7.3.2).

At the same time, there are difficulties setting up citizen science initiatives in terms of choosing the optimum methodologies; quality assurance and validation of the outcomes; managing large numbers of volunteers for many months or even years and keeping them motivated and responding to their questions. To this end, the

[101] Commissioner Moedas' speech at the conference 'A new start for Europe: Opening up to an ERA of Innovation'
[102] Council conclusions on the transition towards an Open Science system
[103] SwafS Work programme 2018-2020

European Commission supported a mutual learning space where citizen science projects and participants can exchange experiences and successful strategies, resulting in the Coordination and Support Action 'Exploring and supporting citizen science' in the 2018-2020 work programme. Furthermore, the growth of citizen science brings with it a need to understand its breadth and consequences. This led to a topic in 2019 dedicated to consolidating and expanding the knowledge base on citizen science in terms of understanding how it is conducted, the actors including incentives and disincentives for their involvement, good practices, the enablers and barriers for citizen science as well as its effects on R&I systems.

7.2. Project portfolio

Citizen Science is addressed across topics in various SwafS work programmes, resulting in 22 funded projects (2020 call not included) which for the purposes of this analysis are categorised as 'deepening the evidence as well as practice and training on co-design and co-creation' (6 projects) and 'doing citizen science' (16 projects). Their combined budget is approximately EUR 58.3 million with EUR 17.6 million for the first group and EUR 40.7 million for the 'doing citizen science' projects.

Fig. 23: Number of coordinators in Member States (MS) and Associated Countries (AC)

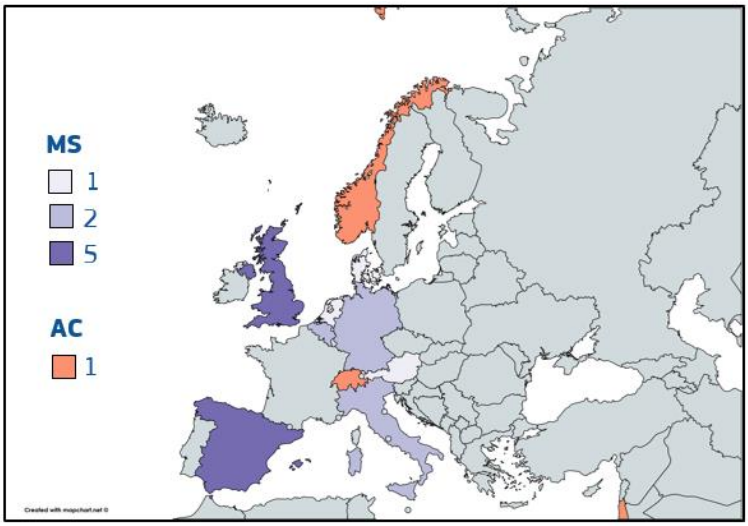


Fig. 24: Number of other partners in Member States (MS) and Associated Countries (AC)

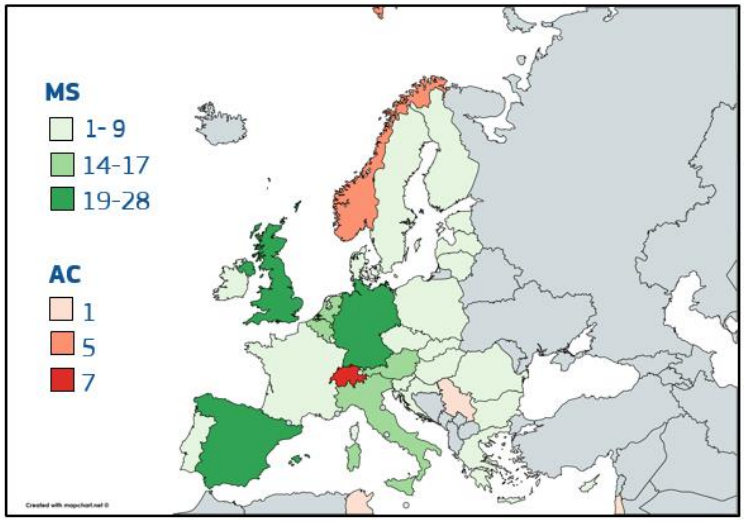


Fig. 25: Number of partners in Third Countries (TC)

Table 14: Co-creation project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
ISSI-2-2014 Citizens and multi-actor engagement for scenario building (CSA)						
CIMULACT	3.3 M	01-06-2015 31-03-2018	FONDEN TEKNOLOGIRADET	DK	**EU:** AT, BE(2), BG, CY, CZ, DE, EL, ES, FI, FR, HR, HU, IE, IT, LT, LU, LV, MT, NL, PL, PT, RO, SE, SK, UK **AC:** CH, NO	cimulact.eu
SwafS-13-2017 Integrating society in science and innovation – An approach to co-creation (RIA)						
SCALINGS	4.0 M	01-05-2018 31-07-2021	TECHNISCHE UNIVERSITÄT MÜNCHEN	DE	**EU:** AT (2), DK, ES, FR, NL, PL, UK(2) **AC:** CH	scalings.eu
SISCODE	4.0 M	01-05-2018 30-04-2021	POLITECNICO DI MILANO	IT	**EU:** BE(2), DE(2), DK(2), EL, ES, FR, IE, IT, NL, PL, PT(2), UK **AC:** RS	siscodeproject.eu
SwafS-15-2018-2019 Exploring and supporting citizen science (CSA)						
EU-Citizen.Science	2.0 M	01-01-2019 31-12-2021	MUSEUM FÜR NATURKUNDE - LEIBNIZ-INSTITUT FÜR EVOLUTIONS- UND BIODIVERSITÄTSFORSCHUNG AN DER HUMBOLDT-UNIVERSITÄT ZU BERLIN	DE	**EU:** AT(2), BE, DE, ES, IE, LT, NL, PT, SE, UK(3)	eu-citizen.science
SwafS-18-2018 Taking stock of the application of the precautionary principle in R&I (RIA)						
RECIPES	2.0 M	01-01-2019 31-12-2021	UNIVERSITEIT MAASTRICHT	NL	**EU:** AT, BG, DE(4), DK, IT, NL **AC :** NO	recipes-project.eu/
SwafS-17-2019 Consolidating and expanding the knowledge base on citizen science (RIA)						
CS-Track	2.3 M	01-12-2019 30-11-2022	THE MOFET INSTITUTE	IL	**EU:** AT, BE, DE(2), EL, ES(2), FI	cordis.europa.eu/project/id/872522

Table 15: Citizen science project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
ISSI-1-2014-2015 Pan–European public outreach: exhibitions and science cafés engaging citizens in science (CSA)						
DITOs	3.5 M	01-06-2016 31-05-2019	UNIVERSITY COLLEGE LONDON	UK	**EU:** AT, BE, DE, ES, FR, NL, PL, SI, UK **AC:** CH	togetherscience.eu
SPARKS	3.5 M	01-07-2015 30-06-2018	ASSOCIATION EUROPÉENNE DES EXPOSITIONS SCIENTIFIQUES TECHNIQUES ET INDUSTRIELLES	BE	**EU:** AT, BE(2), CY, DE, FR, HU, IT, LT, LU, , NL, PL, PT, RO, SK, UK **AC:** CH	cordis.europa.eu/project/id/665825
Big Picnic	3.4 M	01-05-2016 30-04-2019	BOTANIC GARDENS CONSERVATION INTERNATIONAL LBG	UK	**EU:** AT, BE, BG, DE(3), EL, ES(2), IT, NL(2), PL, PT, UK(2) **AC:** NO **TC:** UG	bigpicnic.net
SwafS-01-2016 Participatory research and innovation via Science Shops (RIA)						
SciShops.eu	3.0 M	01-09-2017 29-02-2020	SYNYO GmbH	AT	**EU:** BE(2), CY(2), DE(3), ES(2), HU, IT, LT, NL, RO, SE, SI, UK	scishops.eu
InSPIRES	3.0 M	01-04-2017 31-03-2021	FUNDACION PRIVADA INSTITUTO DE SALUD GLOBAL BARCELONA	ES	**EU:** ES, FR, HU, IT, NL **AC:** TN **TC:** BO	inspiresproject.com
SwafS-23-2017 Responsible Research and Innovation in support of sustainability and governance, taking into account the international context (CSA)						
D-NOSES	3.2 M	01-04-2018 31-03-2021	FUNDACION IBERCIVIS	ES	**EU:** AT, BG, DE(2), EL(2), ES(2), IT, PT(3), UK **TC:** CL	dnoses.eu
SwafS-10-2017 Putting Open Science into action (RIA)						
GRECO	2.9 M	01-06-2018 31-05-2021	UNIVERSIDAD POLITECNICA DE MADRID	ES	**EU:** ES (3), PT, DE (3), BG **AC:** CH **TC**: BR	greco-project.eu/
SwafS-15-2018-2019 Exploring and supporting citizen science (RIA)						
CitieS-Health	2.0 M	01-01-2019 31-12-2021	FUNDACION PRIVADA INSTITUTO DE SALUD GLOBAL BARCELONA	ES	**EU:** ES, IT, LT, NL, SI	citieshealth.eu
MICS	1.9 M	01-01-2019 31-12-2021	CONSERVATION EDUCATION AND RESEARCH TRUST	UK	**EU:** HU, IT, NL, RO, UK	mics.tools
ACTION	2.0 M	01-02-2019 31-01-2022	KING'S COLLEGE LONDON	UK	**EU:** DE, ES(2), IT(2), NL(2), UK **AC:** NO(2)	actionproject.eu
REINFORCE	2.0 M	01-12-2019 30-11-2022	EUROPEAN GRAVITATIONAL OBSERVATORY	IT	**EU:** AT, BE, EL(2), FR, IT(2), UK(2) **TC:** AR	reinforceeu.eu
WeCount	2.0 M	01-12-2019 30-11-2021	TRANSPORT & MOBILITY LEUVEN NV	BE	**EU:** BE(2), ES, IE, SI, UK	tmleuven.be/en/project/wecount
CoAct	2.0 M	01-01-2020 31-12-2022	UNIVERSITAT DE BARCELONA	ES	**EU:** AT(2), DE(2), ES, UK **TC:** AR(2)	cordis.europa.eu/project/id/873048
CSI-COP	2.0 M	01-01-2020 30-06-20222	COVENTRY UNIVERSITY	UK	**EU:** BE, CZ, DE(2), EL, ES, FI, HU, NL **AC:** IL	cordis.europa.eu/project/id/873169
EnviroCitizen	2.3 M	01-04-2020 30-09-2023	UNIVERSITETET I STAVANGER	NO	**EU:** CY, EE, ES, NL, RO, SE	envirocitizen.eu
Crowd4SDGs	2.0 M	01-05-2020 30-04-2023	UNIVERSITE DE GENEVE	CH	**EU:** ES, FR, IT **AC:** CH(2)	cordis.europa.eu/project/id/872944

7.3. Achievements

7.3.1. Citizen engagement: co-creation

CIMULACT's main objective was to engage citizens and stakeholders in the co-creation of research agendas based on real and validated societal visions, needs and demands. CIMULACT built on the principle that the collective intelligence of society gives Europe a competitive advantage and strengthens the relevance of the European science and technology system.

CIMULACT established genuine dialogue between thousands of citizens, stakeholders, scientists and policy makers visions and scenarios and produced valuable suggestions for research and innovation policies and topics. In addition, CIMULACT produced a guide presenting methods for conducting work with citizens and stakeholders.

Finally, the report on comparison of research topics from CIMULACT with those from expert-oriented foresight studies showed that there are marked differences between the research agenda envisioned by citizens compared to those envisaged by experts and policy makers, suggesting that there is room and need for both approaches to complement each other.

The project's outputs include a booklet documenting 23 citizens-based research topics and compiled in a report including recommendations for research and innovation policy.

These were delivered on time to feed into the last work programmes of the Horizon 2020 calls as well as discussions on Horizon Europe. They also proved to be of interest to policy makers at a national level.

For SISCODE, 'co-creation is a non-linear process that involves multiple actors and stakeholders in the ideation, implementation and assessment of products, services, policies and systems with the aim of improving their efficiency and effectiveness, and the satisfaction of those who take part in the process'. SISCODE aims to stimulate the use of co-creation methods in policy design.[104]

In the RRI research landscape report, SISCODE examined how co-creation has manifested in EU-funded projects and policies. It found that many projects tend to fall towards the consultation end of the spectrum rather than towards genuine co-creation. Methods and objectives of co-creation need to be explicit, appropriate to the subject, context and people, inclusive of all stakeholder groups and led by a skilled moderator.

The SISCODE toolbox guides the project's ten co-creation labs in their efforts to figure out new solutions for societal challenges.

SCALINGS works to bring together diverse actors in a joint innovation activity for mutual benefit. SCALINGS aims to identify under which conditions co-creation practices can be scaled-up from one city or country to another. Businesses as well as EU research rely on scaling up co-creation processes to wider markets. The project illustrates this by way of an example: when engineers develop a healthcare robot together with patients and doctors in a hospital in Barcelona, the robot might be optimally suited for one hospital environment but it will unlikely fit to the social, cultural, or organisational context of another hospital, city, or country. SCALINGS

[104] SISCODE: Co-creation in RRI practices and STI policies

questions one-size-fits-all solutions to societal challenges and fosters innovation practices that value the social, cultural and regulatory context. SCALINGS is testing three key co-creation instruments: Living Labs[105], Public Procurement of Innovation[106] and Co-Creation Facilities[107].

EU-Citizen.Science is building a central platform for citizen science in Europe to share useful resources about citizen science, including tools and guidelines, good practices and training modules. Many citizen science projects develop mobile apps or web platforms and only a minority are developed further in follow-on projects; the EU-Citizen.Science Platform will serve as a repository for such citizen science resources and will include lists of hardware and software tools and thereby ensure the sustainability of projects and a common vision among the research community. Furthermore, EU-Citizen.Science will provide criteria for 'good' citizen science.

RECIPES (REconciling sCience, Innovation and Precaution through the Engagement of Stakeholders) aims to reconcile innovation and precaution by developing tools and guidelines to ensure the precautionary principle is applied while still encouraging innovation and to this end, seeks to introduce mechanisms for public involvement in scientific and technological decision making. In May and June 2019, RECIPES hosted citizen meetings in Denmark, Norway, the Netherlands, Italy and Bulgaria. Citizens who took part in the meetings had the chance to reflect on issues related to precaution and innovation in relation to research and to provide their ideas and opinions on the matter.[108]

CS-Track aims to deepen knowledge on citizen science and its implications for science and society, by investigating a diverse set of citizen science activities using web-based analytics and multi-perspective analysis to understand the complex processes that are at the heart of citizen science activities.

7.3.2. Doing citizen science

While the 2018-2020 work programme did not adopt an official definition of citizen science, it did frame it as covering a range of different levels of participation: from raising public knowledge about science, encouraging citizens to participate in the scientific process by observing, gathering and processing data, right up to setting scientific agendas and co-designing and implementing science-related policies.

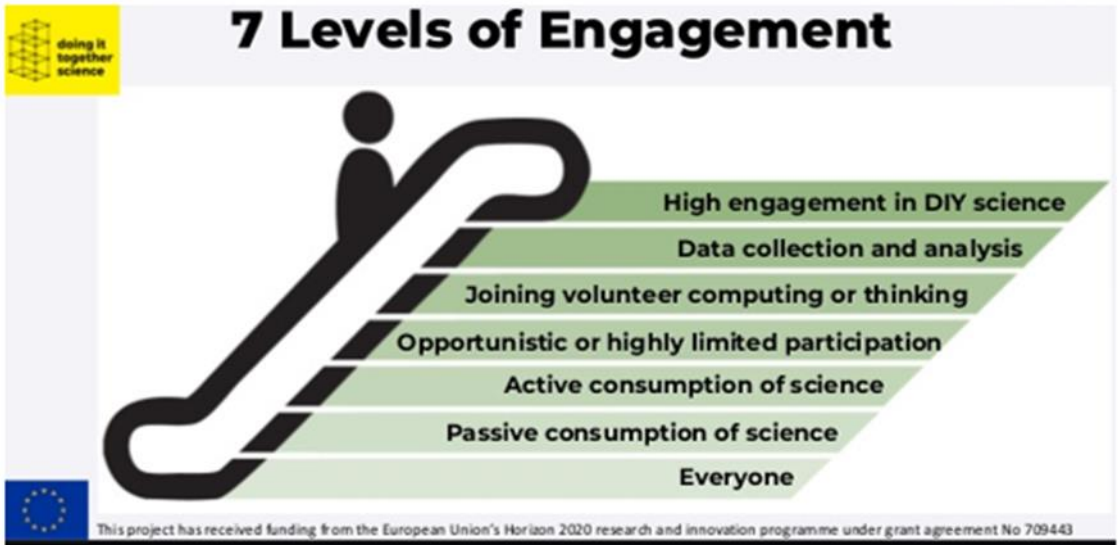
In the 2014-2015 work programme, a number of public engagement projects were pioneers in the field of citizen science and science cafés. BigPicnic focused on a key priority for EU citizens, namely food security. An international network, mainly consisting of botanical gardens, pooled their research expertise in food and food plants, building, through the co-creation approach and public debate, a number of low-cost, outreach exhibitions on food security, using the metaphor of a picnic basket. The project, which has now ended, reached approximately 60,000 people through Science Cafes, and its legacy includes a report documenting public

[105] Living labs take the development of new technologies into the real world. They are sites of collective invention, testing, and demonstration of technologies and sociotechnical futures.
[106] In public procurement of innovation, the public sector uses its purchasing power to act as an early adopter of innovative solutions. It acts as a co-creator by defining public challenges that could be solved through innovation, choosing preferred solution providers, and steering the process towards public benefits.
[107] Co-creation facilities are open, physical or virtual infrastructures for collaborative innovation. They provide lab space, expertise, equipment for staff & external clients or they act as platforms for 'triple helix' interactions between academia, companies and policy makers.
[108] RECIPES event: European citizens on the Precautionary Principle and innovation

views and recommendations for RRI on food security, as well as a toolkit on how to organise Science Cafes.

Under the same call in 2014, Doing it Together Science (DITOs) stands out for its extensive and impressive outreach efforts (over 730 events, engaging over 550,000 people across Europe), and innovative activities. It was designed as a 'leverage' project, inviting partners to carry out citizen science and adding an element of Do-It-Yourself (DIY) science. The escalator framework (Fig. 26: The citizen engagement 'escalator) evolved through the project and became more grounded and clear, positioning the DIY science and citizen science activities within a wider context of public engagement in science and showing the potential for continuity and since the project's completion continues to be used.

Fig. 26: The citizen engagement 'escalator'



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The escalator framework embraces the notion that there are different degrees of engagement and that individuals can move up or down the escalator over their life-course, and that there is no 'optimum' or 'best' level of participation for all people at all times. Participation can be minimal, for example, volunteers sharing computing resources or social media habits without actively engaging in the research itself, or downloading an app that automatically collects data for scientific purposes, yet could still be considered as citizen science.

DiTOs, and its Do-It-Together science bus, was itself an example of an innovative and successful citizen science approach. Several 'science captains' drove the bus across Europe, making a total of 17 stops at a variety of community centres, small towns, public festivals and museums to run participatory workshops and report on their journey on social media. The goal was to involve all kinds of local citizens in ready-made activities and encourage participants to contribute with their own folk remedies and recipes for sharing with new people in new places. This is an excellent way to bring science to young children while at the same time brings citizens closer to the EU.

The project has been mentioned in the Rand report, 'Emerging developments of Citizen Science', as part as a wider strategy to increase citizen engagement in science and policy making. It showed also how citizen science and crowdsourcing can be incorporated into research and innovation within the European Union, in order to help reduce asymmetries between citizens and researchers in their ability to interact

with and access science and the innovations that arise from scientific research. According to the Rand report, Horizon 2020 has been instrumental in driving the growth of citizen science within Europe through explicit and formal backing for the approach by the European Commission.

Science shops are another example of a type of interface between researchers and society, aiming to increase access to science, knowledge and technology for social groups that would or could not ordinarily have had access to them. InSPIRES brings together practitioners and experts to jointly pilot, implement and roll out innovative models for science shops. Concentrating most of its efforts on Research & Innovation in the health sector, with particular attention to ensuring gender balance and inclusion of vulnerable groups (the elderly, adolescents, migrants and refugees), InSPIRES organises science cafés and other public engagement initiatives following a 'glocal' approach. Under the cascade funding mechanism foreseen in the work programme for this topic, InSPIRES organised grants that have supported a number of activities, such as some in Africa (Uganda), engaging with local quadruple helix stakeholders.

The sister project, SciShops.eu, aims to further build on the capacity of the science shops ecosystem in Europe and beyond. The SciShops project seeks to demonstrate the benefits of starting a science shop for every type of organisation as well as the advantages civil society gain from collaborating with science shops in community-based participatory research. The participatory events organised during the project lifetime raise awareness of this win-win concept.

SPARKS was a public engagement project dedicated to creating and implementing innovative ways to engage citizens in science, notably "technology shifts in health and medicine". SPARKS[109] successfully organised an interactive touring exhibition and 200 innovative participatory activities (science cafés, pop-up Science Shops, incubation activities and scenario workshops) across Europe. SPARKS produced a toolkit to prepare Science Espressos, Reverse Science Cafés, Pop-up Science Shops and Scenario Workshops together with a handbook outlining practical guidelines on how to implement the SPARKS methodology by means of concrete activities and tools. These have provided useful input to the emerging concept of missions in Horizon Europe.

D-NOSES, aims to launch a collaborative journey to tackle the problem of odours at a global scale by developing coordinated local case studies in seven European and three non-European countries, with the ultimate objective of placing odour pollution on the global policy agenda. The International Odour Observatory platform, currently under development, will become the one-stop-shop for all stakeholders involved in participatory odour management activities in their own area using the Odour Collect app.

GRECO aims to put open science into action in the photovoltaic (PV) sector. GRECO will develop six cutting-edge photovoltaic products and involve citizens as amateur scientists. Citizens will actively participate in the process of research, development and innovation both in the design of new PV solutions and in the provision of data. The material data generated by citizen scientists will be taken up in the research and innovation process. In return, society will increase awareness and understanding and help shape the direction of the spread of solar energy, thus leading to an overall deeper understanding of photovoltaic research[110].

[109] Horizon Magazine article "'Hacker culture' and citizen scientists taking research beyond the lab', 6 June 2017
[110] Greco website

The 2018-2020 work programme was the first work programme that had a strategic orientation and several topics dedicated to citizen science. A topic on exploring and supporting citizen science in its broad sense gave space to applicants to come up with new ways to tackle research and innovation challenges across all disciplines, through 'hands-on citizen science activities'. It made possible the use of the cascading grant mechanism and encouraged the portfolio of projects to work together with the 'additional dissemination obligations'[111]. Interest in this topic has grown significantly with the number of proposal submissions more than doubling to 69 in the 2019 call compared to the previous year. In 2020, the topic is repeated with slightly amended text, and with the addition of a sub-topic focused on frugal innovation to broaden even further the portfolio of actions in terms of disciplines and sectors represented.

CitieS-Health aims to put citizens' concerns at the heart of research agendas on environmental epidemiology by tackling health issues that concern them. Groups of citizens in five cities in Europe will design and run experiments to explore how pollution in their living environment is affecting their health. To date, it has produced an interactive step-by-step toolkit customised to different stakeholders and domains, with a particular focus on air pollution, noise pollution and health factors.

MICS (Measuring Impact of Citizen Science) is developing knowledge on metrics and instruments to evaluate citizen science impacts. The testing and validation of these tools focus on river restoration as an aspect of nature-based solutions.

ACTION has set up an accelerator to support hands-on citizen science activities to combat and prevent major forms of pollution in the EU. By considering the needs of multiple stakeholders throughout the entire lifecycle of citizen science, ACTION creates methodologies, tools and guidelines to democratise the scientific process, allowing anyone to design and realise a citizen science project, from the early stages of project ideation to validating and publishing the results and beyond. To further pursue this aim the project published a call in August 2019 for new and ongoing citizen science initiatives related to any form of pollution in Europe and worldwide, and with a focus on the involvement of marginalised groups, using the cascading grant mechanism. There was an overwhelming response to this call (116 submissions), out of which six successful applicants received EUR 20,000 to deliver a six-month pilot with the support of the ACTION team. In February 2020, the grantees worked together with the ACTION team on the tools already under development, to co-design other resources aiming at supporting their activities and enhancing their sustainability.

Citizen science's strategy for social media: citizen science projects use co-creation for all tools developed by the project. For example, each partner takes turns in managing the project's Twitter account. This coordinated effort led to the social media accounts being highly successful, and as a result, at the end of DITOs, a new citizen science project, EU-Citizen.Science, inherited the project's social media accounts.

[111] The 2018-2020 work programme foresees additional dissemination obligations: consortia must make active efforts to freely share, in a timely manner and as appropriate, the research strategies, methodologies, and raw and analysed data deriving from their activities (including any evaluation activities), with the other projects funded by SwafS subject to these same additional dissemination obligations. Applicants must acknowledge and incorporate these obligations in their proposal, outlining the efforts they will make towards this in Annex 1 of the proposal. The respective option of Article 29.1 of the Model Grant Agreement applies.

A number of new projects, funded from the 2019 call, started in 2020:

- REINFORCE aims to minimise the gap between society and large research infrastructures in the field of physics through the implementation of four cutting-edge citizen science projects in the fields of gravitational waves, neutrino astronomy, particle physics and cosmic ray interplay with geoscience and archaeology with citizens. The project aims to involve 100,000 citizens in its activities.
- WeCount aims to empower citizens to take a leading role in the production of data, evidence and knowledge around transport and mobility in their local communities and was the subject of a dedicated BBC news article.
- CoAct proposes a radically new approach called 'Citizen Social Science' to face four social global issues (mental health care, youth employment, environmental justice and gender equality), by engaging vulnerable citizens acting as in-the field competent co-researchers.
- CSI-COP investigates GDPR compliance to analyse how far we are being tracked by default as we visit websites and apps on our mobile devices. The findings uncovered by citizen scientists will be used to produce a new taxonomy and an online and open repository of trackers useful to a variety of end-users.
- EnviroCitizen aims to uncover the processes by which citizen scientists working in voluntary environmental-based activities can strengthen their environmental citizenship. The project will study birding activities as a means of developing environmental citizenship.
- Crowd4SDG researches the extent to which citizen science can provide an essential source of non-traditional data for tracking progress towards the Sustainable Development Goals (SDGs) as well as the ability to generate social innovations that enable such progress.

7.4. Recommendations

7.4.1. Policy recommendations

Scientific domains: Citizen science involves a wide range of actors from different sectors (academy, NGOs, public authorities, museums, etc.). While citizen science is applicable across all scientific disciplines, it will differ in terms of the research approach, problem formulation and methods of data gathering depending on the research questions, the disciplines, and the citizens involved.

Measuring citizen science: One of the main challenges for citizen science is to measure the impact and devise indicators that are meaningful for stakeholders. The MICS project, aiming to develop metrics and instruments to evaluate citizen science impacts is a first step in this direction. Efforts to this end should continue in Horizon Europe to emphasize its value in the research and innovation process and for citizen science to be widely acknowledged as a research method producing excellent scientific outcomes.

European platform for citizen science: EU-Citizen.Science will become the one-stop-shop for citizen science resources, ensuring consistency across projects. To complement this effort, an interactive step-by-step toolkit, customised to different research contexts would be a highly useful resource to guide projects new to citizen science. The EU-Citizen.Science platform and its resources should be referenced in the respective work programme topic descriptions.

Inclusiveness: The Horizon 2020 interim evaluation pointed to the need for greater outreach to civil society. In this respect, citizen science is an ideal mode of R&I to

democratise science, build trust in science, and leverage societal intelligence and capabilities in R&I.

Ethical standards: The specific context, the research aims and the disciplinary practices of a project will determine where the activities fall on the spectrum of opportunistic to systematic data collection. In the medical and social sciences, the boundaries of citizen science and data-collection practices can be challenging. Sharing personal and medical data can be part of citizen science, but this depends on the framing and intention of the project, and consideration of whether those taking part are subjects of research or participants who are shaping and carrying out different stages of the project. Some projects, such as SwafS' Pro-Ethics, are elaborating ethical guidelines for projects conducting citizen science activities. Such guidelines should be linked with the European Commission's on-going developments in ethics and integrity in relation to research and innovation.

Environment focus: Many citizen science projects focus on environmental or sustainable development issues, showing citizens' strong concern about these matters. This is an area of high interest for the European Commission, as shown by the recently adopted Green Deal. Synergies will be explored with DG Environment and other relevant DGs, so that citizen science is able to play a role in working towards environmental objectives.

Policy dissemination: The European Parliament's Green/European Free Alliance (EFA) group conveyed their support for citizen science projects focusing on the environment, such as DITOs, which organised several policy events with the support of Members of European Parliament (MEPs). Efforts to raise the European Parliament's awareness about citizen science activities should be coordinated in order to promote the value of DIY science and citizen science.

Terminology: Involving citizens in shaping technology and innovation is a key way of bringing science and society closer together. However, the use of terminology for activities involving stakeholders and the lack of a formal definition of citizen science may lead to some misinterpretations in the research community and among the public at large. It is important to distinguish between the concepts of public engagement, co-creation, citizen science, open science and science communication to clarify the purposes of each in the context of Horizon Europe. For example, the term 'public engagement' has tended to be used in RRI when referring to participatory activities. Furthermore, it would be useful to link these terms with Responsible Research and Innovation.

Declaration on citizen science: DG R&I will organise a Citizen Science conference, under the German Presidency, on 14-15 October 2020, 'Knowledge for Change: A decade of citizen science (2020-2030) in support of the Sustainable Development Goals'. It will address this challenge by focusing on citizen science as a relevant approach to contribute to global challenges and industrial competitiveness in Horizon Europe. The aim is to gather policy makers and citizen science projects from all parts of the world, from local to global scales, and both community-led and academic-led activities, to build the future of citizen science policy making. Financed under the SwafS work programme, this conference will be an opportunity to highlight the diversity of citizen science projects from SwafS and beyond, serve as a forum for reflection on the latest developments, and to define together the impacts, benefits and challenges of citizen science. Most importantly, collaborative sessions will draw recommendations to feed into strategic policy recommendations for the decade 2020-2030. One of the main outcomes will be a Declaration, formulated in an open and participatory process, to chart the path for citizen science to play a full role in helping achieve the Sustainable Development Goals by 2030.

7.4.2. Recommendations for Horizon Europe

Reinforcing Citizen Science: Mainstreaming citizen science, building on the investments made to date in Horizon 2020, is a natural way to reinforce citizen science as a whole. However, while topic texts may be one avenue to approach this, another is to mention citizen science explicitly in the proposal template and the evaluation criterion of Excellence 'Appropriate consideration of interdisciplinary approaches and, where relevant, citizen science activities and the gender dimension'.

Another way to mainstream citizen science could be to develop Massive Open Online Courses (MOOC) on citizen science on the lines of that of University College London and for projects to sign-up for such courses to guide them in the integration of citizen science in their activities.

Furthermore, it is necessary to continue to fund dedicated citizen science actions to pursue efforts in strengthening networks, co-ordinating as well as communication among citizen science projects (particularly, but not limited, to those funded by SwafS and SwafS-type activities in Horizon Europe and supporting newcomers to citizen science activities notably as a result of mainstreaming citizen science in Horizon Europe. This can be done through raising public awareness of citizen science, and the delivery of training to citizen scientists (or potential science practitioners).

Horizon Europe missions & citizen science: Missions, constituted under Horizon Europe, provide a unique opportunity to test and refine mechanisms for consulting and engaging with citizens. Use of citizens' engagement for the definition and implementation of missions under Horizon Europe is crucial. Effective citizen engagement involves three stages of intervention: communication and awareness raising; co-design and co-creation; and co-implementation. Awareness raising on the missions concept is key for the other stages to be successfully deployed. Toolkits highlighted in the achievements sections may be useful resources to develop these missions.

Going local by making the most of cascading grants: Horizon 2020 introduced cascading grants and these are particularly well suited to the 'doing citizen science' topic in order to identify citizen science actors at a more local level.

8. OPEN ACCESS TO PUBLICATIONS AND DATA

8.1. Policy objectives

It is widely recognised that making research results more openly accessible contributes to better science and innovation[112]. The European Commission has strived to put the EU as a front-runner in open access globally.

Since 2006, the European Commission has been developing an overall EU policy on open access, co-developed with the research and innovation communities, and has progressively introduced specific open access requirements in the EU Framework Programmes.

In 2012 in a Recommendation on access to and preservation of scientific information, revised in 2018, the European Commission encouraged all Member States to put public-funded research results in the public sphere to ensure better science and to strengthen the knowledge-based economy.

FP7 introduced requirements for beneficiaries in terms of open access. Under Horizon 2020, any peer-reviewed journal article published, stemming from a funded project, must be openly accessible, free of charge (article 29.2. Model Grant Agreement). The Commission wished to go further in terms of open access and encouraged applicants to open up the underlying data.

The Open Research Data Pilot (ORD pilot) aims to maximise access to and re-use of research data generated by Horizon 2020 projects and takes into account the need to balance openness and protection of scientific information, commercialisation and Intellectual Property Rights (IPR), privacy concerns, security as well as data management and preservation questions.

At the start of Horizon 2020, the ORD pilot covered only selected areas. Since the 2017 work programme, the Open Research Data pilot has been extended to cover all thematic areas of Horizon 2020[113], thus realising the Commission's ambition of 'open research data by default' (but allowing for opt-outs).

Looking at SwafS in particular, the work programme topics addressed text and data mining, innovative approaches to release and disseminate research results and measure their impact, training on open access and re-use of research data.

8.2. Project portfolio

Open access was addressed in four topics over the course of Horizon 2020 work programmes, resulting in 4 funded projects and their combined budget is approximately EUR 7.4 million.

[112] European Commission website for Open Science
[113] Programme Guidelines on FAIR Data Management in Horizon 2020

Fig. 27: Number of coordinators in Member States (MS)

Fig. 28: Number of other partners in Member States (MS) and Associated Countries (AC)

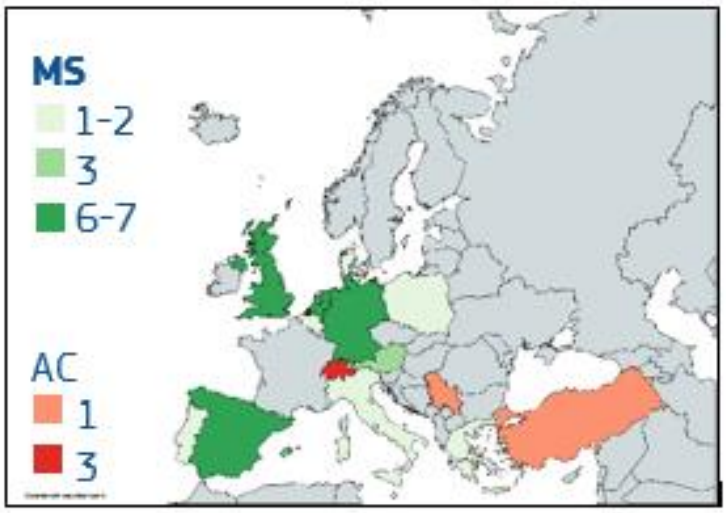

Table 16: Open access to publications and data project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
GARRI-3-2014 Scientific Information in the Digital Age: Text and Data Mining (TDM) (CSA)						
FutureTDM	1.5 M	01-09-2015 31-08-2017	SYNYO GmbH	AT	**EU:** EL, NL(3), PL, UK(3)	futuretdm.eu
GARRI-4-2015 Innovative approach to release and disseminate research results and measure their impact (CSA)						
OpenUP	2.0 M	01-06-2016 30-11-2018	VIESOJI ISTAIGA VIESOSIOS POLITIKOSIR VADYBOS INSTITUTAS	LT	**EU:** AT(2), DE(2), EL, IT, NL **AC:** CH	openuphub.eu/
SwafS-07-2016 Training on Open Science in the European Research Area (CSA)						
FOSTER+	0.9 M	01-05-2017 30-04-2019	UNIVERSIDADE DO MINHO	PT	**EU:** DE(2), DK, ES(2), NL(2), UK(3)	fosteropenscience.eu/
SwafS-04-2018 Encouraging the re-use of research data generated by publicly funded research projects (RIA)						
FAIR4Health	3.0 M	01-10-2018 30-11-2021	SERVICIO ANDALUZ DE SALUD	ES	**EU:** AT, BE, DE(2), ES(4), IT, NL, PT, UK **AC:** CH(2), RS, TR	fair4health.eu/

8.3. Achievements

'The future of science is open' is the philosophy underpinning the FOSTER+ project. Its predecessor, the successful FP7 project, FOSTER, promoted the practical implementation of open science, with activities targeting academic staff, young scientists and policy makers.

Building on the original FOSTER portal and its training resources, FOSTER+ developed more advanced, discipline-specific materials. In terms of its outreach, FOSTER+ organised 150 training events with over 5,000 attendees, more than 50 webinars involving 2,000 participants and trained more than 250 Open Science trainers.

In terms of its legacy, FOSTER+ developed a multi-module Open Science Toolkit, covering key topics such as responsible research and innovation, research data management, software carpentry, text and data mining, reproducible research and open peer review.

Open scholarship has revolutionised the way scholarly artefacts are evaluated and published, while the introduction of new technologies and media in scientific workflows has changed the "how and to whom" science is communicated, and how stakeholders interact with the scientific community.

OpenUP addressed key challenges of the transforming scientific landscape and provided innovative approaches to release and disseminate research results and measure their impact.

The most outstanding results achieved is the creation of online tools for open peer review and the toolbox of innovative dissemination tools for researchers[114].

The exponential growth of data in the digital age has led to the development of powerful techniques for effectively harnessing digital information and discovering new knowledge. In this context, Text and Data Mining[115] (TDM) enables researchers from different disciplines to analyse, extract insights and knowledge, and exploit diverse and complex datasets from various digital media. However, the present use of TDM in Europe is significantly lower than in the US and Asia, most probably due to limitations imposed by the European legal framework[116] before the modernisation of the EU Copyright Directive in 2018. In light of this, the FutureTDM project identified the barriers that inhibit the uptake of TDM by researchers and innovative businesses. FutureTDM provides critical up-to-date assessments of legal regulations and policies affecting TDM in the EU, and places them in the international research and innovation context. This approach led to developing novel policy frameworks and interdisciplinary case-driven practitioner guidelines facilitating the spread of TDM activities. The Collaborative Knowledge Base and Open Information Hub serves as reference for current and future TDM practitioners ensuring broader TDM uptake to boost Europe's research and innovation capacities.

The SwafS 2018 call focused on the need to ensure all data and metadata derived from publicly funded research is FAIR (Findable, Accessible, Interoperable and Reusable). The Fair4Health project's main objectives are in line with this challenge, aiming to facilitate and encourage the European Union's health research community to share and reuse their datasets by demonstrating the potential impact that such a strategy will have on health and social care research. Technical work is well under way on the setting up of the FAIR4Health platform, which should be available in December 2021.

8.4. Recommendations

The recommendations presented below stem primarily from the small portfolio of open access projects.

8.4.1. Policy recommendations

Researchers should be made aware of policy initiatives such as Open Innovation, Open Science, and Open to the World, the European Open Science Cloud, OpenAIRE, the FOSTER+ project, and the Open Access Button.

Research infrastructures and platforms for open access (high-speed data centres, data repositories and virtual platforms) should be promoted.

8.4.2. Recommendations for Horizon Europe

Now that the Open Research Data Pilot has been running throughout Horizon 2020, it is no longer pertinent to refer to it as a pilot. There has been some confusion on the part of applicants between opting in or out of the pilot, which is not part of the evaluation, and the management of data, which is part of the evaluation. Consequently, rather than including this as a question in part A of the proposal, this aspect could be tackled directly under the exploitation and dissemination section of the proposal template, with the appropriate guidance for applicants and the corresponding evaluation sub-criterion adapted accordingly. The evaluation sub-criterion could be phrased as: 'Quality of

[114] OpenUp website
[115] 'Text and data mining' means any automated analytical technique aimed at analysing text and data in digital form in order to generate information which includes but is not limited to patterns, trends and correlations.
[116] Christian Handke (2015) Is Europe Falling Behind in Data Mining? Copyright's Impact on Data Mining in Academic Research

proposed measures to exploit and disseminate project results including management of data and IPR where relevant'.

The lessons learned from the open access projects implemented in SwafS point towards continued efforts in terms of improving the knowledge and skills of researchers on open access matters. The Open Science Policy Platform Working Group on Rewards recommends a review of current training to include and embed open access principles. The Science Careers (see chapter 4.3.3) presents the projects funded under the topic introduced in 2019, targeting the improvement of researchers' skills on open science (encompassing open access), which should continue to be pursued under Horizon Europe.

9. SCIENCE COMMUNICATION

9.1 Policy objectives

Science communication, as a discipline in itself, is conducted by scientists and other R&I stakeholders, and is a career path followed by journalists. Science communication informs citizens about science and innovation, opens up R&I to society and facilitates citizens' participation in activities and debate.

Two concurrent developments lead to the growing need to ensure the quality and reliability of science communication: firstly, dwindling resources in science journalism lead to reduced critical assessment and reporting of science; secondly, the rapid diffusion of open access publications and science-related news through social media increase opportunities for all citizens and civil society groups to reach large audiences about science-related issues but sometimes without the editorial oversight and fact-checking established in the traditional media[117].

In 2016, the European Commission organised a Science Communication event. As conveyed in this event, there are many definitions of science communication. In essence, science communication entails presenting science related topics in a format which is designed for and understandable by the intended audience and remains faithful to the evidence.

Science communication can utilise many methods, and takes various forms including school visits, competitions, science fairs, citizen science, games, online interactive, creative arts etc. One of the main challenges science communication faces is the so-called post-truth society with the traditional intermediary (journals) often absent, granting non-experts the freedom to potentially mobilise support and engage followers online.

The challenge for effective science communication is that while scientists are very good at what they have been trained in i.e. science and research and producing research papers (dissemination), on which their performance is assessed, science communication is not part of their training or perceived as a priority.

In order to have the public on board for solutions to the challenges our society faces, there is a need to build trust also through clear and effective communication. Scientists should consider it their responsibility to make their work understandable by explaining the underlying concepts in order to have a better informed and engaged public in the world of science[118].

Through the science communication topics running from 2018 to 2020, the European Commission wishes to build a knowledge base in communicating science and improve science communication across the EU's Research and Innovation programme.

The SwafS work programme 2018-2020 took into account the results of the interim evaluation of Horizon 2020 which pointed to a need for greater outreach to civil society.

[117] SwafS work programme 2018-2020
[118] Commissioner Moedas opening address for EU SciCom event, July 2016

9.2 Project portfolio

Science Communication as a topic first appeared in SwafS work programme 2018-2020. To date, there are 6 funded projects (2020 call not included) with a combined budget of approximately EUR 7.5 million.

Fig. 29: Number of coordinators in Member States (MS)

Fig. 30: Number of other partners in Member States (MS) and Associated Countries (AC)

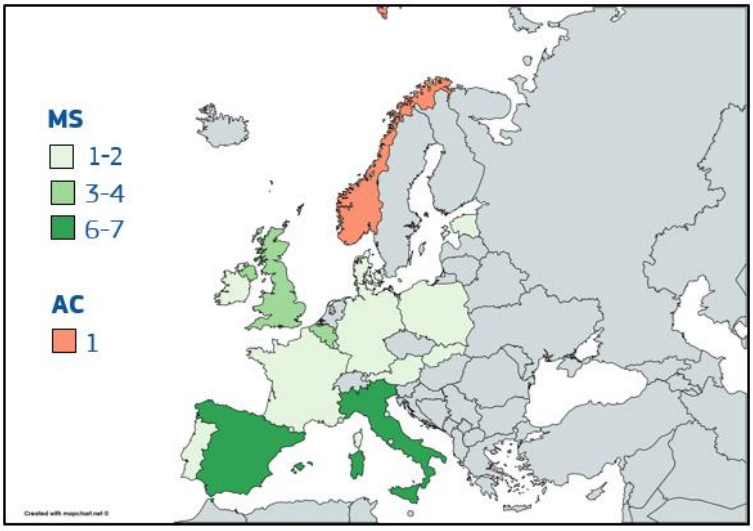

Table 17: Science Communication project portfolio

Project	Budget €	Dates	Coordinator	Country Coord.	Countries Other partners	Website
SwafS-19-2018-2019-2020 Taking stock and re-examining the role of Science Communication (RIA)						
CONCISE	1.2 M€	01-12-2018 30-11-2020	UNIVERSITAT DE VALÈNCIA	ES	**EU:** ES(3), IT, PL(2), PT, SK	concise-h2020.eu
RETHINK	1.2 M€	01-01-2019 31-12-2021	STICHTING VU	NL	**EU:** BE, DE, DK, IT, UK	rethinkscicomm.eu
QUEST	1.2 M€	01-02-2019 31-01-2021	VENICE INTERNATIONAL UNIVERSITY	IT	**EU:** EE, FR, IE, IT(2), UK **AC:** NO	questproject.eu
ParCos	1.4 M€	01-01-2020 30-12-2022	LAPPEENRANNAN–LAHDEN TEKNILLINEN YLIOPISTO	FI	**EU:** BE(2), UK	parcos-project.eu/
TRESCA	1.2 M€	01-01-2020 30-04-2022	ERASMUS UNIVERSITEIT ROTTERDAM	NL	**EU:** AT, DE, ES, IT, UK	trescaproject.eu/
NEWSERA	1.3 M€	01-01-2020 30-12-2022	SCIENCE FOR CHANGE	ES	**EU:** ES(2), IT(2), PT	cordis.europa.eu/project/id/873125

9.3 Achievements

The science communication projects commenced as recently as the end of 2018 and hence most of the achievements are still to come. In this section we explore the objectives of on-going projects and highlight some early achievements.

CONCISE aims to understand the role science communication plays on the origin of beliefs, perceptions and knowledge concerning scientific issues. Through citizen consultations in five Member States, the project will offer insights into EU citizens' information sources and how these influence their beliefs, opinions, and perceptions on four hot topics: vaccines, complementary and alternative medicine use, genetically modified organisms and climate change.

The overall objective of RETHINK is to contribute to making the European science communication ecosystem more open, inclusive, reflexive and adaptive. Its initial Scoping Report on the Science Communication Ecosystem maps the diversity of actors and the content they produce. The research conducted allows comparisons of the online science communication landscapes in different European countries (Italy, the Netherlands, the UK, Sweden, Poland, Serbia and Portugal) and has a broad focus including the work of both professional and 'alternative' science communicators.

RETHINK will produce science communication indicators, guidelines targeted at practitioners, scientists and policy makers to improve the quality of science communication, a catalogue of good practices as well as training resources notably new ways of training those who engage in science communication, including those underserved by current training – such as bloggers and social media commentators.

QUEST aims to develop tools and guidelines for communicators and practitioners working in the fields of journalism, social media, and museums to effectively communicate science. In addition, it seeks to build an engaging science communication community. Climate change, vaccines and Artificial Intelligence are used as case studies.

Quest commenced its activities by scanning the landscape of European science communication in its Report on European Science Communication today. In addition,

QUEST mapped the training opportunities in science communication. It shows that most European countries (115 courses in 18 European countries) offer science communication courses and some, such as the UK, the Netherlands, France, Italy, Ireland, Spain and Germany, where the first master's degrees on the subject were initiated, are still those with the greatest number of courses. As far as level is concerned, for the period of analysis most programmes (75) are at the master's level: only three universities, all of them in Germany, offer bachelor degrees, and four (in Austria, Spain and UK) have formal PhD programmes in science communication[119].

In 2020, three additional projects commenced: TRESCA, ParCos and NEWSERA.

TRESCA focuses on developing trust in science and innovation. The project's goals are to systematically understand what drives public trust in science communication through large scale, experimental survey research and qualitative, deliberative research. The project focuses on three areas of concern around misinformation and digital safety; environmental health; automation and the future of skills and work. TRESCA intends to develop a set of tools including an animated science communication video which will be tested in order to determine best practices for the creation of science communication videos as well as a prototype of a misinformation widget working on encrypted communication channels to help distinguish trustworthy content and sources. These tools are intended for journalists and policy makers to learn how to best facilitate reliable and trustworthy science communication.

ParCos will adopt a participatory approach to the creation of tools and methods to support citizens to take part in conducting, communicating and discussing science. The communication of stories alongside evidence will support citizens in judging the validity of evidence and interpretations with the support of ParCos tools and methods. Ultimately, ParCos aims to foster an environment where citizens demand evidence making it more difficult for the voices of those making unsubstantiated claims to be heard.

Citizen science projects sometimes involve the participation of various quadruple helix stakeholders, which can pose a challenge in terms of science communication due to: 1) the specific science communication tools and strategies to be used for each target group, and 2) the required continuous feedback to each stakeholder group to maintain their engagement throughout the project. NEWSERA will analyse and evaluate the complex science communication strategies addressed to quadruple helix stakeholders in citizen science projects across Europe. To this end, four pilot case studies will be selected from ongoing Horizon 2020 projects mapped under the EU-Citizen.Science platform. Innovative strategies will be co-designed for each stakeholder group.

To conclude on the achievements in science communication, a recent important achievement from a project presented in the Research Ethics and Research Integrity chapter (2.3.2) is of particular pertinence for science communication. The Path2Integrity project, like many other SwafS projects took part in the EUvsVirus Hackathon organised by the European Commission. This hackathon was an online event with the aim of reaching out to innovators and civil society across Europe and beyond in order to develop innovative solutions for coronavirus-related challenges. In total 2,160 innovative solutions were submitted. The 'Trust in Science' project (based on Path2Integrity) won 3rd prize in the hackathon under the 'social and political cohesion' challenge. The project is devoted to raising awareness of scientific facts and developing an online solution, reaching audiences in their native languages, to combat 'fake news' notably in the context of the coronavirus pandemic.

[119] Quest deliverable: Science communication education and training across Europe

9.4 Recommendations

The recommendations presented in this section stem from feedback provided by evaluators during the panel meetings which concluded the evaluation of the science communication proposals.

9.4.1 Policy recommendations

Science communication should be framed in terms of being a one-way or two-way process i.e. from scientists to citizens and/or vice-versa. It would be useful to identify the targets for science communication, whether this is citizens in general or all quadruple helix stakeholders.

9.4.2 Recommendations for Horizon Europe

A future topic on science communication should consider a comparative international analysis to assess how Europe can learn from other countries in terms of augmenting trust in science and scientists.

While the topics to date have been focused on increasing the knowledge base, to complement this effort, a future science communication topic should focus on awareness raising, synthesising findings and good practice, sharing tools, and networking efforts in the spirit of a Coordination and Support Action. Follow-up actions to implement pilot training on science communication could also be envisaged.

CONCLUDING REMARKS

Since 2014, the projects funded under 'Science *with and for* Society' contributed to its primary aims set out in the EU Regulation establishing Horizon 2020, notably to effectively build cooperation between science and society, recruit new talent for science and pair scientific excellence with social awareness and responsibility.[120]

One of the key ways of working towards these three SwafS objectives, and ensuring impact, is the implementation of **institutional changes** in beneficiaries. This is demonstrated by the Key Performance Indicator for Swafs being '*Percentage of research organisations funded implementing actions to promote Responsible Research and Innovation, and number of institutional change measures adopted as a result'*.[121]

The results of a sample of twelve RRI projects revealed that almost 250 individual institutional change actions are implemented or in the process of being implemented by this part of the SwafS portfolio[122].

The pioneers of institutional changes are Gender Equality projects dedicated to the implementation of Gender Equality Plans (GEPs). Out of 168 institutions involved in GEP projects, 130 institutions (78%) implemented or, are in the process of implementing a GEP.

SwafS will well and truly surpass its target of 100 institutional changes in beneficiaries by the end of Horizon 2020.

SwafS stakeholders are in an excellent position to take a leading role in supporting other entities, for example universities envisaging institutional transformation. As Commissioner Gabriel's portfolio encompasses innovation, research, culture, education and youth, exploiting synergies between research and innovation and education is particularly pertinent.

Networking is key to ensure that projects learn from each other and build on existing know-how. DG Research and Innovation and the REA organise thematic cluster events to promote networking between projects and encourage sharing of best practices. Liaising with other SwafS projects was formally encouraged in the 2018-2020 work programme which foresees the inclusion of 'additional dissemination obligations' requiring consortia to share their strategies and methodologies from the outset with a view to reaping the full benefits of synergies. This grant condition was a key element in efforts to build a knowledge and collaboration ecosystem. Project co-ordinators demonstrated strong willingness to work together.

Science Communication is key for bridging the world of researchers and citizens. Researchers need training in order to communicate their work to non-experts and the fruits of the portfolio of projects working on this field will be of widespread interest across the research and innovation community.

International cooperation is one of the priorities of Commissioner Gabriel. SwafS projects have embraced international cooperation and involve partners from around the world.

[120] Regulation (EU) No 1291/2013 of the European Parliament and of the Council establishing Horizon 2020
[121] Horizon 2020 indicators

[122] This data collection exercise did not cover projects dedicated to gender equality, ethics, or open access/open data, which, to various degrees, focus also on institutional changes.

Science Education is the basis for recruiting new talent for science. It is crucial to continue to invest in science education to nourish young curious minds and invest in Europe's future researchers. The high submission rate of proposals throughout Horizon 2020 convey the research community's strong interest in this domain.

Integration services offered by the pan-European network of EURAXESS support centres for researchers' **careers** and their families is an investment in the R&I system and a key enabler of brain and knowledge circulation and should be considered part of the much-needed transformations and scale-up mechanisms to ensure an inclusive, healthy and attractive work environment for excellent research in the renewed ERA.

Gender Equality, enshrined as one of the key priorities of the ERA with a clear commitment from the von der Leyen Commission reinforces the growing importance attached to the Gender Equality Plans (GEPs). GEPs have been a pioneering tool towards institutional change and with Horizon Europe, the aim is to achieve sustainable impact and a multiplier effect.

Research Ethics and Research Integrity are fundamental to the credibility of researchers work. Horizon 2020 achievements include establishing a research ethics and research integrity community, developing frameworks and operating procedures as well as training. Horizon Europe needs to build on this solid base to ensure ethics and integrity are part of the research approach from the outset.

Open access to research outputs contributes to better science and innovation. Continued efforts are needed in terms of improving the knowledge and skills of researchers on open access matters.

Engaging citizens is a priority across the European Commission and a key component of Horizon Europe. Missions, constituted under Horizon Europe, provide a unique opportunity to test and refine mechanisms for consulting and engaging with citizens. Use of citizens' engagement for the definition and implementation of missions under Horizon Europe is crucial. Effective citizen engagement involves three stages of intervention: communication and awareness raising; co-design and co-creation; and co-implementation.

Toolkits and guidelines produced by SwafS funded projects will be useful resources to effectively implement these missions. In the near future, the EU-Citizen.Science platform will serve as the reference point for tools and guidelines, promising practices and training modules on citizen science. The COVID-19 pandemic, which came to the fore in March 2020 with Member States going into lockdown, resulting in citizens across the EU being obliged to stay at home, there was an imminent need for effective online tools. Many SwafS projects adopted contingency measures including moving from physical to virtual events and online activities.

Inclusiveness on all levels underpins SwafS. We need science education for all, gender equality in our organisations, ethics and integrity embedded in research, communication we can trust, open science and ultimately place citizens at the core to ensure excellent Research and Innovation to tackle the challenges of today for a better future.

GLOSSARY

AI: Artificial Intelligence

AM: Additive manufacturing

CoP: Communities of Practice

CSA: Coordination and Support Action

CSO: Civil Society Organisation

DG: Directorate-General

DG CNECT: DG Communications Networks, Content and Technology

DG DEFIS: DG Defence Industry and Space

DG ENV: DG Environment

DG GROW: DG Internal Market, Industry, Entrepreneurship and SMEs

DG HOME: DG Migration and Home Affairs

DG JUST: DG Justice and Consumers

DG R&I: DG Research and Innovation

DG SANCO: DG Health and Food Safety

DIY: Do-It-Yourself

EC: European Commission

EcoC: European Code of Conduct for Research Integrity

EDPS: European Data Protection Supervisor

EEA: European Economic Area

EFA: European Free Alliance

EIGE: European Institute for Gender Equality

ERA: European Research Area

ERDF: European Regional Development Fund

ESA: European Space Agency

ESF: European Social Fund

FAIR: Findable, Accessible, Interoperable, Reusable

FP: Framework Programme

GA: Grant Agreement

GDPR: General Data Protection Regulation

GE: Gender Equality

GEAR: Gender Equality in Academia and Research

GEP: Gender Equality Plan

H2020: Horizon 2020

HEI: Higher Education Institutes

HRS4R: Human Resources Strategy for Researchers

IA: Innovation Action

ICT: Information and Communication Technology
IPR: Intellectual Property Rights
IST: Information System Technology
KSP: Knowledge Sharing Platform
MEP: Members of European Parliament
MOOC: Massive Open Online Course
NGO: Non-Governmental Organisation
OR: Outermost Regions
ORD: Open Research Data pilot
OSPP: Open Science Policy Platform
PV: Photovoltaic
R&I: Research and Innovation
RE: Research Ethics
REA: Research Executive Agency
REC: Research Ethics Committee
RFO: Research Funding Organisation
RFPO: Research Funding and Performing Organisation
RI: Research Integrity
RIA: Research and Innovation Action
RIO: Research Integrity Office
RIS3: Research and innovation strategies for smart specialisation
RPO: Research Performing Organisation
RRI: Responsible Research and Innovation
S&S: Science and Society
SDG: Sustainable Development Goal
SiS: Science in Society
SoP: Standard Operating Procedures
SSH: Social Sciences and Humanities
STEAM: Science, Technology, Engineering, Art and Mathematics
STEM: Science, Technology, Engineering and Mathematics
SwafS: Science with and for Society
TDM: Text and Data Mining
TDS: Talent Development Suite
WP: Work Programme

LIST OF COUNTRY CODES

AL	Albania	**IS**	Iceland
AR	Argentina	**IT**	Italy
AT	Austria	**JM**	Jamaica
AU	Australia	**JP**	Japan
BA	Bosnia and Herzegovina	**KE**	Kenya
BE	Belgium	**KR**	Republic of Korea
BG	Bulgaria	**LB**	Lebanon
BO	Bolivia	**LI**	Liechtenstein
BR	Brazil	**LT**	Lithuania
BY	Belarus	**LU**	Luxembourg
CA	Canada	**LV**	Latvia
CH	Switzerland	**MA**	Morocco
CL	Chile	**MD**	Republic of Moldova
CN	China	**ME**	Montenegro
CO	Colombia	**MK**	North Macedonia
CR	Costa Rica	**MT**	Malta
CY	Cyprus	**MX**	Mexico
CZ	Czechia	**NL**	Netherlands
DE	Germany	**NO**	Norway
DK	Denmark	**PL**	Poland
EE	Estonia	**PT**	Portugal
EL	Greece	**RO**	Romania
ES	Spain	**RS**	Serbia
FI	Finland	**SE**	Sweden
FO	Faroe Islands	**SI**	Slovenia
FR	France	**SK**	Slovakia
GE	Georgia	**TN**	Tunisia
GH	Ghana	**TR**	Turkey
HR	Croatia	**UA**	Ukraine
HU	Hungary	**UG**	Uganda
IE	Ireland	**UK**	United Kingdom
IL	Israel	**US**	USA
IN	India	**ZA**	South Africa

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