D4.1: Diagnosis: RRI in Societal Challenges

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1. Overview

Deliverable 4.1 presents, summarizes and analyses the results of the first phase of project research, covering the Societal Challenges priority of H2020. The diagnosis phase of the project included two intertwined tasks. First, to analyse the specifics of the current use and practices of RRI within these programme lines, and second, to identify and recruit stakeholders to the seven programmes of H2020 into Social Labs (SL). While future deliverables will report on interactions with participants of and pilots co-developed in SLs, Deliverable 4.1 presents an overview of the current state and examples of RRI and Open Agenda activities in this major H2020 pillar.

2. Introduction

Responsible Research and Innovation in European Research and Innovation[1]

Research and innovation (R&I) contribute directly and indirectly to many beneficial advances in how we live and how we support our societies. Indeed, R&I feature centrally in the European strategy for smart, sustainable, and inclusive growth (EC 2010c). At the same time, scientific and technological developments resulting from R&I contribute to undesirable or unsustainable impacts in our lives, societies, and the environment Evidence of unequal benefits and burdens of R&I are visible in many spheres of our daily lives, be it transportation systems, agriculture, health care, water or energy systems.

The European Commission (EC) supports R&I to expand the scientific and technological base of the European economy and industry, fostering broader benefits for society and tackling pressing societal challenges, while also upholding European values of inclusiveness and democratic politics (EC 2013b). One of the tactics taken by the EC to create and disseminate socially and economically beneficial knowledge and drive prosperity and social benefit has been to include cross-cutting requirements into its multi-year, large-scale research framework programmes - most recently Horizon 2020 (H2020) (EC 2013b).

One of these cross-cutting requirements is the concept of Responsible Research and Innovation (RRI) (EC 2013b). RRI activities try to strengthen the ways groups of people think about and respond new opportunities. In practice, this means drawing on more diverse ways of understanding and addressing problems, sharing knowledge, and empowering people to learn and work together. A central aspiration of RRI is to contribute to excellent science and innovation for socially desirable, economically vibrant, and sustainable societies (EC 2014). For the Commission, this means, in particular, focusing on:

- **Gender equality**, including gender balance of R&I teams, and accounting for gender dimensions of R&I projects;

[1] The following two sections are based on a common introductory text used in the NewHoRRIzon deliverables D2.1, D3.1 and D5.1.

- **Public engagement**, envisioned as a two-way communication and learning process to include in R&I industry and SME, policymakers, non-governmental organisations (NGOs), civil society organisations (CSOs), and citizens would not normally interact with each other, on matters of science and technology;
- **Science education and science literacy**, to nurture modes of scientific inquiry, curiosity, and creativity;
- **Open access and Open Science**, to make data and results of research more accessible, earlier to improve R&I;
- **Ethics**, going beyond legal compliance and researcher integrity to include also reflection on questions of how R&I do and do not relate or respond to societal challenges and standards;
- **Governance**, to ensure effective, inclusive, and sustainable ways of co-designing agendas and activities to achieve the above and broader objectives of European R&I.

More recently, the Commission has made additional commitments to Open Science, Open Innovation, and Open to the World (EC 2016) as part of its continued prioritization of fostering alignment among science and society. The EC Open Agenda describes these dimensions, respectively, as:

- **Open Innovation** — “co-creation” that unfolds across innovation ecosystems and requires knowledge exchange and innovation capacity of all actors involved, be they financial institutions, public authorities or citizens, businesses, or academia (EC 2016, p.12).
- **Open Science** — a concept of transformed scientific practice, wherein the foci of researcher activity shifts from “publishing as fast as possible” to “sharing knowledge as early as possible,” in manners that are accessible to as many parts of the innovation ecosystem as possible (EC 2016, p. 34).
- **Open to the World** — "Fostering international cooperation in research and innovation” to enable access to “the latest knowledge and the best talent worldwide, tackle global societal challenges more effectively, create business opportunities in new and emerging markets, and use science diplomacy as an influential instrument of external policy” (EC 2016, p. 59).

The NewHoRRIzon Project

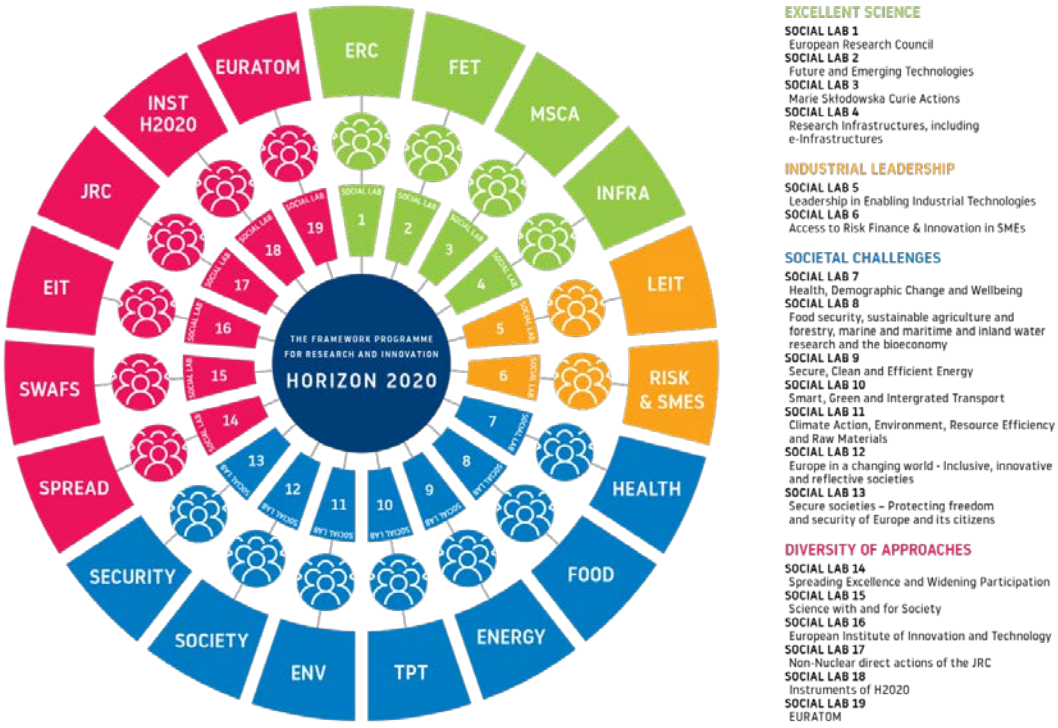
The NewHoRRIzon project (European Commission Grant Agreement No 741402) seeks to promote strong integration of responsible research and innovation and Open Agenda approaches into national and international research and innovation funding. To do so, we are engaging a wide-ranging group of R&I stakeholders from across Horizon 2020 programming and co-creating tailor-made “pilot actions,” based on key needs of European and national research and innovation funding programmes related to RRI and the Open Agenda. Our specific objectives include:

- bringing together different stakeholders to co-create social experiments that foster the uptake of RRI;
- developing narratives and storylines on how to implement RRI;
- providing recommendations on how to better integrate RRI into the next European Framework Programme and beyond;
- raising awareness, mainstream best practices and share NewHoRRIzon results;

- developing and disseminate a concept of Societal Readiness Levels (SRL) of technology, and;
- creating a sustainable RRI Network and RRI Ambassador Programme.

To achieve these objectives NewHoRRIzon has organized 19 Social Labs, where interventions will be co-created for pilot implementation, evaluation and cross-sector learning, one for each Horizon 2020 programme line (see Figure 1). Social Labs build on a tradition of participatory action research to bring together people with common interests in solving complex problems related to technology and society. Inviting people with a range of expertise from all across society, the labs will be creative, engaging spaces for collaborative experimentation. Every Social Lab hosts three workshops and a series of smaller additional activities and meeting formats. Participants have the opportunity to co-create, prototype and test pilot actions and activities to support RRI. In addition, selected participants of each Social Lab are invited to cross-sectional exchange workshops after the second and third series of Social Lab workshops.

Figure 1: NewHoRRIzon Social Labs



NewHoRRIzon Deliverable 4.1

Deliverable 4.1 presents, summarizes and analyses the results of the first phase of project research, covering the Societal Challenges priority of H2020. The diagnosis phase of the project included two intertwined tasks. First, to analyse the specifics of the current use and practices of RRI within this programme line, and second, to identify and recruit stakeholders to the seven programmes of H2020 into social labs. While future deliverables will report on interactions with

participants of and pilots co-developed in social labs, Deliverable 4.1 presents an overview of the current state, enablers, barriers, and examples of RRI and Open Agenda activities.

NewHoRRIzon Social Labs devoted to the Societal Challenges priority prepared the following diagnosis reports, each available in the Annexes to this deliverable:

- NewHoRRIzon Diagnosis Report, Social Lab 7, Health, Demographic Change and Well-Being / Societal Challenge (SC) 1 **HEALTH** (Kerstin Goos and Tanja Bratan)
- NewHoRRIzon Diagnosis Report, Social Lab 8, Food Security, Sustainable Agriculture, Marine and Maritime and Inland Water Research and the Bioeconomy / SC 2 **FOOD** (Michael J. Bernstein)
- NewHoRRIzon Diagnosis Report, Social Lab 9, Secure, Clean and Efficient Energy / SC 3 **ENERGY** (Maria Schrammel and Lisa Marie Seebacher)
- NewHoRRIzon Diagnosis Report, Social Lab 10, Smart, Green and Integrated Transport / SC 4 **TRANSPORT** (Matthias Allinger and Robert Braun)
- NewHoRRIzon Diagnosis Report, Social Lab 11, Climate Action, Environment, Resource Efficiency and Raw Materials / SC 5 **ENVIRONMENT** (Ulrike Wunderle and Tessa Tumbrägel)
- NewHoRRIzon Diagnosis Report, Social Lab 12, Europe in a Changing World - Inclusive, Innovative and Reflective Societies / SC 6 **SOCIETY** (Robert Gianni)
- NewHoRRIzon Diagnosis Report, Social Lab 13, Secure Societies - Protecting Freedom and Security of Europe and its Citizens / SC 7 **SECURITY** (Janika Tyynelä, Mika Nieminen and Veikko Ikonen)

Material presented in Deliverable 4.1 is synthesized from the above reports. Each report draws information, evidence, examples, and experiences from a range of documents and interviews, the methodologies of which are presented in each diagnosis report. In general, desktop research began with investigation of the founding regulation of Horizon 2020 (EC 2013b), and narrowed to scoping documents of H2020, the European Commission Interim Evaluation of Horizon 2020, and general Annexes to each H2020 Work Programme, and the specific Work Programme texts for the seven Societal Challenges programme lines. Supplementary inputs were gathered from the European Commission's online research manual (various proposal templates, ethics guidelines, gender FAQs, proposal templates and evaluation guidance, etc.), Commission documents, and broader academic literature. Project-level information for case studies was gathered from periodic project reports submitted by projects (available on the EC CORDIS website), as well as by reviewing project websites and publicly accessible deliverables.

In addition to desktop research, a total of 73, 45- to 60-minute interviews were conducted with various stakeholders of and participants in the Societal Challenges funding lines. Interviews were semi-structured, applying an interview protocol developed by the NewHoRRIzon Consortium as a point of departure. In most cases, interviews were recorded for future reference in order to validate findings and quotations indicated as important, but not transcribed; notes were taken in the course of the interviews to guide subsequent review and analysis. All interviews were conducted with informed consent of participants, in accordance with the General Data Protection Regulation, EU Regulation 2016/679 (GDPR), using a consent form reviewed and approved by the Norwegian Centre for Research Data.

2.1 Putting Societal Challenges into perspective

During the last ten to 15 years, science, technology and innovation (STI) policies are increasingly being designed to address and solve so-called (Grand) Societal Challenges. This "normative turn" (Daimer et al. 2012) complements the conventional focus of STI policies on economic growth and competiveness with *directionality* (Kallerud et al. 2013; Lindner et al. 2016). In Europe, a key manifestation of this strategic re-orientation was the adoption of the Lund Declaration in 2009 (Kooperation International 2009). And in 2015, the Lund Declaration was revisited, thereby renewing the calls for increased efforts to direct research and innovation towards societal benefits (ERA 2015). It clearly can be observed that STI policies have taken significant steps to focus more on society's major challenges instead of concentrating on the improvement of generic qualities of the research and innovation systems. Well known examples for this paradigm-shift as reflected by high-level policy strategies are the EU's Europe 2020 Strategy, the US Strategy for American innovation or Germany's Hightech Strategy.

Societal Challenges (or Grand Challenges) such as health, food security, or climate change can be understood as broad and highly complex "missions". However, in contrast to the old, technology-driven missions such as the Apollo-Programme, Societal Challenges are characterized by open-endedness, ambiguity, and undetermined outcomes (Foray et al. 2012). The Challenges' objectives tend to be unspecific, open-ended, universal and are formulated rather abstract. They cut across established technological fields and sectors, often encompassing whole socio-economic systems, requiring transdisciplinary knowledge from various fields. Non-conventional forms of innovation, such as social and user-driven innovation, gain importance. In addition, they reach beyond territorial boundaries and interact with international/global developments. Most importantly, addressing Societal Challenges requires system transformation or system innovation (OECD 2015).

Societal Challenges reflect the problem definitions and framings of influential actor coalitions and are a result of debate, negotiations and conflicting interests. As such, challenge definitions are continuously evolving constructs, adjusting to changing perceptions, shifting power relations and new evidence with regard to socio-economic framework conditions. Given the plurality of values and interests, definitions and particularly concretisations of Societal Challenges will more often than not be controversial and contested (Kuhlmann and Rip 2018).

Turning to the European Union's eighth and current Framework Programme for Research and Technological Development "Horizon 2020" (EC 2011c), the growing importance of addressing societal challenges by the means of research and innovation is clearly reflected. In the European Commission's presentation material informing about Horizon 2020, Societal Challenges prominently feature as one of the programme's three main pillars next to excellent science and industrial leadership.[2] The high strategic priority assigned to addressing Societal Challenges is echoed by the budget allocated to this area for the period 2013-2020: 29.7 billion Euro or 38.5% of the total H2020 budget (roughly 77 billion Euro) have been earmarked for funding research and innovation projects in the seven societal challenges (EC 2013a). Thus, Societal Challenges

[2] See, for instance: https://ec.europa.eu/programmes/horizon2020/what-horizon-2020 (accessed 16.09.2018)

receive the single largest share within the H2020 budget, followed by excellence science (31.7%) and industrial leadership (22.1%) (EC 2013a).

The relationship between Societal Challenges in H2020 and RRI is rather indirect. Arguably, the general aim of generating socially desired impact by the means of research and innovation is a shared ambition of both the RRI discourse and the Societal Challenges funding line. However, explicit references to RRI in the section on Societal Challenges in the EC regulation on H2020 are absent. One of the objectives of this deliverable is to uncover the role of RRI, or variations of "de facto rri"[3] in the seven Societal Challenges funding lines of H2020.

2.2 Overview of the seven funding programmes

As outlined previously, the third pillar of H2020 focuses on seven Societal Challenges (SC). In the following, the seven individual programme lines and the corresponding NewHoRRIzon Social Labs (SLs) will be briefly outlined. Key information on budget allocation, number of proposals and projects funded are presented in Table 1.

SC1 - Social Lab 7: Health, demographic change and wellbeing:
According to H2020, Europe is facing five main health and wellbeing related challenges:

i. the rising health and care costs, mainly because of the ageing population having more risk to get chronic diseases and therefore requiring more diversified care which ultimately increase societal demands;
ii. the impact of environmental factors, such as climate change, increasing CO_2 emission in the air, etc., on health;
iii. the increasing threat to lose capability to protect the populations against various type of infectious diseases;
iv. the exploitation of 'Superweed Effect' (Moore 2010): i.e. glyphosate-resistant weeds, spiraling antibiotic resistance, etc.
v. (iv) health inequalities and access to health and care. Europe must invest in research, technology and innovation to develop smart, scalable and sustainable solutions that will overcome those challenges. Europe must work with other global actors and must grasp every opportunity for leadership.

Responding to the societal challenge "Health, Demographic Change and Wellbeing", "*research and innovation (R&I) under Horizon 2020 is an investment in better health for all. It aims to keep older people active and independent for longer and supports the development of new, safer and more effective interventions. R&I under Horizon 2020 also contributes to the sustainability of health and care systems* (EC 2018a).

[3] *De facto rri* is understood as those practices and processes that actors already conduct with the aim pursuing interpretations of what it means to be responsible in research and innovation. Thus, *de facto rri* is not consciously inspired and informed by the EC policy framework of Responsible Research and Innovation (Randles 2016: 32).

The HEALTH programme tries to tackle the above identified challenges by framing funding of health research as an investment in better health for all, in a healthy workforce, a healthy economy and lower public health bills (EC 2018a). As such, the SC1 main policy objectives are to improve health and well-being outcomes, to promote active and healthy aging, to promote a more competitive European health industry and care sector, to maximise the digital potential and to promote the EU as a global leader in the health area.

In 17% of SC1 projects, citizens, CSOs and other societal actors, as representatives of patients or users, contribute to the co-creation of scientific agendas, and thereby, influence the project's design.
For example, H2020 has taken the leadership via Societal Challenge 1 to establish the Global Research Collaboration for Infectious Disease Preparedness (GloPID-R) that links research funders, the scientific community, industry, patient groups and public health actors. The main aim of this collaboration is to construct research capacity so that an effective research response can be established within 48 hours of an outbreak (EC 2017a).

Horizon 2020 offers funding opportunities with respect to diverse health research needs: fellowships, grants for individual or large collaborative public-private consortiums and loan schemes. As such, SC1 takes advantage of all H2020 instruments such as Research and Innovation Actions (RIA), Innovation Actions (IA), Coordination and Support Actions (CSA), Innovation Procurement (Pre-Commercial Procurement PCP, and Public Procurement of Innovation Solutions PPI), SME instrument, public-private partnerships, prizes and loans (InnovFin Infectious Diseases) (EC 2018b).

The type of research should be solution oriented and influence the development of new medical interventions and of evidence-based healthcare guidelines, policies and regulations. Furthermore, it should stimulate the entire health research and innovation cycle, from bench to bedside and the rapid transfer of knowledge (EC 2015a).

The main strategic orientations are as follows (EC 2015a):

1. To create a systemic change in health by promoting personalised health and care research.
2. To foster a stronger European healthcare industry supported by partnerships and innovative financial instruments.
3. To strengthen health research capacities and innovation strategies across all Member States.
4. To make the EU a stronger global player in healthcare research by funding Public Partnerships on "European and Developing Countries clinical Trials Partnership", the "Global Research Collaboration for Infectious Disease Preparedness" and programme-level cooperation schemes with third countries.

SC2 - Social Lab 8: Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy

The FOOD programme is directed to support and connect to a range of broader European Union policy initiatives. These policies include: the Common Agriculture Policy (in particular the Rural

Development Policy); a range of Joint Programming Initiatives, including Agriculture, Food Security and Climate Change, A Healthy Diet for a Healthy Life, and Healthy and Productive Seas and Oceans; the Strategy for a Resource Efficient Europe; the European Innovation Partnership on Agricultural Productivity and Sustainability and the European Innovation Partnership on Water; the Common Fisheries Policy1; the Integrated Maritime Policy; the European Climate Change Programme; the Water Framework Directive; the Marine Strategy Framework Directive; the EU Forestry Action Plan; the Soil Thematic Strategy; the Union's 2020 Biodiversity Strategy; the Strategic Energy Technology Plan (EC 2013b, L 347/150).

The FOOD programme line was originally divided among four thematic areas, each with a range of priorities related to the goal of food security: sustainable agriculture, marine and maritime research, and the bioeconomy (EC 2011c: 54):

a) Sustainable agriculture and forestry; increasing productivity and resource efficiency of agriculture

This priority area calls for multi-disciplinary collaborations on use of “precision technologies and ecological intensification approaches”, as well as genetic “improvement” through conventional and modern breeding approaches. In this field, soil management and rural community development are priority as well as eradication of animal diseases and broader concerns for animal welfare. Ecosystem service approaches to the provision of public goods are also emphasized, as is the important need for agricultural management to help with greenhouse gas mitigation and adaptation to climate change impacts.

b) Sustainable and competitive agri-food sector for a safe and healthy diet

This priority area includes calls for safe and healthy food, based on studies spanning the food chain and services sectors, regardless of organic source. The priority quite explicitly emphasizes more efficient food processing transport and distribution, referencing a larger goal of reducing waste by 50% by 2030, as well as water and energy consumption associated with food production. Concerns associated with the social dimensions of consumer choices and preferences are also included, along with a range of areas related to healthy and safe foods, including food safety, standards, consumer trust and protection, risk communication, contamination exposure, assessment, monitoring, control and tracing.

c) Unlocking the potential of aquatic living resources

Priorities in aquatic areas include: research on drivers of marine ecosystem health and productivity, impact of fisheries on these ecosystems strengthening knowledge and technology related to domestication and aquaculture farming, as well as sustainable production in land, coastal, and offshore areas.

d) Sustainable and competitive bio-based industries and supporting the development of the European bioeconomy

The field places emphasis on transitioning to bio-fuel, building biomass supply streams and biorefineries, supporting bio-based projects; exploring trade-offs of biomass use; minimizing environmental impacts; development of consumer and industrial applications; maximizing economic value; and developing value adds to bioenergy, biofuels, biproducts, bio-waste. This programmatic

priority is especially focused on bringing such value to Europe through application and commercialisation.

A great number of SC2 projects implement the multi-stakeholder approach, where end-users and practitioners are involved during all phases of project activities with their entrepreneurial skills and practical knowledge to develop innovative solutions.
SC2 flagship projects are expected to create direct and indirect employment in EU's lagging regions. For example, the FIRST2RUN project integrates biorefinery which is expected to invigorate local economies across Europe by re-converting old industrial sites and creating skilled jobs.

SC3 - Social Lab 9: Secure, clean and efficient energy
SC3 is structured around the following seven specific objectives and research areas:

- Reducing energy consumption and carbon footprint
- Low-cost, low-carbon electricity supply
- Alternative fuels and mobile energy sources
- A single, smart European electricity grid
- New knowledge and technologies
- Robust decision making and public engagement
- Market uptake of energy and ICT innovation

The ENERGY Work Programme of 2016-2017 defines the three main priorities in two focus areas: "Energy Efficiency and Competitive Low-Carbon Energy" and “Smart and Sustainable Cities”. This programme covers the full innovation cycle (from proof of concept to market uptake). The follow-up work programme of 2018-2020 puts a stronger focus on digitisation as a driver of energy-transformation and introduces a range of financial incentives to steer innovative action and scientific collaboration. The work programmes exhibit an RRI-themed approach as they aim at a broader engagement of stakeholders by including citizens and communities in more significant roles.

The Work Programme Secure, Clean and Efficient Energy puts emphasis on enabling the participation of consumers in the energy transition and improving the efficiency of the energy system, especially as regards the building stock and developing the next generation of renewable energy technologies and their integration in the energy system” (EC 2017b: 9).

Activities funded under SC3 are also expected to have an impact on the implementation of the UN Sustainable Development Goals (UNDP 2015) (SDGs). The main goals addressed are SDG 7 “Ensure access to affordable, reliable, sustainable and modern energy for all”, SDG 11 "Make cities inclusive, safe, resilient and sustainable" and SDG 13 “Take urgent action to combat climate change and its impacts”. Another main goal is the Paris agreement, adopted at the 21st Conference of the Parties in Paris of 12th of December 2015 (COP21 2015).

A number of SC3 projects enable the active participation of citizens in the energy system, e.g. through the development and deployment of advanced ICT tools and services and promoting the role of prosumers (e.g. in smart grids). The dimension of Ethics is explicitly tackled in the Work Programme of 2016-2017.

While it can be argued that SC3 is inherently supports key ambitions of RRI since it aims directly at addressing society's needs. Among the key dimensions of RRI, public engagement features most prominently, followed by Ethics, which at least was explicitly mentioned in the Work Programme of 2016-2017. On call level, however, RRI is not reflected as a holistic concept. Instead, single keys are addressed to some degree, but not in a broad and comprehensive way. Calls with a strong focus on technology development show no awareness at all compared to user/consumer oriented calls, which tend to show at least some awareness of RRI ambitions.

SC4 - Social Lab 10: Smart, green and integrated transport:
In general, SC4 has a two-fold aim: addressing key challenges that Europe faces, and making our industry more competitive and cooperative through transferring these solutions and standards worldwide, as other regions are confronted with similar challenges' (EC 2017c: 8). Furthermore, it aims to boost the competitiveness of the European transport industries and achieve a European transport system that is resource-efficient, climate-and-environmentally-friendly, safe and seamless for the benefit of all citizens, the economy and society. There are a number of mobility-related problems to be mentioned such as congestion, road safety and atmospheric pollution (EC 2014: 13). In order to deal with these problems, the SC4 programme targets:

- Resource efficient transport that respects the environment.
- Better mobility, less congestion, more safety and security.
- Global leadership for the European transport industry.
- Socio-economic and behavioural research and forward looking activities for policy making.

The contents of the work programmes are also in line with the major EU policy orientations such as 'Europe 2020 – A strategy for smart, sustainable and inclusive growth' (EC 2010a), including the 'Innovation Union' flagship initiative (EC 2011b), 'White Paper – Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' and 'A 2030 framework for climate and energy policies' (European Council 2014) and 'An Integrated Industrial Policy for the Globalisation Era' (EC 2010b).

Both Work Programmes 2014-2015 (EC 2015b: 89) and 2016-2017 (EC 2017c: 114) mention that the "European sector must have the capacity to deliver the best products and services, in a time and cost efficient manner, in order to preserve its leadership and create new jobs, as well as to tackle the environmental and mobility defies". The role of SMEs both in the work programme 2014-2015 (p. 89) and 2016-2017 (p. 114) is seen as critical, as they are 'key players in the supply chains' and are 'pivotal for delivering the innovations needed for greater sustainable and smarter mobility, better accessibility and logistics serving business and citizens, and this higher economic growth' (EC 2017c: 114).

At the level of individual calls, the RRI key dimensions are not explicitly mentioned. On the project level, so far only the Mobility4EU project[4] brings the civil society and transport stakeholders together for the co-design activities.

[4] https://www.mobility4eu.eu/ (accessed 02.09.2018)

SC5 - Social Lab 11: Climate action, environment, resource efficiency and raw materials:
The goal of the SC5 funding line is to empower citizens, give them the tools to measure and share, through apps, environmental parameters like air quality, noise, alien invasive species, etc. – in collaboration with a very active European Citizen Science Association (ECSA). The SC5 programme covers (i) Climate Action, (ii) Cultural Heritage, (iii) Earth Observations, (iv) Nature-based Solutions, and (v) Systemic Eco-Innovation activities. The activities are planned to be " the activities from research to market, including: R&D projects, applications of key technologies (e.g. ICT, bio, nano), pilot and demonstration projects, market uptake and replication projects, public procurement of innovative products, processes and services, appropriate support for standardisation and regulatory activities as well as innovation inducement prizes." (EC 2011c: 34). Right from the beginning, these societal challenges had a strong focus on maximizing impact with a "strict focus on a limited number of major challenges that "speak" to the citizen.

The SC5 programme intends to achieve:

- a resource – and water – efficient and climate change resilient economy and society,
- the protection and sustainable management of natural resources and ecosystems, and,
- a sustainable supply and use of raw materials, in order to meet the needs of a growing global population within the sustainable limits of the planet's natural resources and eco-systems.

SC5 objectives are well integrated in the overall strategy of H2020 and the objective with tackling the grand challenges. They will ensure environmental integrity, resilience and sustainability together with the aim of reducing the global warming level below 2° C and enabling ecosystems and society to adapt to climate change and other environmental changes (EC 2018c).

SC6 - Social Lab 12: Europe in a changing world - inclusive, innovative and reflective societies:

The program has a general scope to help increasing integration amongst European communities through the awareness of the differences, changes at the global level and future possibilities. The SC6 addresses three main temporal lapses. Firstly, by looking at the past and at European's heritage(s). Secondly, by responding to present, urgent matters such as migration and social integration. Thirdly, by addressing the changes at the global level requiring innovative solutions for the future.

EU research and innovation will address social exclusion, discriminations and various forms of inequalities. It will explore new forms of innovation and strengthen the evidence base for the Innovation Union, the European Research Area and other relevant EU policies. It will promote coherent and effective cooperation with third countries. Finally, it will address the issues of memories, identities, tolerance and cultural heritage.

In short, SC6 aims at fostering a greater understanding of Europe, by providing solutions and support inclusive, innovative and reflective European societies with an innovative public sector in a context of unprecedented transformations and growing global interdependencies.

The Work Programme 2014-2015 focuses on

- New ideas, strategies and governance structures for overcoming the crisis in Europe
- The young generation in an innovative, inclusive and sustainable Europe
- Reflective societies
- Europe as a global actor
- New forms of innovation in the public sector, open government, business model innovation, social innovation community, ICT for learning and inclusion

The Work Programme 2016-2017 tackles four major challenges currently faced by the European Union:

- Economic recovery and inclusive and sustainable long-term growth with focus on co-creation for growth and inclusion
- Reversing inequalities in Europe
- The global environment in which the EU operates is constantly evolving.
- A better understanding of Europe's cultural and social diversity and of its past will inform the reflection about present problems and help to find solutions for shaping Europe's future.

The aim of the Work Programme 2018-2020 for SC6 is to address the concerns of the European citizens regarding migration, the fourth industrial revolution and the challenges of governance by providing objective scientific elements of assessment regarding these phenomena and formulating elaborate policy options or applicable solutions in order to help better tackle these complex issues and inform citizens objectively.

To accommodate evolving priorities, the work programme has been designed in a flexible way, in order to respond to pressing societal challenges and needs, and further generating possible cross-cutting social impact. This is well illustrated firstly in Call 1, where a new research agenda on migration will support the need for global governance systems with a solid research generated evidence base. Secondly, while the first three years of the SC6 work programme emphasized the aftermath of the economic and social crisis, this work programme focuses on the future of work. It emphasizes the technological transformations and the knowledge and digital driven economy that will shape human productivity, and that will require new learning and training models as well as extensive reorientations of the economic system (collaborative economy, smart specialization, disruptive innovations, etc.). Finally, the current work programme includes topics on radical ideologies and societal polarization, which take into account changing European and international geopolitical realities.

SC6 projects intend to reach specific stakeholders as well as the general users with web-based platforms, social media and communication resources. For example, the Dandelion project makes efforts to support the appraisement of research in inclusive, innovative and reflective societies and improve dissemination activities with regard to citizens, policymakers, academia and the media.

SC7 - Social Lab 13: Secure societies protecting freedom and security of Europe and its citizens:

SC7 is about protecting citizens, society and economy as well as Europe’s assets, infrastructures and services, its prosperity, political stability and well-being. In order to manage and prevent the risks that Europe are facing, it is important to develop innovative solutions (e.g. new technologies), raise

knowledge, enable the cooperation between security solution providers and users and improve the competitiveness of the European security industry (Council of the EU, 2013).

The main goals of the Secure Societies programme are:

- To enhance the resilience of our society against natural and man-made disasters, ranging from the development of new crisis management tools to communication interoperability, and to develop novel solutions for the protection of critical infrastructure;
- To fight crime and terrorism ranging from new forensic tools to protection against explosives;
- To improve border security, ranging from improved maritime border protection to supply chain security and to support the Union's external security policies including through conflict prevention and peace building and
- To provide enhanced cyber-security, ranging from secure information sharing to new assurance models. (EC 2017d).

A few SC7 projects (e.g., CITYCoP, ICT4COP, INSPEC2T, TRILLION, Unity) share the common target of engaging citizens in community policing and strengthening citizens-law enforcement relations.

Table 1 provides key data about the seven Societal Challenges programmes for the years 2014-2018 (January-May), including budget information, proposals submitted, and projects funded.

Table 1. Key information on the Seven Societal Challenge Programmes[5]

SC1 - HEALTH	***2014***	***2015***	***2016***	***2017***	***2018 (Jan-May)***
Funds allocated (EUR)	338M	1.5B	867M	613M	107M
Proposals submitted	18,864	18,916	18,981	19,012	18,333
Projects funded	83	314	205	154	22
Average EU contribution/ total cost (per project)	2.9M	3.6M	3.1M	3.2M	3.5M

[5] The table is based on the data from https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889fb83c4e21d33e/sheet/erUXRa/state/analysis (accessed 02.09.2018)

SC2 - FOOD	2014	2015	2016	2017	2018 (Jan-May)
Funds allocated (EUR)	2.8M	430M	867M	613M	395M
Proposals submitted	18,333	19,048	18,932	18,952	11,237
Projects funded	11	160	195	199	109
Average EU contribution/ total cost (per project)	2.6M	2.2M	2.5M	3.1M	3.6M

SC3 - ENERGY	2014	2015	2016	2017	2018 (Jan-May)
Funds allocated (EUR)	201M	1,320M	860M	890M	406M
Proposals submitted	19,032	18,929	19,000	18,908	18,833
Projects funded	59	318	266	225	113
Average EU contribution/ total cost (per project)	3.4M	3.0M	2.3M	2.7M	2.8M

SC4 - TPT	2014	2015	2016	2017	2018 (Jan-May)
Funds allocated (EUR)	26Mm	819M	1,450M	1,040M	301M
Proposals submitted	19,000	18,913	18,989	18,939	18,824
Projects funded	38	261	357	339	128
Average EU contribution/ total cost (per project)	0.6M	2.6M	2.2M	2.1M	2.0M

SC5 - ENV	2014	2015	2016	2017	2018 (Jan-May)
Funds allocated (EUR)	111M	392M	530M	463M	293M
Proposals submitted	18,636	19,012	18,846	18,986	19,000
Projects funded	41	154	147	131	57
Average EU contribution/ total cost (per project)	2.3M	2.5M	2.9M	2.8M	4.3M

SC6 - SOCIETY	2014	2015	2016	2017	2018 (Jan-May)
Funds allocated (EUR)	31M	128M	261M	140MM	50M
Proposals submitted	18,571	19,063	19,048	18,947	19,167
Projects funded	13	61	120	72	23
Average EU contribution/ total cost (per project)	2.2M	1.6M	1.8M	1.6M	2.1M

SC7 - SECURITY	2014	2015	2016	2017	2018 (Jan-May)
Funds allocated (EUR)	0,4M	224M	245M	227M	182M
Proposals submitted	20,000	18,837	18,837	18,750	18,696
Projects funded	6	81	81	75	43
Average EU contribution/ total cost (per project)	0,05M	2.5M	2.6M	2.7M	3.7M

3. Current situation of RRI in the seven programms

3.1 RRI as reflected by official policy documents

In this section, an overview of the status of RRI across the seven programme lines - termed as six keys, three "Os" or implicitly, e.g. termed as stakeholder engagement, other forms of "de facto RRI" - is provided. The information presented includes comparisons between the different programmes. Also, special observations that stand out compared to the other diagnoses findings are mentioned. If

provided by the individual diagnosis reports, information on the development of RRI-related aspects over time (evolutionary perspective) is presented as well.

- In the SC1 "Health, Demographic Change and Wellbeing" programme, substantial aspects of RRI are quite dominant, as it is stated by the European Commission under H2020 "*research and innovation (R&I) under Horizon 2020 is an investment in* ***better health for all****. It aims to keep older people active and independent for longer and supports the development of new, safer and more effective interventions. R&I under Horizon 2020 also contributes to the sustainability of health and care systems*. Therefore, SC1 programme reveals a high presence of qualities RRI, without explicitly using the RRI terminology ("de facto RRI"). Furthermore, the awareness for ethics, gender balance and stakeholder engagement is be highly present within the SC1 programme. As health-related issues are relevant across national borders, the international dimension -"*open to the world*"- plays a significant role in the content of the programme.

- The SC2 "Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy" programme expects to benefit from RRI and Open Agenda approaches. The programme tends towards to what the founding legislation of H2020 terms "*inclusive innovation*", supported by prioritisation of "*multi-actor approaches"* to "*ensure the necessary cross-fertilising interactions between researchers, businesses, farmers/producers, advisors and end-users*" (EC2013, L347/151). These approaches are vital to the SC2 programme to draw from diverse disciplines and sectors for solutions to food nutrition, aquatic and terrestrial resource sustainability, and bio-based sustainable development challenges. Gender balance as a theme is closely related to social and technical dimensions of food systems. As resources, knowledge, culture, religion and technologies are associated with the people's lives, public engagement, science education and science literacy keys play a critical role within the programme concept. "Open to the World" approaches, supported by "Open Science" and "Open Access" initiatives are mentioned as a means to support coordination and collective action for the scale of system-wide transformations. Last but not least, the necessities for local, regional, national and international action related to food-resource and bio-based economy sustainability raise awareness to another RRI key "governance" for a perpetual R&I transformation through SC2 programme.

- The SC3 "Secure, Clean and Efficient Energy" follows a participative multi-stakeholder approach for the societal transformation. The SC3 programme line is related to general aspirations of the RRI concept since its aims directly address society. Public engagement is the most prominent RRI key dimension in the programme documents. The programme will “put emphasis on enabling the participation of consumers in the energy transition and improving the efficiency of the energy system, especially as regards the building stock and developing the next generation of renewable energy technologies and their integration in the energy system” (EC 2017b: 9). In order to conduct research with society much better, an RRI approach should be followed within the programme. The six RRI key dimensions are included as the base activities guiding a process in the direction of engaging and solution-oriented research.

- The role of RRI for the SC4 "Smart, Green and Integrated Transport" programme line is quite limited. The term RRI only appears once within the stakeholder consultation document in May 2016 for the preparation of Work Programme 2018-2020, and not as an overarching and coherent concept within the program content. All of the RRI-keys and the three O’s are at least implicitly

present within “Smart, Green and Integrated Transport”, but they do often times lack *depth*, *clear definitions* and *reflections upon their scope*. Although it is observed in the last Work Programme 2018-2020 a shift towards RRI, it is unclear whether old assumptions will govern or new perceptions may emerge to change current views.

- The SC5 "Climate Action, Environment, Resource Efficiency and Raw Materials" programme line is very close to rather novel societal challenges associated with attitudes, concerns and lifestyle of citizens, and therefore, highly political. The RRI approach provides methods and tools to conduct research and innovation in a way giving credit to these societal needs in a constructive way contributing in SC5 to the overarching H2020 principles and objectives with societal participation. In this work programme there are certain RRI aspects given as an objective and reference in some calls and topics. Nevertheless, it is remarkable that certain calls have RRI-relevance while the other have the lack of mentioning RRI. RRI is connected to "RRI-projects" with specific contents, participants, practices as well as understanding of excellence and innovation, and not to a common research and innovation strategy. This means that RRI is placed on voluntary basis, but not sustainably rooted in practice.

- The SC6 "Europe in a changing world - Inclusive, innovative and reflective societies" does not perceive RRI as a crucial improvement, unless all keys provided by the EC are implemented at the project level. RRI in SC6 is not mentioned as such in the last Work Programme (2018-2020). The acronym was relevant, and explicitly mentioned in the previous Work Programme (2016-2018), where the objectives of the work programme were stated to be in line with the ones of RRI. Ethical and societal issues are central for this programme line.

- In the SC7 "Secure societies – Protecting freedom and security of Europe and its citizens" programme, ethical reflection is especially important in situations where different courses of action need to be balanced with the values that the society holds. Security research and innovation includes many profound ethical questions in terms of individual and societal security, privacy, surveillance and dual-use of new technologies. RRI can be seen as an important framework providing guidance to develop future security solutions that are wanted, accepted and increasing the security and wellbeing of individuals and society.

3.2 RRI-oriented assessment of the seven programme lines

3.2.1 Role of RRI on different levels

In this section the awareness levels of the role of RRI in general, RRI keys (gender, ethics, public engagement, science education, governance, open access, stakeholder engagement) and the so called 3Os (open innovation, open science, open to the world) in the seven social lab diagnosis reports are compared based on the desktop findings. Differentiated by different levels of observation and analysis, reaching from the level of policy documents to the level of individual projects, the main observations of these analyses are summarised.

On policy document level

- A **high awareness** of RRI was detected in the policy documents of the SC1 (Health) and SC5 (Environment), whereas in SC2 (Food), SC3 (Energy) and SC4 (Transport) **no awareness** of RRI was explicitly stated. The awareness level of RRI was not mentioned in SC6 (Society) and SC7 (Security) diagnosis reports.

- The 3Os are visible in SC1, SC2 and SC5. In SC3 there is **no awareness** for the 3Os, whereas in SC6 there is no specific clarification, respectively. In SC7 we see only a **high awareness** for open science.

- Regarding the role and prominence of the RRI keys, the SCs show a high degree of heterogeneity. Some awareness for the different RRI keys was detected in SC1 and SC2. Ethics - and fundamental rights in particular - had the highest degree of awareness in SC7. However, the remaining keys were not mentioned in the policy document. In general, gender equality, ethics and public engagement are the most frequently mentioned RRI keys in all 7 SCs.

- SC2, SC5 and SC7 emphasize the importance of participatory multi-actor approaches, co-design and stakeholder engagement.

On scoping level

- On scoping level, there are similarities between SC4 and SC7. Both SCs are showing no or very limited awareness for the 3Os; a similar pattern is observed regarding the RRI key dimensions.

- The role of RRI receives **some awareness** only in SC1 and SC2, whereas for the other SCs no awareness was detected.

- The governance key dimension is strongly mentioned in SC6.

On work programme level

- SC4 and SC5 demonstrate **high awareness** for the 3Os, whereas SC2, SC3, SC6 and SC7 are present on the work programme level with **some awareness** for openness. No specific information was found in SC1 regarding the awareness level for the 3Os.

- Regarding the role of RRI keys on work programme level of SCs, SC5 revealed the highest awareness for almost all keys: Gender, ethics, public engagement, governance and open access. SC1 revealed the highest awareness of the key dimension stakeholder engagement.

On call level

- On the call level, similar to the patterns identified above, the highest degrees of RRI awareness were revealed in SC1 and SC2. SC3 and SC4 calls have shown a rather **limited awareness** regarding the role of RRI approach to societal challenges.

- With regard to the 3Os, "openness to the world" appears with a **high degree of awareness** in the SC1 calls, whereas "open innovation" shows **limited awareness.**

- In SC1 and SC5, "gender equality / gender diversity" reached **highest degree of awareness**. In the SC2 calls, a remarkable degree of diversity in all key dimensions was identified - reaching from **limited** to **some awareness**.

- The key dimension governance shows the highest degree of awareness in the SC6 calls. Open access and science education rank high in the SC4 calls.

- Only in the SC7 calls, stakeholder engagement was particularly prominent.

On project level

- In SC1 projects, RRI reaches **high degrees of awareness.** In addition, SC1 projects have high awareness for open innovation within the 3Os as well.

- SC3 projects are relative heterogeneous with regard to the inclusion of the different RRI key dimensions, resulting in an overall tendency of **limited awareness.**

- In SC7 projects, the level of awareness of the RRI approach reaches a **limited** level. A noteworthy exception is the BODEGA project, which demonstrates an unusual high degree of awareness in the context of this programme line. Furthermore, in many projects, for example in TREUSSEC.EU; ICT4COP, NOSY, INSPEC2T, FORENSOR and OCTAVE, gender equality is visible with **some awareness.** Stakeholder engagement as a participative and co-creative approach is highlighted in SC7 projects to deal with the societal challenges and to be responsive to the societal interests.

On proposal template level

- In proposal templates of seven SCs, no RRI awareness has been detected with an exception of SC5, where the role of the RRI approach is mentioned to be implemented only on a voluntary basis.

- Only in SC1 and SC6 there is **some awareness** with respect to the 3Os.

- In general, the awareness levels of the RRI key dimensions reach **limited** to **some awareness.**

- In the SC2 templates, the key dimension governance is mentioned to some extent as a means to make research and innovation more responsive to societal needs.

On evaluation level

- The inclusion of the RRI dimension was found only in SC1 and SC3 evaluations with **limited awareness.**

- In general, no high awareness is detected neither with regard to the 3Os nor with regard to the RRI key dimensions in any SC of the evaluation guidelines. Gender diversity and public engagement were the only RRI key dimensions included with some awareness in the evaluation approaches.

Table 2 provides a schematic overview of the information about RRI awareness provided in the seven diagnosis reports.

Table 2: Degree of RRI awareness on different levels

				SC2 - Food	SC3 - Energy	SC4 - Transport	SC5 - Environment	SC6 - Society	SC7 - Security
				no awareness	no awareness	no awareness	high awareness		
				some awareness	no awareness	no awareness	some awareness		high awareness for open science
				some awareness		limited awareness	some awareness		
				some awareness		limited awareness			high awareness (fundamental rights such as privacy and data protection)
				some awareness	some awareness	limited awareness	some awareness		
				some awareness					
				high awareness	some awareness		some awareness		
				limited awareness					
							some awareness		
				multi-actor approach, anticipatory, responsive	limited awareness		strong participatory approach + co-design, need of a change of mindset and behaviour along the lines of the SDGs and COP21		stakeholder engagement
						no awareness	no awareness		
				some awareness	some awareness	no awareness	some awareness	some awareness	
					some awareness	limited awareness	some awareness	some awareness	
					some awareness	limited awareness	some awareness	some awareness	
							some awareness	some awareness	
					some awareness			high awareness	
					some awareness				
							some awareness		
					Inclusion, Diversity, Outcome Oriented solutions, stakeholder engagement		bottom-up approaches; 'living laboratories' for the co-design; combining all types of innovation including social innovation; multi-level platforms; enabling full, open and unrestricted access	high awareness	
WORK PROGRAMME LEVEL	RRI		high awareness	some awareness	high awareness	limited awareness	included as an objective / vision		
	3 O's	Open innovation Open science Open to the world		some awareness	some awareness	high awareness	high awareness	some awareness	some awareness
	RRI keys	Gender	some awareness	some awareness	some awareness	high awareness	high awareness		some awareness
		Ethics		some awareness	some awareness	limited awareness	high awareness		some awareness
		Public Engagement	some awareness	limited awareness	some awareness	limited awareness	high awareness		some awareness
		Science Education		limited awareness		high awareness			
		Governance		some awareness	some awareness		high awareness	high awareness	
		Open access		some awareness	some awareness	high awareness	high awareness		some awareness
		Stakeholder Engagement	high awareness						
	Implicit			reflexive, inclusive, responsive	SDGs		transparency, responsiveness, adaptive, diversity and inclusion are included in some topics, anticipation and reflexivity is rather indirectly included	some awareness	Security as a social value
CALL LEVEL	RRI		some awareness	some awareness	limited awareness	limited awareness			
	3 O's	Open innovation Open science Open to the world	limited awareness for open innovation, high awareness for open to the world	some awareness		limited awareness		some awareness	
	RRI keys	Gender	high awareness	limited awareness	limited awareness	high awareness			some awareness
		Ethics	limited awareness	some awareness		limited awareness			some awareness
		Public Engagement		some awareness	some awareness	limited awareness			some awareness
		Science Education	limited awareness	some awareness	limited awareness	high awareness			
		Governance		limited awareness	limited awareness			high awareness	
		Open access		some awareness	limited awareness	high awareness			
		Stakeholder Engagement	high awareness						some awareness
	Implicit							Yes	Stakeholder engagement
PROJECT LEVEL	RRI		high awareness			no awareness			limited awareness (except BODEGA project)
	3 O's	Open innovation Open science Open to the world	high awareness for open innovation, limited awareness for open science and open to the world				some awareness	limited awareness	some awareness for open science
	RRI keys	Gender	high awareness		limited awareness				some awareness in TREUSSEC.EU; ICT4COP, NOSY, INSPEC2T, FORENSOR and OCTAVE
		Ethics			limited awareness				some awareness
		Public Engagement			limited awareness	limited awareness	some awareness	some awareness	some awareness
		Science Education			limited awareness	limited awareness			
		Governance			limited awareness		some awareness		
		Open access			limited awareness				
		Stakeholder Engagement	high awareness						
	Implicit							Yes	Stakeholder engagement
PROPOSAL TEMPLATE LEVEL	RRI		no awareness				RRI on a voluntary basis		
	3 O's	Open innovation Open science Open to the world	some awareness					limited awareness	
	RRI keys	Gender	some awareness	some awareness			limited awareness		
		Ethics	some awareness	some awareness			limited awareness		limited awareness
		Public Engagement	some awareness						
		Science Education							
		Governance							
		Open access	some awareness				some awareness	limited awareness	
		Stakeholder Engagement	some awareness						
	Implicit		some awareness, anticipative	high awareness, reflective to the societal challenges			Yes, where relevant	no awareness	
EVALUATION LEVEL	RRI		limited awareness		limited awareness				
	3 O's	Open innovation Open science Open to the world	some awareness	some awareness for open innovation	some awareness				limited awareness for open to the world
	RRI keys	Gender	some awareness	some awareness	limited awareness		limited awareness		
		Ethics							limited awareness
		Public Engagement	some awareness	some awareness	limited awareness				
		Science Education							
		Governance							
		Open access							
		Stakeholder Engagement							
	Implicit		some awareness	responsive			Yes, where relevant		

3.2.2. General use of RRI

In this section, the key findings regarding the general use of the RRI concept from the seven diagnosis reports are summarized.

- SC 1 - HEALTH: The use of the term RRI is rather infrequent, but the awareness of the qualities of RRI is high compared to the other SCs. Explicit references to the key RRI dimensions and three Os can also be found. *Gender* receives particular attention throughout the work programmes and has the potential to play a very important role within health areas, as sex and gender differences play an increasingly important role within health research. *Science education*, on the other hand, plays a minor role. There is an awareness for *public engagement*, though to a lesser extent in a sense of citizen engagement, but rather on the level of organisations and stakeholders. The international dimension plays an important role. *Open innovation*, also understood in the broader sense as the inclusion of a multiplicity of actors, is well established. There has been a change from silo research to multidisciplinary approaches in the health programme. RRI is not the central overarching frame, but it is very easy to find bits and pieces that reflect RRI thinking and RRI-related ambitions. Responsiveness and anticipation also play a significant role in the Health programme.

- SC2 -FOOD: There is a strong connection between Food programming and the governance key of RRI. In the second and third programmes of SC2, *RRI* was identified as a coherent umbrella concept at the topic level. *RRI* as a whole likely seems to be included in evaluation criteria. RRI-related expected impacts are inconsistent and not elaborated with a transparent process or clear logic. It is also unclear to what extent, if any, an RRI related impact would receive emphasis or severity with regard to any other expected impacts for a given topic.

Beyond RRI, the SC2 programme is actively responsive and seeking to address issues like *gender balance*, *open access* and *ethical issues*. In the second and third Work Packages (WP 2018-2020), clear mention of *gender balance* and diversity issues are made. Some progress to address broader ethical concerns can be observed, whereas *public engagement* and *science education* seem less prominent in the SC2 programmes. Most statements related to public inclusion or outreach at the work programme and topic-levels speak to a uni-directional view of science and society relationships. WP 2018-2020 aims to achieve a continued use of the multi-actor approach by involving citizens, civil society and all other stakeholders. Regarding *science education* and *science literacy*, only one priority area - namely Blue Growth - in the WP 2018-2020 explicitly mentions science education.

- SC3 -ENERGY: The SC3 programme line shows RRI awareness, as each introduction of programme lines (2016-2017 and 2018 -2020) emphasizes the RRI approach and its significance. Moreover, the three Os are visible. All keys could be identified on their own on different call levels. *Public Engagement* is identified as the most important key. *Gender* plays a role and is actively addressed. The programme line does not aim at *Science Education* in an RRI sense, but rather focuses on increasing skills in adult education in general. The *Ethics* key is only implicitly addressed, and a tick-boxing task on proposal template level is implemented. Just like the RRI keys, the three Os are emphasized in the introduction of the programme line, but could not be traced on call level.

- SC4 - TRANSPORT: In the SC4 programme line, all RRI keys are at least implicitly present, but their scope is quite limited. The term RRI appears only once within all Work Programme documents. *Open Science* has a vital role within the programme line, as Open Data Research Pilot because the default during Work Programme 2016-2017, meaning that gran beneficiaries "will engage in research data sharing by default" (WP16-17, p. 9). *Open innovation* is addressed relatively weak, as the term is only defined once within all documents. *Openness to the World* is seen as necessary to tackle global challenges, but at the same time, the SC4 has one of the lowest international participation rates within all of Horizon2020. *Ethics* is seen as a challenge whenever public acceptance needs to be achieved for the dissemination of specific technologies. *Gender* plays a marginal role, and is perceived to be another demographic factor amongst others. *Open Access* plays a lesser role in terms of scientific results. Instead it focuses on getting open access to data that is necessary for the realisation of the technological visions of ICT, ITS and automation. *Public Engagement* focuses on industry, research, education and policy, but not on civil society. *Science Education* and *Science Literacy* plays a major role within work programme documents. Main concerns are having access to a skilled labour force and to educate users on the proper use of technologies.

SC5 -ENVIRONMENT: RRI is traceable as a vision in the programme line. The systematic approach gives strong impetus to societal impact. RRI is more present than just in the sense of a mere tick-boxing exercise and puts strong emphasis on societal impact. It is reflected indirectly in the addressed challenges. The term is not mentioned in the general introduction, but within the scope of the calls.

The six keys are included in the Work Programmes. *Ethics* is not explicitly mentioned in the WP 2014-2015 As H2020 piloted on open access, privacy received increased attention. *Gender equality* has become highly present within the WP 2018-2020.

Three Os are straddling between the key "open access" and the process dimension "openness & transparency". The WPs 2014-2015 and 2016-2017 use these terms without calling 3 Os.

- SC6 -SOCIETY: In the SC6 programme line the explicit presence of all RRI keys is missing. The word *ethics* is almost completely absent. If *gender* is an encouraged aspect in the work programme, the other keys are scarcely addressed. In the WP16-17 the notion of RRI is explicitly mentioned, but not all work programmes have conducted the investigations with the same depth about RRI. The three Os are highlighted only in the section "other actions", and only a small amount of funding has been allocated to the investigations.

SC7- SECURITY: RRI, as a comprehensive approach, is hard to recognise in the SC7, but a variety of RRI keys can be found. Data protection and privacy are playing a major role throughout the work programmes. *Open access* is supported in all programme levels. *Stakeholder engagement* is seen as an important aspect, but how stakeholders are engaged, varies depending on the security theme and project. *Public engagement* is mostly present in calls of cybersecurity and radicalisation.

The three Os are not widely presented within the programme line. Dissemination of security research results is encouraged, which demonstrates how open science is present in policy documents.

In the light of these observations and comparative analysis across the seven SCs, the following patterns can be identified:

- RRI, as term, appears most frequently and prominently in the SC2-FOOD and SC3-ENERGY programmes. In the SC4-TRANSPORT and SC5-ENVIRONMENT funding lines, the term RRI is being used, but at a clearly lower level than in the SC2 and SC3. In the SC1-HEALTH, the term RRI is used at a very low level.
- A high *RRI awareness is* observed by SC-1HEALTH, SC2-FOOD, and SC3-ENERGY programme lines. Here, RRI awareness is not just a tick-boxing action, and it is explicitly mentioned in SC5-ENVIRONMENT and SC6-SOCIETY programme lines. In SC4-TRANSPORT and SC7-SECURITY, an RRI awareness in the work programmes can hardly be observed.
- The three Os are widely presented and well established in the SC1-HEALTH, SC4-TRANSPORT and SC7-SECURITY. In particular, within the SC4 WPs, the "open innovation" is well-addressed. The presence of "open science" has been perceived to play a vital role within the programme line. The "Open to the world" ambition is seen as a global challenge to be tackled. On the other side, only a small amount of funding is allocated to the SC6-SOCIETY programme line. The so-called three Os has been highlighted in the section of "other actions" in the work programmes.
- Except for the SC6 and SC7 programme lines, the *gender* key is actively addressed and plays a very important role in the SC1, SC2, SC3 and SC4 programmes.
- The key *ethics* is a rather obscure key within the programmes. In the SC3, for instance, it is only present as a tick-boxing exercise. In the SC1, SC2, SC5, SC6 and SC7, the key is not explicitly addressed. In the SC4, *ethics* has been seen as a challenge.
- *Science education* as well as *science literacy* play a marginal role only in the SC4 programme line. In other programmes such as in the SC1, SC2 and SC4, the key is not referenced as significant, and therefore, plays only a minor role.
- The *governance* key receives strong emphasis only in the programme line SC2. In other SCs, the key as a term is absent.
- *Open access* has received a very visible role in the SC6. The key is also present in SC5, at a lower level, though. It plays much lesser role in the SC4.
- *Public engagement* has been seen as the most important key within the SC3 work programmes. Both for SC1 and SC4, the work programmes do not focus on citizens and civil society. For the SC7, it has been perceived as an important concept, but understood only in narrow sense of stakeholder engagement.

3.2.3 RRI beyond the keys

In this section, the key findings from the seven diagnosis reports about a broader conceptualisation, reaching beyond the immediate application of the RRI key dimensions, is presented. In many ways, this covers different manifestations of "de facto RRI".

- SC1-HEALTH: The awareness of qualities of RRI is high. To a great extent this awareness is implicit and reaches beyond the three Os and the keys. In this programme line, RRI is not the central overarching frame, but it is very easy to find important elements that essentially reflect an RRI thinking.

- SC2-FOOD: The programme is suitable for the broader understandings of RRI not currently promoted by the Commission. Introductory texts to FOOD R&I as well as each work programme reflect a response to sustainability challenges facing humanity and the planet. Procedural dimensions of responsibility in R&I are also to be observed in FOOD programming. At the policy level, the programme has direction to facilitate forward-looking activities, which is a clear indication of an anticipatory stance. Work programme development evolves from diverse inputs from different stakeholder groups through advisory bodies, public consultations and the strategic advice of bodies like the Standing Committee on Agriculture Research (SCAR) (c.f. EC SCAR 2015). Above responsiveness to normative anchors and anticipation, a number of expert contracts for evaluation, strategy reviews, stakeholder conference, and supporting policy analyses create opportunities for reflexivity at the programme level.

- SC3-ENERGY: RRI mainly consists of stakeholder engagement and is used to address the challenge of an enthusiastic energy system transformation. The RRI concept is, therefore, not present as a holistic approach.

- SC4-TPT: Within this programme line, RRI is neither traceable as an approach, a method nor a process. Instead, the keys are present, but their scope is quite limited. The programme line creates a *knowledge-hierarchy*, where the primacy is given to industry and academia when setting agendas and roadmaps.

- SC5-ENV: Openness & transparency, responsiveness & adaptive as well as diversity & inclusion are well represented in the work programmes of the SC5 programme. Anticipation & reflexivity are not explicitly considered in the programme line, but they are inherent in the "Biodiversity scenarios" topic. They are also implicitly present, when, for example, R&I projects are advised to take society in.

- SC6-SOCIETY: Both the Expert Advisory Group's recommendations and the EC's answers are deeply integrating ethical aspects in the development of R&I within the particular framework. The work programme descriptions are tackling all the issues raised by the report and, therefore, the relation between current WP and previous ones are not only boiled down to scientific results but also mainly to extrinsic suggestions. The urge for democratisation, engagement and analysing the level of trust concerning policy-makers are concrete signals of the direction that should be taken into account.

- SC7-SECURITY: The observations show us that the meaning of RRI is growing with each work programme. For example, while in the first Security work programme 2014-2015 RRI is missing, it is mentioned in the work programme 2016-2017 for the first time. Integration of social sciences and humanities and RRI is happening within the programme line, but inconsistencies were observed in all work programmes. Data security and privacy play a major role, but at the same time, other ethical aspects like fairness and transparency are left out of the programme. Policy documents are particularly worried about the need of social acceptance within the programmes. The stakeholder engagement is mentioned in the work programmes, but this tends to be understood rather as the engagement of practitioners and public authorities while ignoring civil society actors and citizens. The concepts of "privacy" and "data protection" are highly present in the work programme 2018-2020. Last but not least, RRI is often seen as a question of following legislative and regulatory demands instead of broader understanding of its wider content.

3.2.4 Conceptual underpinnings of Research and Innovation in the seven programme lines

This section attempts to provide an overview of key theoretical and conceptual foundations of research and innovation and responsibility understandings in the seven programme lines, as presented in the respective sections 4.2.4 of the SL diagnosis reports (see Annex).

Not surprisingly, the seven programme lines reflect quite distinct understandings of research and innovation and how funding should be designed to achieve desired ends. Despite these differences, which reflect different problem areas, research disciplines, normative orientations, professional ethos, actor constellations, and traditions, the seven programme lines share - with different degrees of intensity - a commitment to challenge-oriented approaches. A strong emphasis to fund research and innovation activities that are likely to contribute to solving societal problems is particularly visible in SC 1 (HEALTRH), SC 2 (FOOD) and SC 5 (ENVIRONMENT).

Turning away from issues of directionality and focusing more on procedural aspects of research and innovation, pronounced differences between the seven programmes become apparent. It can be observed that the programmes deal with the RRI key dimensions quite differently. While a number of SCs put strong emphasis on societal embeddedness, which is usually operationalised by the means of different forms of public engagement and participation (e.g., SC 1 - HEALTH, SC 2 - FFOD, SC 5 - ENVIRONMENT) and/or ethics (e.g., SC 6 - SOCIETY, SC 7 - SECURITY), this ambition seems to be rather absent in others (e.g., SC 4 - TRANSPORT).

These differences can in part be explained by exploring the underlying conceptual foundations as reflected by the key policy documents that had been analysed in the SL diagnosis reports. Those SCs that emphasise societal embeddedness tend to - at least implicitly - follow a broad understanding of innovation. Here, forms of non-technical, social, frugal, inclusive etc. innovation are mentioned. In some SCs, competing paradigmatic understandings of research and innovation and its relationships with society are at play in parallel. Call texts specifically encourage activities aiming at improved societal embedding, while at the same time policy documents seem to conceptualise technology as something separate from society (e.g., SC 2 - FOOD).

Taken together, different conceptual framings of research and innovation can be identified, reaching from a narrow technology push / technology fix perspective to more sophisticated understandings of the complex interplay between and co-construction processes of technology and society.

3.2.5 Overall assessment if RRI in the 7 programme lines

Based on the findings documented in the sections 4.2.5 of the respective SL diagnosis reports, Table 3 proved a summary of the degree of awareness of RRI and the key RRI dimensions in the H2020 Societal Challenges programme lines.

Table 3: RRI awareness based on desk-top research

SL	Degree of awareness			
	High	Some	Limited	No
#7		• RRI as a concept (implicitly) • Ethics • Public engagement	• Gender	
#8	• Gender • Open access and open science • Open innovation • Governance (Rural Renaissance programming)	• Ethics • Public engagement • Science education and science literacy (Blue growth programming)	• Science education and science literacy (other programme areas) • Governance (other programme areas) • Reflexivity / anticipation as responsible innovation concepts beyond the RRI keys	
#9	• Public engagement	• Gender • Ethics • Governance • Science education • Open access • Open science • Open innovation • Open to the World • RRI as holistic concept		
#10		• Societal impact of technologies • Ethics	• Public engagement	
#11		• RRI as a concept (implicitly and explicitly) • Open science • Open innovation • Open to the World	• Governance	
#12		• RRI as a concept • Public engagement • Ethics	• Open science • Open innovation • Open to the World	
#13		• RRI as a concept (on work programme level) • Ethics	• RRI as a concept (on project level) • Stakeholder engagement	

3.3 Findings from the stakeholder interviews

3.3.1 Understandings of RRI

This section presents the key findings and observations derived from the stakeholder interviews as reported in the seven SL diagnosis reports.

In very general terms, the insights on the degree of awareness about the concept of RRI and the manifestations of responsibility understandings in research and innovation generated by the interviews in the seven Social Labs (SL) echo the patterns identified in the desk top analyses.

Turning to the awareness of the official RRI concept as put forward by the European Union, the interviews conducted in the seven programme lines revealed low to medium levels of awareness of and knowledge about RRI. The interviews conducted in the Social Labs Health (#7) and Society (#12) show the highest awareness levels within the Societal Challenges programme lines, whereas the interviewees recruited from the programme lines Energy (SL #9), Security (SL #13) and Transport (SL 10) were nearly unaware of the term "RRI".

However, it would be completely misleading to conclude that the interviewees were ignorant about responsibility issues in general. The cross-SL analysis provides us with quite a nuanced picture about different understandings of the meaning of responsibility in research and innovation contexts. In some programme lines, "de facto RRI" was quite well aligned to the essence of the RRI concept despite different terminologies. For instance, in the programme lines HEALTH, SOCIETY and FOOD, actors expressed a strong conviction that their research and innovation activities should effectively contribute to addressing societal challenges and contribute to improving our societies. To varying degrees, stakeholder and citizen involvement, the application of certain ethical principles and multidisciplinarity were included in many interviewees' statements on how higher levels of responsibility could be achieved. Other funding lines (particularly TRANSPORT and ENERGY), however, seem to reflect a more narrow, rather inward-looking understanding of responsibility. Here, many actors provided accounts of responsibility largely confined to the responsible conduct of research. Broader understandings of responsibility that would also include a reflection on the relationship between science and society and how these relationships could be improved were absent. These actors tend to view the government to be responsible for addressing issues of broader societal concern.

With regard to the six key dimensions of RRI, four overarching conclusions can be drawn from the responses provided by the actors interviewed in the seven SLs. First, as most interviewees were initially not acquainted with the term RRI and the underlying policy concept, the majority did not associate the keys with RRI. Second, after a brief introduction and some explanations about the relationship between the EU's RRI concept and its constituent keys, many interviewees did see value in the keys as a means of making the rather abstract RRI concept more tangible, thereby acknowledging their general relevance. In addition, some interviewees stated that the RRI key dimensions added some additional aspects of responsibility they had not considered previously. Third, those interviewees already acquainted to RRI and/or the broader debates about responsibility in research and innovation, commented that the keys reflect a rather narrow understanding of

responsibility, not fully capturing many features and dimensions. In this sense some interviewees criticised that sustainability is not included among the key dimensions. And fourth, all SLs had difficulties to grasp the key dimension "governance".

Comparing the roles and understandings of the official six key dimensions of RRI across the seven SLs, a similar pattern as in the case of general responsibility awareness (de facto RRI) emerges. Those SLs that seem to have higher levels of awareness (such as HEALTH, FOOD, ENVIRONMENT and SOCIETY), also tend to report more concrete experiences with the individual keys. Here, particularly the keys ethics, public engagement and gender were frequently emphasised as relevant. In turn, the keys are of lower relevance to the SLs TRANSPORT, SECURITY and ENERGY. Interestingly, essentially all seven SLs report low awareness and/or relevance of the key science literacy/science education. Zooming in to the individual SLs, a number of peculiarities with regard to the keys can be observed: The interviewees in the HEALTH programme line report a very high degree of institutionalisation of the ethics dimension. In the FOOD SL and to some extent in the ENERGY SL, ethics was understood much more in terms of ethical ways to deal with data (transparent, accessible). For many interviewees of the SL TRANSPORT, ethics was not understood to be primarily a responsibility of the individual researcher, whereas public engagement was seen as a means to generate technology acceptance. The ENVIRONMENT and the SOCIETY SLs emphasised the potentials of public engagement for this area. And in the SECURITY SL, concerns were raised regarding open access / open data due to security requirements and the sensitive data in this research field.

3.3.2 Understandings of societal impacts and embeddedness of R&I

In comparative terms, the interview partners from the seven programme lines reflected different degrees of awareness and took different positions with regard to the need to work for higher levels of societal embeddedness of research and innovation. However, compared to the understandings of RRI as reported in the previous section 3.2.1, the differences between the individual SLs seem less pronounced as the objective of societal embeddedness meets only little opposition.

Based on the interviews, the SLs HEALTH, SOCIETY, FOOD, ENVIRONMENT and ENERGY report high levels of understanding about societal embeddedness and clearly agree that more needs to be done to improve the integration of R&I in society. Some interviewees from these SLs stated that they would like to see greater overlap between excellent research and strong societal impact of their research activities. Others responded that their research fields (i.e., FOOD and ENERGY) are in essence about achieving higher societal impacts. Interestingly, the most frequently mentioned approach to reach higher levels of societal embeddedness were participatory methods, ranging from multi-stakeholder processes to various types of co-creation. Lower degrees of awareness and in some cases even rejection of the notion of societal embeddedness was found in the responses from interview partners in the SLs TANSPORT and SECURITY. Here, some of the interview partners' responses echoed traditional technology-fix perspectives. Stakeholder and particularly citizen involvement was therefore seen as a low priority or even as something causing more problems than being useful.

Barriers to societal embeddedness and impact observed by the interview partners include difficulties to get certain stakeholder groups (depending on the project: industry, politics, civil society) involved in RRI projects, silos between departments and disciplines, problematic effects of current science

metrics and indicators that tend to work against higher societal impacts, too strong focus on short term perspectives and insufficient focus on long-term benefits and sustained effects, lack of resources (mainly financial), lack of knowledge and training about RRI, lack of space for experimentation and possibilities to escape from routines. Some interview partners also mentioned a lack of opportunities for conversations to reflect, as a community, on general RRI issues and beyond.

Factors that were mentioned to be conducive for societal embeddedness include the growing prominence of the overarching goals of the SDGs, the fact that issues of responsibility are becoming more and more pressing and obligatory in many walks of life (not only in research), researchers' motivation, requirements to add RRI-type issues in proposals and rigorous evaluation standards enforcing the uptake of social impact, and collaborating in interdisciplinary and transdisciplinary teams.

3.3.3 RRI-oriented assessment of the seven programme lines based on the interviews

Based on the interviews findings as reported in the SL diagnosis reports, the RRI-oriented assessment for the seven Social Labs is summarized in the following table:

Table 4: Overview of RRI-orientation based on SL interviews

SL	Degree of awareness			
	High	Some	Limited	No
#7	• Understanding of RRI • Ethics • Public engagement • Gender	• RRI as a concept (implicitly) • Science literacy/science education • Open access/open science	• Governance	
#8	• Gender • Open innovation	• Public engagement • Open access/open science • Governance	• RRI as a concept • Ethics • Science education / science literacy	• Concepts of responsible innovation beyond the keys
#9	• Public engagement • Ethics	• Gender • Science education / science literacy • Governance • RRI as a holistic concept (Realm of "Smart Cities")	• Open access • Open science • Open innovation • Open to the World • RRI as a holistic concept (Realm of "Smart Cities")	
#10	• Public engagement • Gender	• Science communication • RRI as a concept	• Open science • Open access • Open data	

SL	Degree of awareness			
	High	Some	Limited	No
#11	• Better embeddedness of R&I in society	• RRI as a concept		
#12	• Better embeddedness of society in R&I • Public engagement • Gender • Stakeholder engagement	• Ethics	• RRI as a concept	
#13		• Ethics • Stakeholder engagement • Gender • Governance	• RRI as a concept • Public engagement • Open access	• Science education

3.4 Selected projects

In the seven SL diagnosis reports, a number of different projects from the Societal Challenges programmes were identified and briefly portrayed. These case briefs provide an overview of the selected project and show how the projects relates to RRI with the aim of providing an illustration of how the ambitions of RRI play out (or not) in concrete project settings. The case briefs are available in the SL diagnosis reports (section 4.4 - see Annex of this deliverable). The selection criteria applied by the SLs were heterogeneous and do not claim to be representative for the respective funding programme.

The projects identified and included in the diagnosis reports are:

SL #7 - HEALTH:
HYPMED (Digital Hybrid Breast PET/MRI for Enhanced Diagnosis of Breast Cancer)

SL #8 - FOOD:
BioSTEP (Promoting stakeholder engagement and public awareness for a participative governance of the European bioeconomy)
STAR-ProBio (Sustainability Transition Assessment and Research of Bio-based Products)

SL #9 - ENERGY:
SMARTER TOGETHER (Smart and Inclusive Solutions for a Better Life in Urban Districts)
CITYkeys (Smart City performance measurement system)
ESPRESSO (systemic standardisation approach to Empower Smart citieS and cOmmunities)

SL #10 - TPT:
no selected projects

SL #11 - ENV:
GREEN-WIN (Green growth and win-win strategies for sustainable climate action)

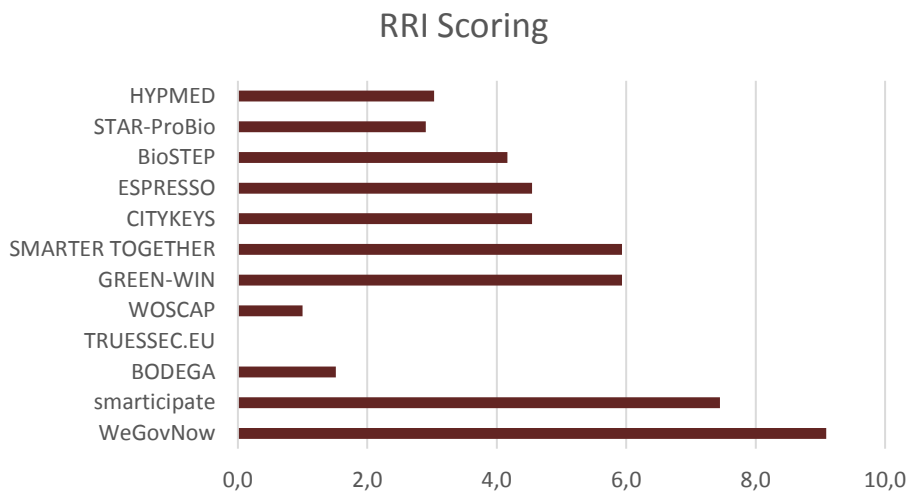
SL #12 - SOCIETY:
WeGovNow (Towards We-Government: Collective and participative approaches for addressing local policy challenges)
smarticipate (smart services for calculated impact assessment in open governance)

SL #13 - SECURITY:
BODEGA (BOrdDErGuArd - Proactive Enhancement of Human Performance in Border Control)
TRUESSEC.EU (TRUst-Enhancing certified Solutions for SEcurity and protection of Citizens' rights in digital Europe)
WOSCAP (Whole-of-Society Conflict Prevention and Peacebuilding)

For all SL work packages of the NewHoRRIzon project (WPs 2-5), University of Leiden (CWTS) conducted a text mining analysis of all H2020 projects with the aim to improve our understanding of the extent to which RRI has been integrated in funded projects. Based on the analysis, RRI scores for individual projects were calculated (see Figure 2).

Figure 2 shows the overall RRI scores for the 12 selected projects from the SL diagnosis reports.[6]

Figure 2. RRI scores of selected SL projects

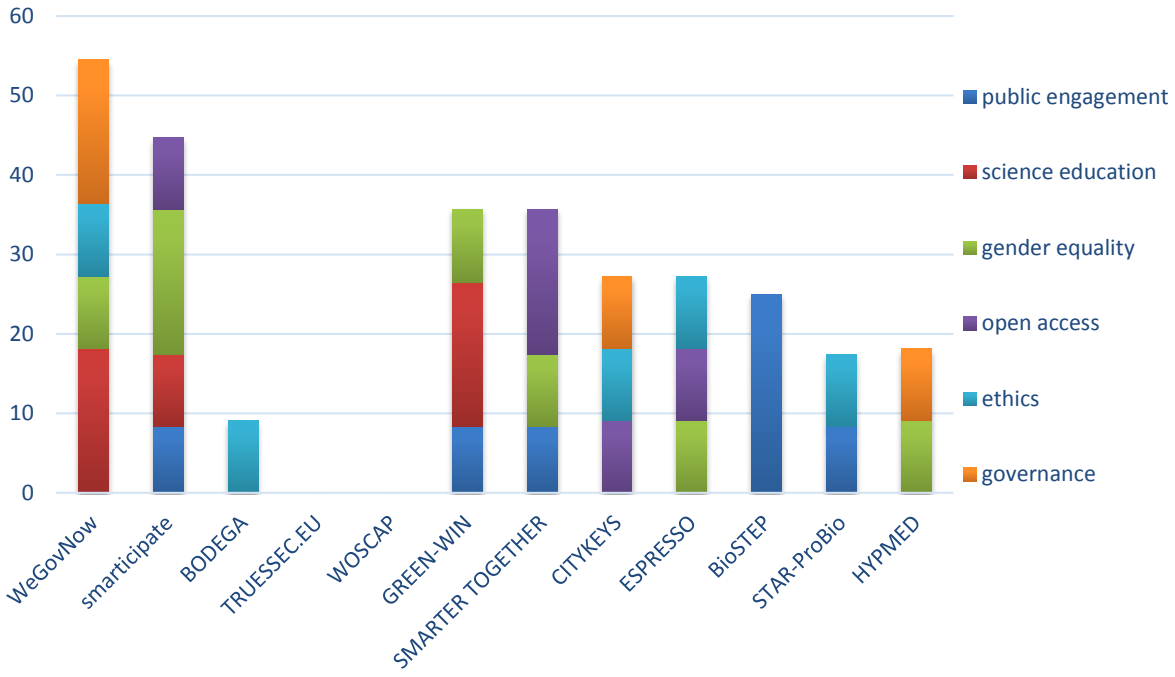


According to the results in Figure 2, the projects WeGovNow and smarticipate reach the highest RRI scores (both from SL #12), whereas the lowest RRI scores were calculated for the projects WOSCAP, TRUESSEC.EU and BODEGA. Notably, the RRI scores presented are not for ranking of RRI efforts, but to inform and promote reflection on the overall integration of RRI on the project level.

Besides simply using the frequency of RRI-keywords of project abstracts, the selected projects were also analysed with regard to the RRI key dimensions. The results of this more differentiated analysis for the 12 selected projects are shown in Figure 3.

[6] The data used was retrieved from the Cordis Data portal, using the objective/abstract text of all H2020 proposals. In a second step, a word-frequency analysis, by applying a selection of key-words for each of the RRI keys (10-12 for each), was carried out. In order to improve the accuracy, the frequency of keywords was checked and an adjusted list was generated (removing keywords with frequencies <5 and >300; re-iteration of keyword selection process. Finally, a 'RRI' score for each of the H2020 project was calculated, reflecting the frequency of the selected RRI key words in the objective/abstract text of the H2020 projects.

Figure 3. Characterisation of selected projects by RRI key dimensions



4. Summary and Conclusions

Deliverable D4.1 summarises the key findings and observations generated in the diagnosis exercises of the seven Societal Challenges SLs. With few exceptions, the deliverable is based on the information, analyses and interpretations provided by the individual diagnosis reports (which are included as reference in the Annex of this deliverable). A key objective of the diagnosis phase of the NewHoRRIzon project was to generate information about the state-of-play of RRI, the RRI key dimensions and the "3Os" in the seven funding lines. The information base for this diagnosis draws on a broad range of documents related to the programmes (e.g., relevant EC regulations, H2020 evaluations, work programmes, call texts, evaluation guidelines, proposal templates, CORDIS data) and interviews with relevant stakeholders (a total of 73).

In very general terms, the findings from the Societal Challenges diagnoses regarding the degree and quality of the institutionalisation of RRI ambitions and practices are mixed, showing a very high degree of heterogeneity across the seven programmes. Consequently, clear and unambiguous patterns did not emerge. While some programmes indicate significantly higher levels of RRI awareness than others according to the different policy documents analysed, this heightened awareness does not necessarily translate into a uniform and coherent uptake of the RRI key dimensions on the level of individual projects, for instance. And conversely, programme lines that tend to abstain from using the RRI-terminology are not necessarily ignorant about core qualities of RRI, and can, in comparative terms, be quite advanced in institutionalising (de facto) RRI-related practices on the project level and/or on the level of the stakeholders interviewed. This general observation also cautions us to prematurely assess complete funding lines as "RRI ignorant" or "RRI advanced", and urges us to take differentiated and sometimes contradictory findings into account.

Looking at the overall findings from the document analyses, the RRI concept as a term is far from being mainstreamed. At this point, the term RRI is most frequently used in SC2 (FOOD) and SC3 (ENERGY). The SCs 1 (HEALTH), SCs 4 (TRANSPORT) and SC 5 (ENVIRONMENT) do use the term, but at lower levels. However, if the essence of the RRI concept is taken into account, a slightly different picture emerges. RRI awareness continues to be strong in the SCs 2 and 3, but SC1 (HEALTH) shows a very well developed understanding of RRI as well. In the SCs 5 (TRANSPORT) and SC7 (SECURITY), on the other hand, it was difficult to identify indications of RRI awareness. The three "Os" are widely presented and well established in the SC1-HEALTH, SC4-TRANSPORT and SC7-SECURITY.

The degree to which the RRI key dimensions are represented in the relevant documents is another important indication of RRI institutionalisation. Again, the overall picture tends to be rather divers. The keys dimensions gender, ethics and public engagement are most frequently mentioned across all seven SCs. However, there are exceptions to this pattern: the gender key, for instance, is not actively addressed in the SCs 6 (SOCIETY) and SC 7 (SECURITY). Science education and science literacy seem to have a very low priority across the board, with the exception of SC4 (TRANSPORT), where this dimension seems to receive a bit more attention.

The findings also show that RRI awareness and representation of RRI key dimensions at the level of policy documents, work programmes and even call texts does not automatically and effectively

translate into RRI ambitions at the level of projects and ultimately at the level of research and innovation practices. Besides possible time lag effects, one reason for this gap might be the low degree of RRI institutionalisation at the level of evaluation. With the exception of the key RRI dimensions gender and to some extent public engagement, none of the RRI keys were included in proposal templates and evaluation guidelines.

In very general terms, the observations made in the stakeholder interviews by and large echo the results of the document analyses. Regarding the awareness of and knowledge about the RRI concept as promoted by the European Union, low to medium levels were identified. In the interviews conducted with stakeholders in the SLs HEALTH and SOCIETY, the highest levels of RRI awareness were recorded, whereas the interviewees from the SLs ENERGY, SECURITY and TRANSPORT seemed to be nearly unaware of the term RRI.

However, it would be misleading to conclude that those interviewees, who did not recognise the official RRI concept, were ignorant about responsibility issues in general. The cross-SL analysis provides us with quite a nuanced picture about different understandings of the meaning of responsibility in research and innovation contexts. In some programme lines, "de facto RRI" was quite well aligned to the essence of the RRI concept despite different terminologies. For instance, in the programme lines HEALTH, SOCIETY and FOOD, actors expressed a strong conviction that their research and innovation activities should effectively contribute to addressing societal challenges and contribute to improving our societies. Other funding lines (particularly TRANSPORT and ENERGY), however, seem to reflect a more narrow, rather inward-looking understanding of responsibility. Here, many actors provided accounts of responsibility largely confined to principles of responsible conduct of research and research integrity.

The different understandings of responsibility and the different manifestations of responsible practices in research and innovation are not particularly surprising given the different problem areas, disciplinary cultures and norms, actor constellations, professional ethos etc. represented in the seven SLs. While a number of SCs put strong emphasis on societal embeddedness, which is usually operationalised by the means of different forms of public engagement and participation (e.g., SC 1 - HEALTH, SC 2 - FFOD, SC 5 - ENVIRONMENT) and/or ethics (e.g., SC 6 - SOCIETY, SC 7 - SECURITY), this ambition seems to be rather absent in others (e.g., SC 4 - TRANSPORT).

Arguably, these differences reflect different underlying conceptualisations of research and innovation and the imagined ideal-typical relationship between science and society. These different "theories" interact with and are mediated by diverse dominant frames and norms on the respective scientific communities involved. Those SCs that emphasise ideas of societal embeddedness tend to - at least implicitly - follow a broad understanding of innovation. Here, forms of non-technical, social, frugal, inclusive etc. innovation are mentioned. In some SCs, competing paradigmatic understandings of research and innovation and its relationships with society are at play in parallel. Taken together, different conceptual framings of research and innovation can be identified, reaching from a narrow technology push / technology fix perspective to more sophisticated understandings of the complex interplay between and co-construction processes of technology and society.

The comparative view on the seven Societal Challenges programmes revealed differences in the degree and concrete manifestation of responsibility ambitions. The findings of the diagnosis phase

of NewHoRRIzon allow us to draw the conclusion that the institutionalisation of RRI has in some areas already made substantial inroads, most likely facilitated by already existing de facto RRI convictions, while in a few other SCs a number very basic, paradigmatic debates about the general relationship between science and society need to be pushed forward. For the next years, these results call for continued efforts to mainstream RRI and the 3 Os in order to stabilise and further support the positive developments that have been observed. Reducing or even terminating mainstreaming efforts in the next European framework programme would mean to jeopardise the successful transformations in many of the research and innovation communities already underway before they have had a chance to deeply take root in the research and innovation systems.

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6. Annex: Social Lab Diagnosis Reports

Contents

NewHoRRIzon Diagnosis Report

Social Lab 7

"Health, Demographic Change and Well-being"

Grant Agreement No.	**741402**
Project Start Date	May 1st, 2017
Duration of project	48 months
Version	1.2
Author	Kerstin Goos Tanja Bratan

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1. Executive Summary

This report provides information on a diagnosis of the state of responsible research and innovation (RRI) in European Commission (EC) programming related to health (Societal Challenge 1). With a budget of 7.472 billion Euros, Health is one of the largest H2020 programmes.

European research and innovation tries to tackle the identified challenges related to health, which are chronic and infectious diseases, pandemic threats, antimicrobial resistance and the side effects of an aging population. Funding health research is framed as an investment in better health for all, in a healthy workforce, a healthy economy and lower public health bills.7 As such, the SC1 main policy objectives are to improve health and well-being outcomes, to promote active and healthy aging, to promote a more competitive European health industry and care sector, to maximise the digital potential and to promote the EU as a global leader in the health area.

The concept of responsibility in health research has a long tradition and been traditionally well established in terms of research ethics (ethical approval, informed consent, data protection) as well as, to a lesser degree, in terms of public engagement. Accordingly, there is a high degree of implicit awareness of responsibility in the programme line. There is also some awareness of the concept of RRI. The inclusion of RRI has evolved over H2020 health programming: While there is no mention in the 14/15 work programme, in WP 16/17 and WP 18/20 RRI has an overarching role, stakeholder engagement and multidisciplinarity of project teams are demanded explicitly throughout all work programmes. Gender is mentioned in more than half of the action descriptions. Ethics is being mentioned increasingly as H2020 progresses, but for many projects is present to some extent in any case as ethical approval from an ethics commission will be required.

Overall, it can be said that multidisciplinarity and the international dimension play an important role. Ethics is implicitly very important and in some calls also explicitly, but sometimes merely plays the role of a tick-box exercise as it is highly formalised in terms of the requirements for ethical approval. Gender is also well established at a formal level, but on a practical level is either not considered relevant or mostly covers gender balance in research teams, rather than differences in men and women in terms of needs and preferences as well as responses to treatment. There is good awareness of public engagement, but mostly on the level of organisations (such as patient organisations) rather than at individual patient or citizen level. The involvement of other stakeholders is also often lacking. Open access is present to some extent and is gradually increasing, e.g. through the need to make information on clinical trials available in registers. Science education plays a minor role. There is little concern for sustainability, both in terms of environmental issues as well as long-term benefits of projects.

2. Scope of this document

This diagnosis report is not an official deliverable. It is for internal use only by those involved in the Social Lab on Health, the leader of the NewHoRRIzon Work Package 4 on Societal Challenges as well as other interested members of the NewHoRRIzon Consortium.

The report has the purpose of providing a basis for starting the Social Lab process and the comparison across the different pillars of H2020.

7 https://ec.europa.eu/programmes/horizon2020/en/area/health

3. Methods

The report is based on the analysis of a broad range of documents and websites including scoping papers, policy documents, work programme documents, information on funded projects, evaluation documents.

Ten semi-structured interviews with health researchers and others involved in funding or facilitating/ supporting health research were carried out between March and June 2018 (three male, seven female). They lasted between 40 and 110 minutes and were audio recorded. The recordings were used to document the main points made in the interviews.

3.1. General scope of the program

European research and innovation tries to tackle the identified challenges related to health, which are chronic and infectious diseases, pandemic threats, antimicrobial resistance and the side effects of an aging population. Funding health research is framed as an investment in better health for all, in a healthy workforce, a healthy economy and lower public health bills.[8] As such, the SC1 main policy objectives are to improve health and well-being outcomes, to promote active and healthy aging, to promote a more competitive European health industry and care sector, to maximise the digital potential and to promote the EU as a global leader in the health area.

3.2. What is your program about?

Responding to the societal challenge "Health, Demographic Change and Wellbeing", "*research and innovation (R&I) under Horizon 2020 is an investment in better health for all. It aims to keep older people active and independent for longer and supports the development of new, safer and more effective interventions. R&I under Horizon 2020 also contributes to the sustainability of health and care systems*."[9]

Horizon 2020 tries to offer funding opportunities for a diversity of health research needs: fellowships, grants for individual or large collaborative public-private consortiums and loan schemes. As such, SC1 takes advantage of all H2020 instruments such as Research and Innovation Actions (RIA), Innovation Actions (IA), Coordination and Support Actions (CSA), Innovation Procurement (Pre-Commercial Procurement PCP, and Public Procurement of Innovation Solutions PPI), SME instrument, public-private partnerships, prizes and loans (InnovFin Infectious Diseases).[10]

The type of research supported should stimulate the entire health research and innovation cycle, from bench to bedside and the rapid transfer of knowledge. Research should be solution oriented and influence the development of new medical interventions and of evidence-based healthcare guidelines, policies and regulations (European Commission 2015c).

The main strategic orientations are as follows (European Commission 2015c):

1. To create a systemic change in health by promoting personalised health and care research. Following the idea of tailoring the right therapeutic strategy for the right person at the right time research projects are supported and a programme-level cooperation approach with member states to avoid fragmentation is funded.

8 https://ec.europa.eu/programmes/horizon2020/en/area/health
9 https://ec.europa.eu/programmes/horizon2020/en/h2020-section/health-demographic-change-and-wellbeing
10 Scoping paper for Horizon 2020 work programme 2018-2020, Societal Challenge 1: Health, demographic change and well-being, p.2. The Scoping Documents can be found here: https://ec.europa.eu/programmes/horizon2020/en/what-work-programme

2. To foster a stronger European healthcare industry supported by partnerships and innovative financial instruments. Private companies should be encouraged to apply research results for meeting challenges faced by society and for creating more high-quality job. The IMI (Innovative Medicine Initiative) contributes to this idea by bringing together relevant stakeholders, a specific SME instrument is designed for highly innovative companies, and better access to loans via the InnovFin infectious Diseases is funded.

3. To strengthen health research capacities and innovation strategies across all Member States. Through ERA-NETs and Joint Programming Initiatives (JPIs) coordination is supported and the Active and Assisted Living Programme (AAL) continues to support market oriented research and SMEs and works together with the European Innovation Partnership for Active and Healthy Ageing (EIP-AHA) to ensure wider dissemination of results.

4. To make the EU a stronger global player in healthcare research by funding Public Public Partnerships on "European and Developing Countries clinical Trials Partnership", the "Global Research Collaboration for Infectious Disease Preparedness" and programme-level cooperation schemes with third countries.

3.3. What is the size and structure of your program in terms of budget, applications and projects?[11]

Programme structure

"Health, demographic change and wellbeing" offers 15 funding channels: collaborative research, JPI (Joint Programming Inititatives), ERA-NET, FTI (Fast Track to innovation), SME instruments, InnovFin Infectious Diseases, Horizon Prizes, ESFRI (European Strategy Forum on Research infrastructures), IMI (Innovative Medicine Initiative), AAL (Active and Assisted Living Programme), EDCTP (European and developing Countries Clinical Trials Partnership), ERC (European Research Council), FET (Future and Emerging Technologies), MSCA (Marie Sklodowska-Curie Actions), EIT Health. It is structured into the following five areas:

- Collaborative research: support multidisciplinary and cross-sector research on health and care for generating and translating new knowledge into applications and benefits for the society (research priorities are personalized medicine, innovative health and care industry, infectious diseases and improving global health, innovative health, and care systems/integration of care, decoding the role of the environment, digital transformation in health and care, trusted big data solutions and cybersecurity).

- Innovative health and care industry: translate innovation into practical health and care application benefiting citizens, healthcare systems and businesses (IMI, SME instrument, FTI, INNOVFIN ID, EIT Health, horizon prizes).

- Working with member states and international partners: foster European and global coordination in health and disease research (EDCTP, AAL, ERA-NET, Joint Programming Initiatives).

- Blue Sky research: reinforce and extend the excellence of the EU's science base, including in life sciences and health-related research (ERC, FET, MSCA).

11The 3rd Health Programme runs in parallel to H2020. Further info about 3HP and external coherence with H2020 can be found in the recent 3HP evaluation

- Infrastructures: Support facilities, resources and services used by the science community to conduct research and foster innovation (12 European strategy forum on research infrastructures (ESFRI) projects in the health research area).

The Health Work Programmes "Health, demographic change and well-being" are structured as follows: the focus area call of the **Work Programme 2014-15** is named "Personalising health and care" and funds collaborative research in 34 topics, within seven research priority areas. These are: "Understanding health, aging and disease", "Effective health promotion, disease prevention, preparedness and screening", "improving diagnosis", "innovative treatments and technologies", "advancing active and healthy aging", "integrated, sustainable, citizen-centred care", and "Improving health information, data exploitation and providing an evidence base for health policies and regulation". In addition, funding for 15 coordination activities is offered (e.g. JPI activities, ERA-NET activities, GACD activities, EIP-AHA) as well as the "fast track to innovation pilot" and "other actions" including, for instance subscription fee for the Human Frontier Science Programme Organisation, tenders for programme evaluation, studies and impact assessment, the Scientific Panel for Health, or grants to the Global Alliance for Chronic Diseases.

The Health **Work Programme 2016-17** consists of the Call "Personalised Medicine" in which 21 topics in the six research priority areas "Understanding health, well-being and disease", "Preventing disease", "treating and managing disease", "active ageing and self-management of health", "methods and data", "health care provision and integrated care" are funded. Funding for 17 coordination activities is offered, for instance for valorisation of FP7 Health and H2020 SC1 research results, GACD prevention, support for Europe's leading Health ICT SMEs, Digital health literacy or standardisation needs in the field of ICT for Active and Healthy Ageing. As in WP 2014-15, the FTI pilot and SME instrument are funded as well as "other actions", including for instance InnoFin ID Pilot, evaluation of the EDCTP2 and IMI2 programme, or the Horizon Price.

The Health **Work Programme 2018-20** is structured into three Calls: "Better Health and care, economic growth and sustainable health systems", "Digital transformation in Health and Care" and "Trusted digital solutions and Cybersecurity in Health and Care". The first call consists of the five research priorities "Personalised Medicine", "Innovative health and care industry", "Infectious diseases and improving global health", "Innovative health and care systems- integration of care", "decoding the role of the environment, including climate change, for health and well-being". The second call has no focus areas, and the last call has two focus areas: "Focus Area on Digitising and transforming European industry and services" and "Focus Area on Boosting the effectiveness of the Security Union". Seven "other actions" are funded, e.g. subscription fees for the Human Frontier Science Pogramme, activities of the Scientific Panel for Health, External expertise, or Grants to the GACD.

Several activities, which are not included in the work programmes, are also part of the "Health, demographic change and well-being" challenge:

- Innovative Medicines Initiative (IMI) will continue to support collaborative research projects and builds networks of industrial and academic experts to boost pharmaceutical innovation in Europe.

- Active and Assisted Living Programme (AAL) will continue to support market-oriented research and SMEs, and work in tandem with the EIP on AHA to ensure the wider dissemination of best practices

- European and Developing Countries Clinical Trials Partnership (EDCTP)

In addition, the **European Research Council** (ERC) promotes investigator-driven, or bottom-up frontier research via grants, **future and emerging Technologies** (FET) offers grants for developing new lines of technology through unexplored collaborations between advanced multidisciplinary science and cutting-edge engineering and the **Marie Sklodowska-Curie Actions** (MSCA) provide grants for all stages of researchers careers and encourage transnational, intersectoral and interdisciplinary mobility. **EIT Health** (European Institute of Innovation &Technology) is another funding channel to provide grants to increase competitiveness of European industry, improve the quality of life of Europe's citizen and the sustainability of healthcare systems.

Budget allocation

The budget for SC1 in H2020 is 7.472 billion for the whole period 2014-2020. As of 1 January 2017 21% of the budget has been allocated, which is 1.55 billion EUR (Interim Evaluation Annex 2, p.587).

The detailed budget allocation per research priority is as follows:

Table 1**. Activities and allocated share of budget dedicated to SC1 for the programming period 2014-2017**

Activities in the legal basis	Allocated share of thematic budget [excluding IMI, EDCTP, AAL, the SME-Instrument, and project funding specific implementation aspects (ERA-NETs, CSA, etc.)
Understanding health, wellbeing and disease	16.5%
Preventing disease	16.5%
Treating and managing disease	40%
Active ageing and self-management of health	13%
Methods and data	7%
Health care provision and integrated care	7%

Source: European Commission 2017a, p.587, SC1 work programme 2014-2017.

By 1 January 2017, 281 projects were ongoing, none has been abandoned. 90% of funding is implemented via RIAs (237 projects), 2.5% of funding are CSAs (29 projects), 3% of funding are ERA-Net Co-funds (7 projects) and 0.4% of the funding are PCP/PPI CO-funds (4 projects).

Table 2: **Key data on signed grants per type of action (SME instrument & IMI excluded) for SC1: number, EC contribution**

INSTRUMENT	Nr of Signed Grants	EC Contribution to Projects (€ million)	Participant Total Costs in Signed Grants	Average Project Costs in Signed Grants (€ million)	Average Project EC Contribution to Signed Grants (€ million) and % of total costs
COFUND-EJP	1	49.9	74.1	74.1	49.9 (67%)
COFUND-PCP	6	22.2	26.4	4.4	3.7 [72 %]
COFUND-PPI	2	5.4	17	8.5	2.7 [32 %]
CSA	29	38.7	41.0	1.4	1.3 [94 %]
ERANET-Cofund	7	48.0	155.4	22.2	6.9 [31 %]
IA	4	13.6	15.2	3.8	3.4 [89 %]
RIA	237	1 380	1522	6.4	5.8 [91 %]
TOTAL / average	281	1 536	1820	6.5	5.5 [84 %]

Source: European Commission 2017a, p.589, CORDA, 1 January 2017.

Besides the standard collaborative research projects, several other instruments, which are not part of the work programmes, are also implemented in SC1 (European Commission 2017a, p.590):

- EUR 189 million had been committed for the IMI2 JU (15 projects)
- EUR 51.5 million had been committed for the Ambient Assisted Living (AAL2) Art 185 partnership (52 projects)
- EUR 214.8 million had been committed for the European & Developing Countries Clinical Trials Partnership (EDCTP2) Art 185 initiative (19 grants signed)676
- EUR 50 million had been committed for the InnovFin ID scheme
- EUR 2 million had been committed for two inducement Prizes.
- 14.6 million had been committed for the Human Frontier Science Programme.

Applications

In the first three years of H2020 SC1 actions resulted in 5644 eligible proposals (of which 2820 are related to the SME-instrument). The cumulated amount of EU contribution requested is more than 10 times higher than the foreseen budget. The evaluation resulted in 1687 proposals scoring above threshold. The number of selected projects was 588, the number of grants signed was 542 (of which 278 for the SME instrument) (European Commission 2017a, p.589ff).

The success rate of proposals is 9.4 %. The chance of an applicant in a collaborative research proposal is 11.2%, and 8.5% for the SME-instrument (European Commission 2017a, p.591).

Participation patterns

The characteristics of participants are as follows (European Commission 2017a, p.591):

- Higher or secondary education (mainly universities): almost 40 % of participations in H2020 - SC1
- research organisations: 25%
- Companies: 20 %

- other public bodies/other, including patients' and users' associations: 15 %

94% of funding goes to EU member states, more concretely to EU-15 countries (90.7 % of the total EU contributions by 1 January 2017). EU-13, Associated countries and Third countries receive similar shares (3.2 %, 2.7 %, 2.8% respectively). The geographical characteristics of beneficiaries look as follows:

Table 3: **Participation patterns (number and shares of participations, EU contribution, and rate of success, as % of proposals submitted, and as % of budget available) per group of country for SC1**

GROUP	Nr of Applications in Eligible Proposals (Nr of distinct Applicants)	Average number of Applications per Applicant	Share of Applications in Eligible Proposals	Nr of Applications in Retained Proposals (Share of Applications)	Success Rate of Applications (Success Rate of applicants)	EC Contribution requested in Eligible Proposals (€ million)	EC Contribution to applications in retained proposals in € million (Average contribution to applications)
EU-15	23 804 (6349)	3.7	81.4%	2 678 (82%)	11.3% (10.5%)	12 504.7	1 313.1 (0.5)
EU-13	2 319 (953)	2.4	7.9%	232 (7%)	10.0% (6.4%)	821.6	52.2 (0.2)
AC COUNTRIES	2 006 (705)	2.9	6.8%	199 (6%)	9.9% (5.5%)	762.3	49.4 (0.2)
THIRD COUNTRIES	1 122 (740)	1.5	3.8%	153 (5%)	13.6% (9.2%)	392.0	36.3 (0.2)
TOTAL	29 251 (8747)	3.3	100.0%	3 262 (100%)	11.2% (10%)	14 480.6	1 451.0 (0.4)

Source: European Commission 2017a, p.593, CORDA data, 1 January 2017, Applicants and Applications by Country groups (excl. SME instrument and JUs)

4. Current situation of RRI in the program

4.1. RRI in brief

Health research having direct impact on the physical and mental well-being of society as well as economic productivity means that ensuring it meets societal needs is of high importance.

Substantial aspects of RRI are quite dominant in the Health work programme, with the first sentence being the goal to achieve "better health for all". In general, we expect comparatively high presence of qualities of RRI, without them being explicitly called RRI. We assume that the awareness of ethics and gender is high in the health area, as well as stakeholder engagement. As health issues cross borders, it can be assumed that the international dimension (open to the world) also plays an important role.

4.2. Desktop findings:

4.2.1. Role of RRI

Policy document level

No	
Yes	Keys: some awareness O's: some awareness Implicit: high awareness

Drawing mainly on the Horizon 2020 regulation and the advisory group report, we detect a high awareness of RRI. To a huge extent this awareness is implicit and beyond the three Os and the keys (referring to substantial de facto RRI, multidisciplinarity and stakeholder involvement), but explicit references to the keys and the three Os can also be found. Nevertheless, particularly the Advisory Group Report shows that there is room for a lot of improvement.

Explanation:

Horizon 2020 Regulation (The European Parliament and the Council of the European Union 2013)
Scanning through the Horizon 2020 Regulation of 2013, the first sentence of the chapter related to "Health, demographic change and well-being" states the specific objective of the work programme, which is "to improve lifelong health and well-being of all" (p.148). A substantial dimension of RRI is reflected in this statement, including anticipatory ideas. Furthermore, the international dimension is emphasized by referring to the fact that "disease and disability are not stopped by national borders" (p.148). Involvement of all stakeholders, including patients and end-users, patient organisations, and health and care providers, as well as better informing citizens as part of health promotion and multidisciplinary research approaches can be found on the agenda of the health work programme. In general, H2020 dismissed the disease-centred approach as it is formulated in terms of challenges. As such, multidisciplinary research is favoured instead of silo research.

Interim Evaluation & Scoping Paper[12]
According to the interim evaluation, "SC1's main policy objectives were from the start in line with the Three O's main objectives Open Innovation, Open Science and Open to the World" (European Commission 2017a, p.603).

The Scoping Paper for SC1 classifies the policy objectives as follows:

SC1 main policy objective	Relevant 3 Os
To improve health and well-being outcomes	Open innovation, Open science
To promote active and healthy aging	
To promote a more competitive European health industry and care sector	
To maximise the digital potential	Open innovation, Open science
To promote the EU as a global leader in the health area	Open to the world, Open science

SC1 Advisory Group Report 2016[13]
The Advisory Group Report 2016 covers vertical themes (personalised medicine, rare diseases, infectious diseases, non-communicable diseases, paediatrics, public health and prevention including migration, active and healthy aging), horizontal themes (big data, eHealth/mHealth/ICT, integration of care, environment and health, green solutions and sustainability including climate change) and cross-cutting issues (SSH/integration/inequalities/migration/Ethics, sex and gender differences in medicine, Commercialisation within SC1, encouraging stronger and successful involvement of EU-13). For each theme, a separate working group prepared a report.

12 The Scoping paper can be found here: https://ec.europa.eu/programmes/horizon2020/en/what-work-programme
13 starting point of deliberations H2020 for 2018-2020, requested by DG RTD

RRI in the vertical themes: Reading through the report, qualities of responsible research and innovation can be found throughout the whole text without calling it RRI. One important reference point is the European and international scale of health research that needs interoperability of databases and facilitates the development of the European market (for e.g. Personalised medicine). Integrated approaches are demanded, stakeholder engagement and the encouragement of dialogues are necessary to reach wide acceptance (including public acceptance). The need for multidisciplinary approaches, concerted R&D approaches (industry, SMEs and research organisations) or coherent support for open innovation is mentioned several times throughout the report. Predictive research and research on the best prevention programmes play an important role in the theme "public health and prevention". Generally, prevention, patient involvement and citizen empowerment are recurrent keywords.

RRI in the horizontal themes: As big data has been identified as a highly important aspect of health research, harmonisation and standardisation of data resources play an important role, progress towards use of big data requires integrated and multidisciplinary approaches. The challenge of legal, ethical and data protection issues need to be tackled, interdisciplinarity is important as well as a better coordination between stakeholders (e.g. in the care area).

RRI in cross-cutting issues: Regarding SSH issues, the Advice Report states that a more inclusive approach to ethics and SSH is necessary, as it will allow "to really put the patient/participant at the centre of [...] research and treatment endeavours [...]" (SC1 Advisory Group 2016, p.103). Ethical considerations, psychosocial issues, privacy protection while data is shared across international platforms, avoidance of increase of social inequalities in Europe by using participatory research as an instrument, following holistic approaches and synergistic benefits of multi-disciplinary research or examination of resilience factors against reduced well-being are proposed as research actions. Identified potential game changers are workplace health promotion intervention, identification of resilience factors and correlation with well-being, and democratising healthcare and research across resource-poor and rich areas.
The topic "sex and gender differences" plays an important role in health research. The report calls for an improvement of sex and gender integration into research, because there is a need for further research on how intervention and therapies affect men and women differently. One research orientation should be "a multi-sectoral and interdisciplinary commitment to routinely include sex and gender considerations into all research programmes" (SC1 Advisory Group 2016, p.112).

Scoping level

No	
Yes	Keys: some awareness O's: some awareness Implicit: some awareness

Explanation:

The Scoping Paper for the work programme 2018-20 is based on the SC1 Advisory Group report and subsequent stakeholder consultations (closing date 15 July 2016) as well as conclusions of several events organised by DG RTD and DG CNECT. The scoping paper guided the preparation of the work programme itself. It identified four strategic priorities (p.3 ff.): "Better health and care, economic growth and sustainable health systems", "Decoding the role of the overall environment for health and well-being", "Digital transformation in Health and Care" and "Trusted big data

solutions and cybersecurity for health and care". While "RRI" as a term does not appear in the further descriptions of these four priorities, several dimensions of it can be found in there: The priority "better health and care, economic growth and sustainable health systems" implies "taking care of the future" and an orientation towards what could be called "right impacts". It is about "reconciling better health and healthy ageing with the need to develop sustainable health and care systems and growth opportunities for the health and care related industries" (p.4), implemented for instance via the research area "improving global health". Several references to the specific need of patients and providing evidence of benefits to the society are made. The text refers to the international dimension of health problems and calls for international cooperation when relevant. "Empowering the participation of citizens and facilitating the transformation of health and care services to more person-centred and community-based care models" (p.7) is defined as part of the ultimate goal to manage health and well-being in the strategic priority "digital transformation in health and care". This priority also aims at creating open health innovation, international cooperation and cross-border and within-border interoperability. Reference to qualities of RRI can be also found in the descriptions of the scope of the suggested calls: for instance, it says that the call should "make health and care systems and services more accessible, responsive and efficient in Europe and beyond" (p.8) and an important line of research will be "to identify effective adaptive responses and behaviours also a the systems level" (p.9). The full research and innovation cycle is taken into account. Regarding digital healthcare systems, the call addresses research on use of big data for improving health and care. A broad range of new trust and data models, analysis of behavioural and physiological patterns, early risk detection and disease prevention may be encompassed.

Work programme level

No	
Yes	Keys: some awareness O's: some awareness Implicit: high awareness

Regarding the health work programme level, i.e. the overall challenge "health, demographic change and well-being" in H2020, we can draw on several bits and pieces to get an impression of RRI herein:
Looking at the objectives of the Health work programme, implicitly RRI is very present. Framing funding health research as an "investment in better health for all" in order to improve health and well-being appears to be very close to societal needs and RRI. Global concerns and health inequalities are addressed, future challenges are taken into account, i.e. an anticipatory dimension of RRI can be found here. Stakeholder engagement plays an important within the whole work programme: "an appropriate European level research, development and innovation effort, in cooperation with third countries and with the involvement of stakeholders, including patients and end-users, can and should make a crucial contribution to addressing these global challenges [...]" (The European Parliament and the Council of the European Union 2013, p.148). Engagement is mainly understood as engagement of organisations such as CSOs, patient organisations or SMEs. Engagement of individuals only plays a minor role, mainly in the sense of dissemination. Gender has a central role in the Health work programme, although the awareness for gender in research content is just about to increase. Participation in the Open Research Data Pilot is voluntary for all Health projects. On the general work programme level, we see a development between 2014 and 2018: on the descriptive level, WP 2014-15 doesn't mention the

term RRI at all, WP 16-17 mentions it in the introduction and WP 18-20 mentions RRI and the three Os in the introduction.

With regard to the development of the work programmes, in the interim evaluation it is stated that "consulting stakeholders has been an integral part of the programming process, a process that actually started as early as 2011, with two Advisory Workshops" (European Commission 2017a, p.606). In order to develop the work programmes, SC1 particularly considered the targeted consultations of stakeholders in 2014, the SC1 advisory group reports and a stakeholder consultation for the work programme 2018-2020 in 2016. SC1 also shows flexibility to react to current health policy needs such as Ebola, ZIKA or migration (European Commission 2017a, p.583), which reflects the work programmes' ability to be responsive.

Call level

No	
Yes	Keys: some awareness O's: high awareness Implicit: high awareness

The term RRI is mentioned in WP 2016-17 and WP 2018-20, but only in the introduction. However, an awareness for dimensions of RRI does exist in the work programmes. Stakeholder engagement and multidisciplinarity of project teams is demanded throughout all work programmes. Gender is mentioned in more than half of the action descriptions from the beginning on. Ethics plays a relatively small role, science education plays a minor role. Substantial dimensions of RRI, such as "improving the quality of life of citizens" are very obvious, also reflected in the decision to fund for instance vaccine development, rare diseases, care or prevention.

Explanation:

Work Programme 2014-15 (European Commission 2015a)
Looking at the SC1 Work programme descriptions, RRI is not explicitly mentioned in **WP 2014/15**. Implicit references to RRI are made through two statements in the introduction to the work programme: one says "further appropriate stakeholder and public engagement will be organised", and the second one refers to the Open Research Data Pilot, which is novel in H2020 and offers SC1 projects to participate on a voluntary basis.
In the call texts, action lines and thematic descriptions the term RRI does not appear. References to qualities of RRI are made in various ways though:
Gender: The text of the PHC (personalising health and care) call refers to gender in practically every action description. The formulation is as follows: proposals should "take into account sex and gender differences" or "sex and gender differences should be included where appropriate" or "where relevant". The HCO (Coordination activities) are more attentive to explaining gender dimensions, but fewer topics, though better introduced. Gender appears in 4 topics (out of 17).
Ethics: The work programme description mentions ethics in 10 out of 34 action descriptions within the "personalising health and care" (PHC) call. Within the coordination activities only one (out of 17) actions explicitly mentions "ethics". Usually, ethics is mentioned together with other "SWAFS issues": The formulations are for instance that the proposal should include "the assessment of behavioural, ethical, legal, regulatory and social implications [...]", the expected impact should include "ethical and societal considerations", proposals should "assess existing

screening and disease prevention strategies and programmes, on the basis of health outcomes, quality-of-life, equity and cost-effectiveness and ethical considerations", proposals should have "the necessary ethical and regulatory authorisations to carry out the work" or "gender and ethical issues should be paid due attention".
Science Education: Science education plays a minor role in the SC1 work programme: there is some reference to health education in "PHC 4 - 2015: Health promotion and disease prevention: improved inter-sector cooperation for environment and health based interventions" and two actions in which patient empowerment and self-management of health play a role (PHC 26 and PHC 27). In addition, HCO 15 - 2014 Mobilisation and mutual learning action plan aims at contributing to the implementation of SWAFS, i.e. to the five keys.
Public Engagement & stakeholder engagement: Stakeholder integration plays a role. In 12 out of 34 action descriptions in the Personalising Health and Care Call (PHC), stakeholders are mentioned in various ways: "involve relevant stakeholders such as policy makers, the private sector, civil society organisation and so on", "Proposals should build on [...] stakeholder engagement in order to be driven by relevant user needs to ensure end-user acceptance", "views of relevant stakeholders and citizens should be taken into account", "user involvement" or the utilisation of the "capacity and potential of the patient as a co-producer of health".
Besides the public in general, stakeholders in the health system could be patient organisations, member states, health authorities, industry, financial institutions, investors, insurers, the research community and public authorities. Within the call texts of the coordination activities (HCO), 9 out of 17 action descriptions make a particular reference to dissemination, engagement of stakeholders or end-users. The focus clearly lies on stakeholders and less on citizens or patients as individuals.
Three Os: In line with the importance stakeholder engagement plays, open innovation is reflected in WP 14-15, although the term "open innovation" does only appear once. 'Open to the world' is important insofar as the need for international cooperation is mentioned throughout the whole work programme.

Work Programme 2016-17 (European Commission 2017b)

In **WP 2016/17**, RRI is mentioned in the introduction: "The 'Health, Demographic Change and Well-being' Work Programme 2016-2017 integrates the principle of responsible research and innovation in all its activities, including addressing gender/sex differences as well as ethics, social sciences and humanities (SSH) whenever relevant." There is again, as in WP 2014/15, reference to the Open Data Pilot. In the call texts, action lines and thematic descriptions the term RRI does not appear. References to qualities of RRI are made in various ways though:
Gender: The text of the PM (personalised medicine) call refers to gender in practically every action description. The formulation is as follows: proposals should "take into account sex and gender differences" or "sex and gender differences should be included where appropriate" or "where relevant". The HCO (Coordination activities) is a bit more detailed in the role gender should play, but gender appears only in 2 topics (out of 17).
Ethics: Ethics is mentioned in 9 out of 22 action descriptions or the Personalised Medicine Call. It does not play a role in the Coordination activities, and only a minor role in SME instruments. Formulations referring to ethics are "proposals should address relevant ethical implications", "the research should pay particular attention to ethical issues" or "provide robust safeguards to ensure compliance with ethical standards and privacy protections".
Public Engagement and stakeholder integration: Very generally, stakeholder integration plays an important role. In 10 out of 22 action descriptions in the Personalised medicine (PM) call, stakeholders are mentioned in different ways: "involve relevant stakeholders" is an often used phrase, "applicants are encouraged to actively involve patient associations" (SC1-PM-2), "foster

dissemination of scientific results and knowledge exchange between stakeholders", "a public engagement component should be included" (SC1-PM-5) or "due consideration should also be paid to involve patients and take their views into account wherever relevant" (SC1-PM-9). Besides the public in general, stakeholders in the health system could be patient organisations, member states, health authorities, industry, financial institutions, investors, insurers, the research community and public authorities. Within the call texts of the coordination activities (HCO), 8 out of 17 action descriptions make a particular reference to dissemination, engagement of stakeholders or end-users.
Science Education: Science education plays a minor role in the SC1 work programme: there is one action description covering the topic in some way, called "promoting mental health and well-being in the young". Another reference is related to education materials with regard to active and healthy ageing and ICT solutions and with regard to education and training opportunities for eHealth workforce.
Three Os: In line with the importance stakeholder engagement plays, open innovation is reflected in WP 16-17, although the term "open innovation" does only appear once in "SC1-PM-12-2016: PCP - eHealth innovation in empowering the patient". 'Open to the world' is important insofar as the need for international cooperation is mentioned several times.

Work Programme 2018-20 (European Commission 2017c)

WP 2018/20 particularly refers to the principle of Openness (three Os), and states that SC1 aims to deliver solutions for a better health for all by building on the three Os. The introduction also says that "this Work Programme implements several overall recommendations expressed in the Horizon 2020 interim evaluation, such as enhancing societal involvement and societal impact". Related to *RRI*, it says: "*Social sciences and humanities* research is incorporated, and sex differences and gender aspects are addressed where relevant. SC1 integrates the *principle of responsible research and innovation*, including *ethics*, in all its activities. [...] In line with promoting 'Open Science', grant beneficiaries in this work programme will engage in research data sharing by default, as stipulated under Article 29.3 of the Horizon 2020 Model Grant Agreement (including the preparation of a data management plan), and in particular FAIR2 (findable, accessible, interoperable and reusable) data sharing. Participants may however opt out of these arrangements, both before and after the signature of the grant agreement. "For clinical studies, the 'Open Science' approach requires (i) the registration of the study prior to the enrolment of the first patient in a registry which is part of the WHO Registry Network, and (ii) in line with the WHO 'Joint statement on public disclosure of results from clinical trials' the disclosure of the study results by posting on the results section of the registry and through journal publication within 12 months from primary study completion. In the call texts, action lines and thematic descriptions the term RRI does not appear. References to qualities of RRI are made in various ways though:
Gender: In the "better health and care, economic growth and sustainable health systems" call, gender is mentioned in every action line except the ERA-NET. "Proposals should take into account sex and gender differences" is an often used phrase, often in combination with "where relevant". In all other calls gender is mentioned regularly, except the "Digital transformation in health and care", gender plays only a minor role.
Ethics: Ethics is mentioned in 19 out of 48 action descriptions of the work programme calls. Formulations referring to ethics are "proposals should address relevant ethical implications" or "the research should pay particular attention to ethical issues". In the call "Digital transformation in Health and Care" ethics occur as ethical aspects of data, confidentiality, and anonymity of data transfer.
Science Education: Science education plays a minor role in the SC1 work programme: there are only very few references to training and education activities in the health field.

Public Engagement: Stakeholder and/or citizens are mentioned in 20 out of the 48 action descriptions. In fact, patients and citizens themselves only play a smaller role compared to stakeholders such as industry, regulatory authorities, SMEs, health and care professionals, civil society representatives. In two action descriptions it is required that "relevant stakeholders must be involved in the consortium". It seems that the wording has become more demanding, it is less "where relevant" or "as appropriate" but rather "stakeholders must be included".
Three Os: In line with the importance stakeholder engagement plays, open innovation is reflected in this work programme, although the term "open innovation" does only appear once. 'Open to the world' is important insofar as the need for international cooperation is mentioned throughout the whole work programme.

Project level

No	
Yes	Keys: some awareness O's: some awareness Implicit: some awareness

The role of RRI in the projects varies. In some projects procedural dimensions of RRI do not play a role at all, but the aim of it responds to a societal demand (such as vaccine development). Several projects attempt to include a variety of stakeholders, sometimes also citizens or patients.
Scanning through about 60 funded projects, we identified, very roughly, three categories of projects: some "RRI Highlight projects", in which the awareness of the concept of RRI is very high. Many projects try to include a variety of stakeholders and/or reach a wider public with their dissemination activities or they highlight any one quality of RRI. And a third group of projects might relate to RRI through a particular aim reflecting societal needs.
As follows, results of the interim evaluation are presented to give a general overview of RRI within the SC1 projects. In a second step, the results of our analysis of CORDIS abstracts and projects websites of projects funded in Work programme 2016-2017 will be presented.

Results of the interim evaluation (European Commission 2017a)
The Three Os: The assessment of the current portfolio by the project officers suggests that 42 % of projects (39 % of the funding) are considered relevant to *Open Innovation*[14]. For instance, the project ICT4Life will develop a modular health service platform to allow for the efficient provision of integrated care adapted to different end-user needs for patients suffering from dementia, Alzheimer's or Parkinson's disease. The IMI Joint Undertaking as being the worlds' largest PPP in the health sector has also been a pioneer of open innovation. As SC1 promotes better standardised and harmonised data at the EU level, 62.5 % of projects are considered relevant to *Open Science* (European Commission 2017a, p.604). 45.5% of projects are found relevant to the *Open to the World* priority, 56% of SC1 collaborative projects have at least one third or AC country team in their consortium (European Commission 2017a, p.605).

Stakeholder Engagement: In 17.4 % of SC 1 projects, citizens, CSOs and other societal actors contribute to the co-creation of scientific agendas and contents[15]. They are representatives of patients or users who provide useful, sometimes crucial, information on the needs and expectations of important stakeholders, thereby influencing the project's design. Such

14 Data resulting from the assessment by the POs of the relevance of their projects to cross-cutting and policy objectives.
15 Data on this cross-cutting issue is provided by EC project officers during grant agreement preparation.

organisations are highly involved in the European Innovation Partnership for Active and Healthy Ageing initiative (EIP-AHA), and they play an active role in the definition of personalised medicine. Another example is the HBM4EU initiative, which represents a novel way of collaborating between several Commission services, EU agencies and national representatives, highlighting how research funding can build bridges between the research and policy worlds. A joint effort of 26 countries and the Commission, it aims to coordinate and advance human bio-monitoring in Europe and will thereby provide better evidence of the actual exposure of citizens to chemicals and the possible health effects to support policymaking. Patient associations, user organisations and similar types of stakeholders are directly involved and play a significant role in a large number of projects, e.g. in some areas all projects must include end-user representatives to allow for verification of impact in real environments.
Gender: The separate interim evaluation focusing on gender equality (European Commission 2017e, p.21) shows that gender flags regarding the integration of the gender dimension in the content of RRI in WP 14-15 are very frequent in SC1 health topics: 22 out of 33 topics are gender flagged. Only SwafS has a higher share of flags (6 out of 6 topics). Regarding the funded projects, 126 out of 190 received a gender flag in WP 14-15.

Analysis of CORDIS abstracts and project websites
The work programme 2016/17 is structured into six research priority areas "Understanding health, well-being and disease", "Preventing disease", "treating and managing disease", "active ageing and self-management of health", "methods and data", "health care provision and integrated care" in which funding in 22 topics invite to submit proposals. CORDIS data shows that so far 64 projects related to 14 of the topics have received funding. By scanning the CORDIS abstracts of the funded projects and gathering further information from the websites of the projects (if available), we tried to assess the role of RRI for the project level:
Within the research priority "Understanding health, well-being and disease" one focus lies on the facilitation and optimization of research based on already existing cohorts. RRI understood as Open Science is reflected in the projects' aim to harmonize and integrate already existing cohort data (e.g. HarmonicSS, RECAP, Lifebrain, MultipleMS, EUROlinkCAT, Lifecycle). Addressing and involving affected patients is also a common approach, not only in their role as objects of study and health data resources, but also as valuable contributors to set research priorities (EUROlinkCAT). In addition, the building of stakeholder networks plays an important role, bringing together different disciplines, patient organizations, policy makers and research organizations and/or affected patients.
Beyond these rather procedural elements, the expected social impact is clearly of importance for the funded projects. For instance, on the website of MultipleMS it is stated: "we are a diverse group of scientists and physicians with a common goal: to improve the lives of people with MS"[16]. A project called LIFECYCLE has three (out of thirteen) work packages related to the "Impact for societies and individuals"[17].
The research priority "preventing disease" covers one theme that foresees explicit funding for the "Human Biomonitoring Initiative" and another theme called "vaccine development for malaria and/or neglected infectious diseases". All of the selected projects aim in some way at improving health and well-being for all age groups or particular age groups. The HBM4EU builds bridges between the research and policy world by bringing together policy makers, scientists and other stakeholder together to ensure that related research addresses societal concerns. The projects focusing on vaccine development should deliver new vaccine candidates in support of the sustainable development goal to "end by 2030 the epidemics of malaria and neglected tropical disease".

16 http://www.multiplems.eu/
17 https://lifecycle-project.eu/for-scientists/workpackages/

Within the thematic research priority "treating and managing disease", all projects are funded under the two action lines "new therapies for chronic diseases" and "clinical research on regenerative medicine". As the topic descriptions leave some room for interpretation, the extent to which qualities of RRI are taken into account varies widely between the funded projects: While the HIVACAR project states that it has been conceived under the framework of RRI (patients and other stakeholders will have a key role from the inception of the project until obtaining the results), the majority of the other funded project do not follow any particular approach regarding the procedures which are typically associated with responsible research and innovation. Again, besides that, what all funded projects have in common is the aim to improve the quality of life of patients.
The research priority "active ageing and self-management of health" inspired a great variety of project proposals: one action line focused on PCP (precommercial procurement) by challenging industry to develop systems that connect patients, carers and health professionals (ProEmpower, LIVE INCITE, STARS, NIGHTINGALE). While both the idea as such and the articulated requirements seem to align with ideas of responsible innovation, we do not have any knowledge so far regarding the particular progress made within the funded projects. Another thematic focus lies on personalised coaching where all projects follow a user centric design process in the development of solutions (EMPATHIC, vCare, CAPTAIN, NESTORE, SAAM).

Proposal Template level

No	
Yes	Keys: some awareness O's: some awareness Implicit: some awareness

The Participant portal[18] offers proposal templates for different funding opportunities. For the Health Work Programme, several templates are relevant, e.g. RIA/IA, CSA, PCP, PPI, ERA-NET Cofund, EJP, SME, FTI. To exemplify the role of RRI, the proposal template for RIA/IA 2018-2020 has been analysed[19]:

The template contains a check box for a section on ethics, investigating whether the research involves human embryos/foetuses, humans, human cells/tissues, personal data, animals, third countries, environment & health and safety, dual use, exclusive focus on civil applications, misuse, other ethics issues. Another section contains information about the "Extended Open Research Data Pilot", which is related to the three Os. Participation is flexible in the sense that not all research data needs to be open and that applicants can opt out of the pilot.

Under section "1.3 concept and methodology; quality of measures" it is stated "where relevant, describe how the gender dimension i.e. sex and/or gender analysis is taken into account in the project's content". The RIA/IA template requires in the "Concept section" that applicants have to "identify any inter-disciplinary considerations and, where relevant, use of stakeholder knowledge. Where relevant, include measures taken for public/societal engagement on issues related to the project."
In the sub-section 2.1 "expected impacts" of the "2. impact" section, RIA/IA wants applicants to describe "any substantial impacts not mentioned in the work programme, that would enhance

18 http://ec.europa.eu/research/participants/portal/desktop/en/funding/reference_docs.html#h2020-call_ptef-pt-2018-20
19 Differences to WP 14-15 and WP 16-17 and CSAs are minor, as RIA/IA and CSAs are the main funding instruments, we chose to analyses them.

innovation capacity; create new market opportunities, strengthen competitiveness and growth of companies, address issues related to climate change or the environment, or bring other important benefits for society". Barriers and obstacles should be described, such as regulation and standards, but also public acceptance, workforce considerations or financing of follow-up steps - the idea of anticipation is reflected here.
Section 2.2 "measures to maximise impact" requires the provision of a "plan for the dissemination and exploitation of the project's results". In an additional note it is stated that "the full range of potential users and uses, including research, commercial, investment, social, environment, policy-making, setting standards, skills and educational training where relevant" should be considered. Another note relates to the follow-up of the project saying that the applicant "should give due consideration to the possible follow-up of your project, once it is finished. Its exploitation could require additional investments, wider testing or scaling up. Its exploitation could also require other pre-conditions like regulation to be adapted, or value chains to adopt the results, or the public at large being receptive to your results." Again, an anticipatory dimension can be found here. Part of the dissemination and exploitation of results are also "measures to provide open access". Section 5.1 is fully devoted to ethics, in a sense of "responsible conduct of research". The requirements are stated in case any ethics issues are entered: an ethics self-assessment has to be submitted and particular ethics documents (such as ethics committee opinion) have to be provided.

As we can see, the term RRI does not appear in the proposal template. Several references to the threes Os, the keys and de facto RRI are made though. Open Access, ethics, gender, stakeholder engagement, public engagement are explicitly mentioned, although mostly in a "conservative" way, as there is no obligation to explain these dimension (except ethics), but a rather voluntary task to take them into account, *where relevant*. Beyond the dimensions and the three Os, "benefits for society" are also mentioned, i.e. substantial RRI.

Evaluation level

No	
Yes	Keys: some awareness O's: some awareness Implicit: some awareness

RRI as a term does not explicitly play a role in the General Annex H 'Evaluation rules', but some dimensions of RRI are mentioned. The formulations related to RRI give some room for interpretation though and therefore seem to be rather soft. As follows, firstly, RRI relevant phrases of the evaluation rules are presented. Secondly, further explanations of the participant portals' FAQs are described. In a last step, we will present an additional dimension of evaluation: the key performance indicators (KPI) for the Health programme.

General Annex H, Work Programme 2016-17/Evaluation criteria (European Commission 2017d)
General Annex "H. Evaluation rules" for H2020 Work Programme 2016-17 lists the award criteria "excellence", "impact" and "quality and efficiency of the implementation" and the related aspects that have to be considered in order to receive scores. Within the "excellence" criteria, for RIA, IA and SME instruments one RRI relevant aspect is the "appropriate consideration of interdisciplinary approaches and, where relevant, user of stakeholder knowledge". As such, proposals must show that interdisciplinary approaches and use of stakeholder knowledge are adopted if appropriate. Proposals must explain if an interdisciplinary approach is not appropriate.

For ERA-NET activities and EJP Cofund actions the "level of ambition in the collaboration and commitment of the participants in the proposed ERA-NET action to pool national resources and coordinate their national/regional research programmes", which would fall under "*open to the world".*
RRI relevant aspects of the award criteria "impact" can be found in the following phrases: RIA, IA and SME instrument actions should deliver "any substantial impact not mentioned in the work programme, that would enhance innovation capacity, create new market opportunities, strengthen competitiveness and growth of companies, address issues related to climate change or the environment, **or bring other important benefits for society**". Almost all types of actions should "exploit and disseminate the project results (including management of IPR) and manage research data where relevant" as well as "communicate the project activities to different target audiences". ERA-NET Cofund actions in particular should also pool "national/regional resources and contribute to establishing and strengthening a durable cooperation between the partners and their national/regional research programme". Regarding the quality and efficiency of implementation, all types of actions have to take the "appropriateness of the management structures and procedures, including risk and innovation management" into account.

Participant Portal
The Participant Portal FAQs explain how *RRI* should be addressed and evaluated in H2020 proposals.[20] It states that if topics are RRI flagged, applicants should react to the topic description and explain how "they will involve societal actors relevant to the topic in specific activities or in the overall approach in one or more of the five dimensions of RRI (depending on the topic text)". Evaluators will then consider the explanations when evaluating the 'excellence' criteria. Currently (Feb 2018) 81 (open and forthcoming) topics are flagged with an RRI tag in the Participant portal. None of these flagged topics is from Health SC1.[21]
According to the FAQs, if *public engagement* is indicated in the topic description, evaluators will assess the proposals under the 'excellence' criteria (concept and methodology, appropriate interdisciplinary considerations, where relevant stakeholder knowledge) and 'impact' (communication, dissemination and exploitation activities).[22] It will be examined if the engagement process is methodologically sound, includes the appropriate expertise and resources, is well-timed and is likely to have a genuine positive impact during and after the project.
The same accounts for g*ender*: if it is specified in the topics in what way gender is relevant under the scope and impact of the topic description, evaluators will check how sex and/or gender analysis is taken into account and consider this while giving scores under the "excellence" and/or the "impact criteria".[23] In addition, in case of ex-aequo proposals gender comes into play as a ranking factor.

As it is the case for *RRI*, lists of work programme topics where other cross-cutting issues play a role have been created:
- for gender[24], currently (Feb 2018) 31 out of 45 (open and forthcoming) topics in SC1 are gender flagged (119 (open and forthcoming) topics of all current topics have a Gender tag in the Participant portal).

20 https://ec.europa.eu/research/participants/portal/desktop/en/support/faqs/faq-944.html
21https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/ftags/rri.html#c,topics=flags/s/RRI/1/1/0/default-group&callStatus/t/Forthcoming/0/1/0/default-group&callStatus/t/Open/1/1/0/default-group&callStatus/t/Closed/1/1/0/default-group&+callStatus/asc
22 https://ec.europa.eu/research/participants/portal/desktop/en/support/faqs/faq-939.html
23 https://ec.europa.eu/research/participants/portal/desktop/en/support/faqs/faq-977.html
24https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/ftags/gender.html#c,topics=flags/s/Gender/1/1&+callStatus/asc

- for 'Open Innovation[25]', currently (Feb 2018) 15 out of 45 (open and forthcoming) topics in SC1 are flagged (92 (open and forthcoming) topics of all current topics have an 'open innovation tag' in the Participant portal).
- For 'Open Science[26]', currently (Feb 2018) 11 out of 45 (open and forthcoming) topics in SC1 are flagged (56 (open and forthcoming) topics of all current topics have an 'Open Science tag' in the Participant portal).
- For 'Open to the World'[27], currently (Feb 2018) 14 out of 45 (open and forthcoming) topics in SC1 are flagged (148 (open and forthcoming) topics of all current topics have an 'Open to the World' in the Participant portal).

The fact that work programme topics receive particular flags for RRI, gender, open innovation, open science and open to the world shows that they are perceived to be relevant. Looking at the distribution of flags, currently (Feb 2018) two thirds of SC1 calls are tagged with a gender flag, none is tagged with an RRI flag, roughly one third of current topic calls is tagged with 'open innovation', 'open science', 'open to the world' respectively. Referring to these tags, RRI and its dimensions is only of medium importance.

Key Performance Indicators (KPI)
The European Commission monitors the implementation of Horizon 2020 through monitoring reports based on KPI to assess the results and impact of H2020. The indicators are defined "as the measurement of an objective to be met, a resource mobilised, an effect obtained or a context variable" (European Commission 2015b, p.6). These KPI are focused on assessing the impact of H2020 and will be based on the periodic and final reports provided by the projects. The legal basis for the KPI is Annex II of the H2020 Council Decision (Council of the European Union 2013). For the priority "Societal challenges" (of which Health is part of), the following KPI are defined (Council of the European Union 2013, p.1037f.):

- Publications in peer-reviewed high impact journals in the area of the various societal challenges
- Number of prototypes and testing activities
- Patent applications and patents awarded in the area of the various societal challenges
- Number of joint public-private publications

As a matter of fact, RRI or dimensions of RRI do not play a role in the KPIs defined for the societal challenges part of Horizon 2020.

4.2.2. General use of RRI

The relevance of the term RRI is rather low in the Health work programme, but the awareness of qualities of RRI is high. To a great extent this awareness is implicit and beyond the three Os and the keys (referring to substantial/de facto RRI, multidisciplinarity and stakeholder involvement), but explicit references to the keys and the three Os can also be found. For instance, gender receives particular attention throughout the work programmes, though a particular focus on gender in research content is just about to be foregrounded. Particularly gender has the potential to play a very important role within the health area, as sex and gender differences within health research, e.g. with regard to individualised treatment, gain more and more prominence. Science education plays a minor role; there is an awareness for public engagement, though to a lesser extent

25https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/ftags/open_innovation.html#c,topics=flags/s/OpenInnovation/1/1&+callStatus/asc
26https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/ftags/open_science.html#c,topics=flags/s/OpenScience/1/1&+callStatus/asc
27https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/ftags/open_to_the_world.html#c,topics=flags/s/IntlCoop/1/1/0/default-group&callStatus/t/Forthcoming/0/1/0/default-group&callStatus/t/Open/1/1/0/default-group&callStatus/t/Closed/1/1/0/default-group&+callStatus/asc

in a sense of citizen engagement, but rather on the level of organisations (such as patient organisations). The international dimension plays an important role, open innovation understood as including a multiplicity of actors is also well established.

There has been a change from silo research to multidisciplinary approaches in the health programme - a development that is in line with the RRI approach. Within the great variety of funded projects and initiatives of the Health programme, RRI is not the central overarching frame, but it is very easy to find bits and pieces that reflect an *RRI thinking* - may it be a particular focus on one of the RRI keys or the general aim to improve health, to promote active aging. Responsiveness and anticipation also play a significant role within Health.

4.2.3. RRI beyond the keys

Please see 4.2.2.

4.2.4. Theoretical framework of RRI applied in the program line

The Health work programme is a response to the EU policy priority "societal challenges", precisely "Health, demographic change and well-being". According to the Horizon 2020 Regulation (European Parliament and the Council of the European Union 2013), all activities tackling the challenges shall take a challenge-based approach. This may include "basic research, applied research, knowledge transfer or innovation, focusing on policy priorities without predetermining the precise choice of technologies or solutions that should be developed" (p.124). It is stated that "Non-technological, organisational and systems innovation as well as public sector innovation will be given attention in addition to technology-driven solutions". A "critical mass of resources and knowledge across different fields, technologies and scientific disciplines and research infrastructures in order to address the challenges" is emphasised. Regarding Health, the specific and plain objective for "health, demographic change and well-being" is "to improve the lifelong health and well-being of all" (p.147). Further elaborations bring in the economic aspects: it is about "high-quality, economically sustainable and innovative health and care systems, as part of welfare systems, and opportunities for new jobs and growth" (p.147). Although the Health approach is citizen centred and anticipatory in sense of care for the future, it is also about hard financial facts as social and economic health costs are rising. However, reading further through the H2020 regulation, a clear commitment to societal embeddedness is made: it is stated that an R&I approach which is supposed to effectively tackle the health challenge depends on the involvement of all stakeholders, including patients and end-users, multidisciplinary teams and the integration of the perspective of social and economic science and humanities.

4.2.5. Overall assessment of RRI in the program line (based on desktop research):

There is some awareness of RRI in the health programme line. The concept of responsibility in health research has a long tradition and is well established in terms of research ethics (ethical approval, informed consent, data protection) as well as (to a lesser degree) in terms of public engagement (mostly at patient organisation level). Gender is well established at a formal level, but is often implemented poorly, rather than differences in terms of needs and preferences as well as responses to treatment in men and women.

Often, RRI is implicitly rather than explicitly present in programme line.

Category	Value	Description

A	High awareness • Gender	• RRI as concept is (implicitly or explicitly) present in most documents on all levels; • RRI keys and O's are used and referred to in several documents; • Governance structures reflect societal embeddedness; • Upstream/Downstream engagement is present on multiple levels
B	**Some awareness** • RRI as a concept • Ethics • Public engagement	• RRI as concept is(implicitly or explicitly) present in some documents; • Some RRI keys and O's are used and referred to in any document; • There is some process of better social embeddedness through governance or engagement
C	Limited awareness	• Responsibility or ethical awareness is referred to in any document • Any RRI key is mentioned; • There is reference to the need for social embeddedness of the research at hand.
D	No awareness	• RRI as concept is not present in any document; • No RRI key is mentioned implicitly or explicitly; • There is no reference to societal embeddedness or civic engagement;

4.3. Interview findings

This section discusses the findings from the expert interviews. Overall, they confirmed the findings from the desk research but also expanded and enriched them.

4.3.1. Shared understanding of RRI

A high level of awareness of responsibility in general was found in interviews, although interview partners had varying degrees of awareness of the concept of RRI. Those who were not familiar with the keys found them to be helpful on the one hand in defining what is meant by RRI but at the same time quite abstract. They sometimes observed that their own understanding of responsibility was broader and could not be fully captured by the keys. However, one or two of the keys usually added an aspect, which they had not previously considered. One interviewee observed "the three or the six pillars are a good starting point but are not enough," and this sentiment was shared by most participants. A view also expressed was that governance actually serves as an umbrella term for the other keys.

Related terms used by interviewees included sustainable innovation (defined as “safe, acceptable, affordable, accessible”), ethically acceptable innovation, social innovation, participatory research, corporate social responsibility, etc. Not everyone was comfortable with the concept of RRI, with some finding it “too rigid” or “too mechanistic”.

The view on whether a concept being promoted by the European Commission was positive or not differed according to the interview partner’s country. While most perceived it as a positive step and saw an opportunity for funding and recognition in labelling their work as RRI, others were more hesitant in case the Commission moves on to another label or trend. One interview partner expressed much scepticism towards the RRI concept of the Commission, which may be borne out of a general scepticism towards Brussels.

But in essence, a great need for changing the way research is done and aligning it better with societal needs was expressed. Interdisciplinary collaboration, stakeholder engagement, considering the diversity of the population, better awareness and understanding of science, transparency of findings, environmental aspects as well as other issues were seen to play an important role here. RRI was considered as an instrument that can help researchers and funders create better research processes and outcomes and ultimately lead to better societal impact.

Regarding the keys put forth of the Commission:

- Awareness of ethics as a key was high, but while all interview partners considered it important, most did not feel the need to discuss this much further. Perhaps as ethics is a very institutionalised part of health research, through the need to be granted ethical approval by an ethics commission. Two interview partners observed that with the amount of regulation in this field, researchers are now mostly concerned with fulfilling them rather than actually “caring” about conducting their research in an ethical way. In their view, the amount of regulation has stifled bottom-up initiative that were there before and has reduced ethics to mostly a formality.

- Public engagement had a high priority for almost all interview partners. It was observed that engaging the public usually happens at the level of patient organisations, but does not include individual patients or citizens in general. It was suggested that for health research to be responsible, other stakeholders from the innovation system (i.e. care providers, funders, insurers, industry, etc.) also need to be included, perhaps making the term “stakeholder engagement” more appropriate.

- The awareness of gender was also high, although it was mostly being considered in terms of the balance of female and male researchers in research teams and at decision making level, with a particular focus on gender in research content just beginning to emerge. With gender being an established part of work programmes and proposal templates, it was also sometimes seen as an obligatory tick-box exercise, which unfortunately had little impact on the research itself. The lack of other criteria for diversity in this key was criticised.

- There was a good degree of awareness of science literacy/ education among interview partners, with quite a few actively involved in education. Different stakeholder groups were targeted with different materials.

- Open access/open science was sometimes conflated with science literacy but among researchers awareness was generally high and the concept of making research results available and easily accessible was mostly welcomed. One interview partner expressed

concern that open access and the three Os in general could “distract” from real responsibility.

- The key of governance was hardest to grasp for interview partners. While some saw it as an umbrella term for the other keys, some felt that the work they were involved in was not related to governance.

4.3.2. Beyond RRI

Awareness and acceptance of a better social embeddedness of research was high among interview partners. Some expressed regret about the lack of overlap between excellence in research and research impact and wanted to see this improved in the future.

Barriers mentioned included:

- Misconception among researchers that if they share responsibility they delegate power
- Difficulties in getting private companies involved in RRI projects
- Universities still being quite “siloed” into specialist fields
- Current indicators for measuring “good” research
- General focus on short-term financial benefits rather than long-term societal benefits
- Financial resources
- Lack of awareness and access to information about RRI
- Obligatory, rigid and lengthy processes (e.g. for ethical approval)
- Lack of “space” for responsibility and opportunities to escape from routines

In Interviews it was often criticised that in H2020 and in health research in general there is little concern for sustainability, both in terms of environmental issues and long-term benefits and valorisation of projects.

Participants also identified a number of factors that positively affect the embedding of social responsibility in research:

- SDGs as overarching goal, scope of the problems being addressed require different disciplines and collaboration
- Current external pressures for responsibility in many areas of life
- Ethics being an intrinsic part of health and this being a good starting point
- Researchers’ motivation
- Adding work packages dedicated to RRI in health projects
- Companies being able to use being responsible for publicity (e.g. through CSR reports)
- Journals increasingly requesting information on conflict of interest
- Working in interdisciplinary teams

- Environmental aspects around health beginning to become more important (i.e. pollution through health)

One interview partner suggested: "Don't start from natural science or social science but start from the problem and if you want to tackle it, you have to disentangle it into several aspects and work on these aspects in interdisciplinary or transdisciplinary groups". While the process may take longer, the outcome will be better and willingness to adopt it will also be higher.

4.3.3. Assessment of RRI based on interviews

Category	Value	Description
A	**High Awareness** • Understanding of RRI • Ethics • Public engagement • Gender	• RRI as concept well understood by all stakeholders; • RRI keys and O's are used and referred to by most stakeholders; • Operationalization of RRI already present
B	**Some awareness** • RRI as a concept (implicitly) • Science literacy / science education • Open access / open science	• RRI as concept understood by some stakeholders; • Some RRI keys and O's are referred to by some stakeholders; • The need for mainstreaming through operationalization is referred to by some stakeholders
C	**Limited awareness** • Governance	• Vague awareness of RRI as concept by a few stakeholders; • Any RRI key referred to by some stakeholders; • Some ideas of operationalization of RRI present
D	**No awareness**	• RRI as concept is not present; • No RRI key is mentioned; • No reference to or explicit refusal of societal embeddedness or civic engagement;

4.4. Case briefs

Below, two cases of Societal Challenge 1 projects and supporting infrastructure are presented. The information is based on the information available in the CORDIS database as well as the project's website. Cases were selected to illustrate different projects from the programme line and their approaches to responsibility.

Digital Hybrid Breast PET/MRI for Enhanced Diagnosis of Breast Cancer (HYPMED)[28]

HYPMED is a H2020 Research and Innovation Action (RIA, Project ID: 643736) funded between May 2015 and April 2020 for almost 5.5 million Euros. The project is coordinated by the European Institute for Biomedical Imaging Research (EIBIR) in Vienna/ Austria and there are nine other participants in the consortium. The project is funded under the call PHC-11-2015 -

28 http://www.hypmed.eu

Development of new diagnostic tools and technologies: in vivo medical imaging technologies, which focuses on "development of new diagnostics (more sensitive, robust and selective) for improved clinical practice [and] the translation of multidisciplinary scientific and technological knowledge from diverse fields into clinical applications."[29]

In the project a hybrid system of two medical imaging modalities (MRI and PET scan) for improved diagnosis of breast cancer and personalised therapy control are being developed. The aim is to increase survival rates through earlier diagnosis. With PET scanners being still rather rare and such scans not being available to many patients, the project aims to develop a radiofrequency coil that can be connected to any regular clinical MR scanner to transform it into a high-resolution PET/MRI hybrid system. The system can then be used to identify even the smallest breast cancer, better characterize it as well as its response to therapy.

While this is undeniably an innovative and valuable approach, the project does not appear to deal with the closely related risk of diagnosis of cancer that may never progress into an advanced cancer and would not have been detected otherwise, causing unnecessary distress and side possible side effects of interventions as well as costs.

Patient organisations are not part of the project consortium, which is made up of only clinical and technical partners. There is no dedicated work package on ethics and ethical aspects probably mainly played a role in the ethical approval process. Some degree of interdisciplinarity is present but appears rather focused on producing and validating the (technical) outcome of the project. International aspects are present. Science education does not seem to play a role. From the information available there is no indication that the peculiarities of male breast cancer (which is prone to being diagnosed later than female breast cancer, resulting in diminished treatment options) are being taken into account.

Integrated Technology Ecosystem for ProACTive Patient Centred Care ProACT [30]

ProACT is a H2020 Research and Innovation Action (RIA, Project ID: 689996) funded between January 2016 and June 2019 for almost 4.9 million Euros. The project is coordinated by Trinity College Dublin and the consortium involves 12 other participants. The call is PHC-25-2015 - Advanced ICT systems and services for integrated care and aims to fund research on "new models of care organisation demonstrates that advanced ICT systems and services may have the potential to respond to, amongst others, the increasing burden of chronic disease and the complexity of co-morbidities and in doing so contribute to the sustainability of health and care systems."[31]

The project aims to "develop and evaluate an ecosystem to integrate a wide variety of new and existing technologies to improve and advance home-based integrated care for older adults with multimorbidity, including associated co-morbidities". It does this by developing and providing a so-called ICT-AT ecosystem (information and communications technology and assistive technology) to elderly people with diabetes, chronic heart failure, COPD and mild cognitive impairment and evaluating its use in their own homes.

The project has a dedicated ethics work package, takes an ecosystem approach and maps the key stakeholders involved in the ecosystem using desk, qualitative and ethnographic research methods. For the design and development of the technology an iterative, co-creation, user centred design approach is taken and exploitation, sustainability and scalability are sought through health economic, commercial and business development models. A persistent problem in healthcare

29 https://cordis.europa.eu/programme/rcn/665180_en.html
30 http://www.proact2020.eu
31 https://cordis.europa.eu/programme/rcn/665196_en.html

delivery, the fragmentation between home, primary and secondary care, is also tackled. This indicates that are some elements of the anticipatory and reflexive dimensions of RRI are present beyond the EC keys as well as addressing the keys of ethics, public engagement, open innovation.

While “diversity in terms of gender” was “encouraged” in the recruitment process, no further attention seems to be given to gender aspects and how they might affect use, acceptance, and benefits from the system. Science literacy also does not appear to play a role.

5. Conclusions

Health research has a long history of responsibility and therefore it is not surprising that there is a high level of acceptance. Responsibility is also particularly crucial here because of the inherently contentious nature of health research. Research priorities, i.e. which aspects to focus efforts on and which not, have direct implications for the health, well-being and productivity of European populations. In healthcare delivery, a balance is to be struck between providing the best possible care and keeping healthcare costs at bay. New technologies and methods such as gene editing can have implications far beyond what can be foreseen today. It is therefore paramount that health research is conducted responsibly.

In the H2020 programme line, there is a high degree of implicit RRI with a commitment to interdisciplinarity, public engagement, ethics, gender and international aspects. These have been implemented to varying degrees of success. Other aspects of RRI are less present, such as science education and science literacy. Environmental issues, which are not part of the RRI keys, hardly play a role despite the obvious dependency of health on the environment. The relevance of the term “RRI” itself is rather low.

It can be assumed that compared to other programme lines, RRI has been implemented reasonably well. Despite this, many deficits are apparent, which perhaps indicate that there is also a need for further development of the concept of RRI and possibly also a fine-tuning it for the health context.

Many aspects of RRI are being interpreted rather narrowly, for example public engagement not always paying sufficient attention to the need for including other stakeholders from within the health innovation ecosystem, or the focus on gender at the expense of other aspects of diversity. Ethics as a key can be limited to purely fulfilling the requirements of the ethics application form and not using the opportunity for wider reflection and deliberation about the research process and possible outcomes.

Consequently, there appears to be significant scope for better aligning research with societal needs and thus increasing its impact. The Health programme certainly offers positive examples that can be used to examine and mainstream good practices.

6. Timeline for Diagnosis

Month	Task(s)
4	Start of Diagnosis
4	Get to know the program line
5	Identify relevant stakeholders/experts for interviews
6-7	Interviews with experts (in total 15-.20)
7-10	Transcribe interviews, analysis

10	Finalizing Report
15	DX.1 due in M15 – ensure you send your reports to WP lead on time

7. Literature, links, resources

Council of the European Union 2013: Council Decision of 3 December 2013 establishing the specific programme implementing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decisions 2006/971/EC, 2006/972/EC, 2006/973/EC, 2006/974/EC and 2006/975/EC. 20.12.2013, Official Journal of the European Union, L 347/965. Online: https://publications.europa.eu/en/publication-detail/-/publication/8bc6bfc8-b6b5-4841-b01c-5e862e8d7847/language-en, accessed 8 March 2018.

European Commission 2015a: Horizon 2020, Work Programme 2014-2015, 8.Health, demographic change and well-being, revised. Consolidated version following *European Commission Decision C (2015)2453 of 17 April 2015.*

European Commission 2015b: Horizon 2020 indicators. Assessing the results and impact of Horizon 2020, Luxembourg: Publications Office of the European Union. Online: https://ec.europa.eu/programmes/horizon2020/en/news/horizon-2020-indicators-assessing-results-and-impact-horizon, accessed 8 March 2018.

European Commission 2015c: The 'Health, demographic change and well-being' societal challenge. Fact Sheet. Online: www.kowi.de/Portaldata/2/Resources/horizon2020/coop/h2020-health-fact-sheet.pdf, accessed 8 March 2018.

European Commission 2017a: Commission staff working document, interim evaluation of Horizon 2020, Annex 2. SWD(2017) 221 final, Brussels, 29.5.2017.

European Commission 2017b: Horizon 2020, Work Programme 2016-2017, 8.Health, demographic change and well-being. *European Commission Decision C(2017)2468 of 24 April 2017.*

European Commission 2017c: Horizon 2020, Work Programme 2018-2020, 8.Health, demographic change and well-being. *European Commission Decision C(2017)7124 of 27 October 2017.*

European Commission 2017d: H. Evaluation Rules. In: European Commission 2017: Horizon 2020, Work Programme 2018-2020, 19.General Annexes, European Commission Decision C(2017)7124 of 27 October 2017, p.28-33. Online: http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-ga_en.pdf, accessed 8 March 2018.

European Commission 2017e: Interim Evaluation: Gender equality as a crosscutting issue in Horizon 2020.

European Commission 2018: H2020 Programme, Proposal Template 2018-2020, Administrative forms (Part A), Project proposal (Part B), Research and Innovation Actions (RIA), Innovation Actions (IA), Version 3.4, 1 February 2018. Online: http://ec.europa.eu/research/participants/data/ref/h2020/call_ptef/pt/2018-2020/h2020-call-pt-ria-ia-2018-20_en.pdf, accessed 8 March 2018.

SC1 Advisory Group 2016: Advice for 2018–2020 of the Horizon 2020 Advisory Group for Societal Challenge 1, "Health, Demographic Change and Well-being". Online: http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=2942, accessed 8 March 2018.

The European Parliament and the Council of the European Union 2013: REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC. Official Journal of the European Union, 20.12.2013.

NewHoRRIzon Diagnosis Report

Social Lab Nr. 8

Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy (FOOD)

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Project Start Date	May 1st, 2017
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Version	1.0
Author	Michael J. Bernstein

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1. Executive Summary

This report provides information on a diagnosis of the state of responsible research and innovation (RRI) in European Commission (EC) programming related to Societal Challenge 2 (SC2): Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy (FOOD).[32] SC2 is an approximately EUR 3.7 billion programme of the EC Horizon 2020 (H2020) research and innovation (R&I) framework programme 8 (FP8). The FOOD programme line attends to four thematic areas: food security, sustainable agriculture, marine and maritime research, and the bioeconomy. The programme is co-managed by the European Commission Directorates General for Research and Innovation (DG-RTD) and Agriculture and Rural Development (DG-AGRI), and additional coordination with Maritime Affairs and Fisheries (DG-MARE).

FOOD programming emphasizes involving societal actors from across food production, distribution, consumption, waste, and recycling value chains in its research and innovation activities. The SC2 approach to what the founding legislation of H2020 terms "inclusive innovation" is supported by prioritization of "multi-actor approaches" to "ensure the necessary cross-fertilising interactions between researchers, businesses, farmers/producers, advisors and end-users" (EC 2013a, L347/151). Stakeholders to the programme (ranging from academe to policy and industry to farmer and labour organizations and consumer groups) hold a plurality of views on the nature of science and society relationships (unsurprising, given the heterogeneity of objectives, aspirations, disciplines, and sectors enrolled in the FOOD R&I enterprise). In the context of this heterogeneity and diversity, FOOD programming seeks to implement responsible research and innovation practices (RRI)[33] and Open Science, Open Innovation, Open to the World (Open Agenda) approaches, as required by REGULATION (EU) No 1291/2013 (EC 2013a).

At the policy level, Open Innovation, Open to the World, and governance issues with FOOD R&I are most strongly emphasized dimensions. Across each successive work programme, SC2 has sought to emphasize RRI approaches generally, with emphasis on issues of gender; Open Science / Open Access; Open Innovation (through multi-actor approaches). Emphasis in work programme texts can be traced to individual calls and projects. Of SC2 stakeholders interviewed and engaged in the course of research for this report, there was high awareness of several dimensions of RRI and inclusive innovation (Open Innovation), but less awareness of the overarching term RRI. Given the broad and transformative ambitions of SC2 programming, RRI and Open Agenda approaches could be strengthened in an effort to continue to add value to EC R&I programming for food-resource and bio-based sustainable development.

2. Scope of this document

This diagnosis report is not an official deliverable. It is for internal use only and unless otherwise indicated, for Social Lab 8, the leader of the NewHoRRIzon Work Package 4 on Societal Challenges, or for members of the NewHoRRIzon Consortium carrying out duties related to the grant agreement. The scope of the report is to provide necessary information for diagnosis of the state of responsible research and innovation (RRI) in programming activities related to Societal Challenge 2: Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy (FOOD). Research conducted to develop the diagnosis further served to support the development and initiation of Social Lab 8 in the project. By presenting research input and data

32 Throughout this diagnosis report, "SC2" and "FOOD" will be used interchangeably to refer to the same programme line of H2020.

33 Unless otherwise stated, use of RRI in this report refers to an umbrella term that encompasses concepts and activities related to six European Commission RRI keys: gender, ethics, open access, public engagement, science education and science literacy, and governance.

collected in a systematic way, this document provides ground for comparison across Horizon 2020 (H2020) Programmes within the Societal Challenge pillar, and across other H2020 pillars, as well as at other levels of interest to project consortium members.

3. Methods

Diagnosis of the FOOD programme of EC H2020 consisted of desktop and interview research. Desktop research began with investigation of the initiating policy document of Horizon 2020 (EC 2013a), and narrowed to scoping documents of H2020, paying specific attention to texts mentioning FOOD (EC 2011a; 2011b; 2011c; 2011d). Additional input for initial analysis was the European Commission Interim Evaluation of Horizon 2020 (EC 2017a). To support analysis of how responsible research and innovation is enacted by FOOD, these policy-level documents were reviewed for a) indications of research and innovation goals; b) research and innovation structures; c) general funding levels; and d) mentions and measures of responsible research and innovation (with indicators of public engagement, open access, gender, ethics, science education and science literacy (RRI keys)); responsible innovation (denoted by procedural elements of inclusion, anticipation, reflexivity, and responsiveness); and reference to Open Innovation, Open Science, and Open to the World (Open Agenda). Information on FOOD activity (proposals funded, levels and types of participation, money committed) was gathered from Commission staff working documents: interim evaluation of Horizon 2020: Annex 1 (EC 2017b) and Annex 2 (EC 2017c), as well as the Europa web-based dashboard on H2020 projects.[34]

Attention was next turned to the 2014-2015; 2016-2017; 2018-2020 FOOD Work Programme documents. Each document contained a general introduction to the two-to-three year vision for the program; specific solicitation texts across programme elements; evaluation guidelines, and budget information. Supplementary inputs were gathered from the European Commission's online research manual (various proposal templates, ethics guidelines, gender FAQs, project evaluation templates and guidance, etc). Project-level information was gathered from periodic project reports submitted by FOOD-funded projects (posted on the EC CORDIS website), as well as by reviewing project website and publicly accessible deliverable documentation.

In addition to desktop research, a total of 17 (9 female, 8 male), 45-60 minute interviews were conducted with various stakeholders of and participants in Societal Challenge 2 programming (see Table 1 for a further breakdown of participants). Interviews were semi-structured, taking a jointly-developed interview protocol (please see Annex: Interview Protocol) as a point of departure. Interviews were recorded for future reference in order to validate findings and quotations indicated as important while notes were being taken in the course of the interview.

34 Europa Webgate available at: available at: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/erUXRa/state/analysis

Table 4: **country and type of organizations of interview participants in the diagnosis**

Country	Number of participants	Organizational type	Number of participants
Netherlands	3	Higher or Secondary Education Establishments	3
France	2	Other	2
Norway	5	Private for-profit entities (excluding Higher or Secondary Education Establishments)	1
Belgium	2	Public bodies (excluding Research Organisations and Secondary or Higher Education Establishments)	8
Germany	3	Research Organisations	3
Spain	1		
Hungary	1		
Sweden	1		

Participants interviewed ranged from FOOD project coordinators; programme and agricultural policy advisors to the Commission; bioeconomy stakeholders, national contact persons, European Commission officers, and ERA-Net Co-fund coordinators. Within their home countries, the individuals interviewed include research council officials, research organization managers, professors, labour and industry representatives, policy officials, and business persons.

3.1. General scope of the program

Societal Challenges programs are designed to pursue "research, technological development, demonstration and innovation actions" across a variety of objectives (EC 2011d). Societal Challenge 2 foci include, specifically, "to secure sufficient supplies of safe, healthy and high-quality food and other bio-based products, by developing productive, sustainable and resource-efficient primary production systems, fostering related ecosystem services and the recovery of biological diversity, alongside competitive and low-carbon supply, processing and marketing chains" (EC2013, L347/150). The stated goal of the FOOD program is, through research and innovation, to foster a transition to "sustainable, efficient and integrated" use of biological resources and ecosystems. Sustainability and efficiency goals are described in terms of minimized inputs, impacts, and wastes, as well as the production of societal value.

The FOOD program is directed to support and connect to a range of broader European Union policy initiatives. These policies include: the Common Agriculture Policy[35] (in particular the Rural Development Policy[36]); a range of Joint Programming Initiatives,[37] including Agriculture, Food Security and Climate Change, A Healthy Diet for a Healthy Life, and Healthy and Productive Seas and Oceans; the Strategy for a Resource Efficient Europe[38]; the European Innovation Partnership on Agricultural Productivity and Sustainability[39] and the European Innovation Partnership on Water[40];

35 European Commission Common Agricultural Policy at a glance, available at: https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance_en
36 European Commission, available at: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32013R1305
37 European Commission, European Research Area Coordination of Research Programs, available at: https://ec.europa.eu/research/era/joint-programming-initiatives_en.html
38 European Commission Roadmap to A Resource Efficient Europe, available at: http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm
39 EIP-AGRI, available at: https://ec.europa.eu/eip/agriculture/
40 EIP-WATER, available at: https://www.eip-water.eu/

the Common Fisheries Policy[41]; the Integrated Maritime Policy[42]; the European Climate Change Programme[43]; the Water Framework Directive[44]; the Marine Strategy Framework Directive[45]; the EU Forestry Action Plan[46]; the Soil Thematic Strategy[47]; the Union's 2020 Biodiversity Strategy[48]; the Strategic Energy Technology Plan[49] (EC 2013a, L 347/150).

Programmatic focus on the 'bioeconomy' entails another set of priorities especially related to the European strategy for, "Innovating for Sustainable Growth: A bioeconomy for Europe."[50] The 'bioeconomy' is discussed as an EU 2 trillion industry providing 20 million jobs and accounting for 9% of employment (in 2009 figures), across Europe (EC 2013a). A definition of the bioeconomy includes "production of renewable resources from land, fisheries and aquaculture environments and their conversion into food, feed, fibre bio-based products and bioenergy as well as into the related public goods" related to biodiversity and ecosystem service provision (EC 2013a, L347/151). Societal Challenge 2 programming further connects to broad United Nations Food and Agriculture Organization issues, as well as global challenges related to soil degradation, water contamination, loss of biological diversity; climate change; enhancing use of Ocean, sea, coastal resources, and other resource (e.g., forests) sustainably (EC 2017c).

As set by the founding legislation of H2020, SC2 programme targets include 20 publications per 10 million of funding; 2 patents per 20 million; 1 Union legislation reference per 10 million. Additional performance indicators for the societal challenge lines include peer-reviewed high impact journals; patent applications; and Union pieces of legislation referring to activities supported in the Societal Challenge area (policy impact, unique) (EC 2011d, p. 91).

According to the interim evaluation of H2020, the FOOD programme is viewed as scientifically justified in focus; valued by stakeholders, and highly policy relevant to European Commission strategic agendas as well as the Open Agenda (EC 2017c). Strategic programming processes with greater stakeholder inclusion—despite issues with translation from high-level objectives to practical topics—were identified as positive. Societal Challenge 2 is co-managed by the EC Directorate General for Agriculture, with additional coordination occurring between DG RTD and DG MARE—important connections when it comes to sustaining programmatic relevance to EU legislative and policy agendas (EC 2017c).

41 European Commission Common Fisheries Policy information available at: https://ec.europa.eu/fisheries/cfp_en
42 European Commission Integrated Maritime Policy information available at: https://ec.europa.eu/maritimeaffairs/policy_en
43 European Commission Climate Change Programme information available at: https://ec.europa.eu/clima/policies/eccp_en
44 European Commission Water Framework Directive information available at: http://ec.europa.eu/environment/water/water-framework/index_en.html
45 European Commission Marine Strategy Framework Directive information available at: http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm
46 European Commission Forest Strategy information available at: https://ec.europa.eu/agriculture/forest/strategy_en
47 European Commission Soil Thematic Strategy information available at: http://ec.europa.eu/environment/soil/three_en.htm
48 European Commission Biodiversity Strategy to 2020 available at: http://ec.europa.eu/environment/nature/info/pubs/docs/brochures/2020%20Biod%20brochure%20final%20lowres.pdf
49 European Commission Strategic Energy Technology Plan information available at: https://ec.europa.eu/energy/en/topics/technology-and-innovation/strategic-energy-technology-plan
50 Information and current state on the European Commission Bioeconomy Strategy available at: https://ec.europa.eu/research/bioeconomy/index.cfm?pg=policy&lib=strategy

3.1.1. What is your program about?

The FOOD programme line was originally divided among four thematic areas, each with a range of priorities related to the goal of food security: sustainable agriculture, marine and maritime research, and the bioeconomy (EC 2011d, p. 54). Over time, the programme has demonstrated flexibility in response to shifting societal / research policy needs, for example in 2016, adding a consumer and citizen focus to research topics, and additional inclusion of sustainable food and nutrition and security issues (EC 2017c, p. 686). A brief review of substantive programmatic interests is presented below (for reference, each bi-annual work programme breaks-out a set of priorities, each with a sub-set of priority areas, and a host of topics within each priority area]

Sustainable agriculture and forestry; **increasing productivity and resource efficiency of agriculture**

This priority area calls for multi-disciplinary collaborations on use of "precision technologies and ecological intensification approaches", as well as genetic "improvement" through conventional and modern breeding approaches. Soil management is a priority in this area, as well as eradication of animal diseases and broader concerns for animal welfare. Ecosystem service approaches to the provision of public goods are also emphasized, as is the important need for agricultural management to help with greenhouse gas mitigation and adaptation to climate change impacts. Attention to rural community development—calling for socioeconomic research on institutions to "ensure cohesion of rural areas and prevent economic and social marginalization"—is another aspect of this programmatic priority.

Sustainable and competitive agri-food sector for a safe and healthy diet

This priority area includes calls for safe and healthy food based on studies spanning the food chain and services sectors, regardless of organic source. The priority are quite explicitly emphasizes more efficient food processing transport and distribution, referencing a larger goal of reducing waste by 50% by 2030, as well as water and energy consumption associated with food production. Concerns with the social dimensions of consumer choices and preferences are also included, along with a range of areas related to healthy and safe foods, including food safety, standards, consumer trust and protection, risk communication, contamination exposure, assessment, monitoring, control and tracing. In support of the cross-cutting H2020 requirement to pay attention to climate change and sustainable development (EC 2013a, L347/113, Article 14.1.e), this priority area also focuses on food chain resilience to environmental and climate hazards, as well as other changes.

Unlocking the potential of aquatic living resources

FOOD programming focuses on aquatic areas of research and innovation, as well. Research on sources and drivers of marine ecosystem health and productivity, as well as the impact of fisheries on these ecosystems, feature as areas of interest to Societal Challenge 2. Priorities in aquatic areas further include: strengthening knowledge and technology related to domestication and aquaculture farming, as well as sustainable production in land, coastal, and offshore areas. Biotechnology, too, is noted as a pathway to exploring and "exploit[ing] the large potential offered by marine biodiversity and aquatic biomass" for a range of markets, from chemical and material to pharmaceutical and cosmetic (EC 2011d, p. 58). A cross-cutting programmatic focus on marine and maritime research seeks also to further enhance exploitation of seas and oceans for a variety of uses (EC 2013a, L347/153).

Sustainable and competitive bio-based industries and supporting the development of the European bioeconomy

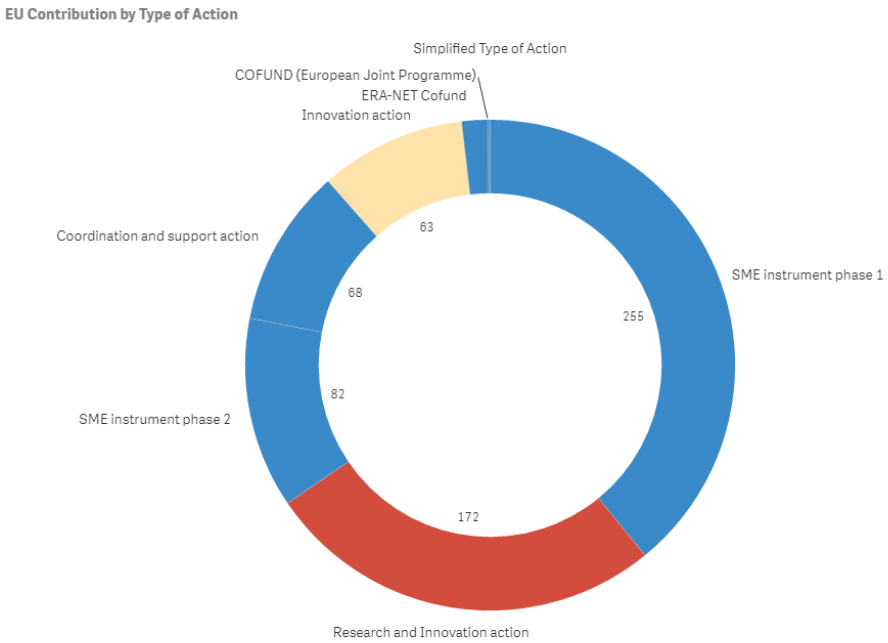
In partnership with the Leadership in Enabling and Industrial Technologies pillar of H2020, Societal Challenge 2 places emphasis on transitioning to bio-fuel, building biomass supply streams and bio-refineries; supporting bio-based projects; exploring trade-offs of biomass use; minimizing environmental impacts; development of consumer and industrial applications; maximizing economic value; and developing value-adds to bioenergy, biofuels, biproducts, bio-waste. This programmatic priority is especially focused on bringing such value to Europe through application and commercialization.

According to Annex 2 of the Interim Evaluation of H2020, a main challenge in FOOD programme implementation has been related to a lack of transparency in how the above, "high level challenges and objectives" are apportioned into topics; the balance of project size; distribution among research and innovation; and reconciliation of short and mid-term policy pressures with long-term DG policy and R&I perspectives (EC 2017c, p. 728-729).

3.1.2. What is the size and structure of your program in terms of budget, applications and projects?

As of 2 July 2018, 652 grants have been signed by the Societal Challenges 2 programme (Figure 1) Proportionally, SME instrument phase 1 projects represent 39% of projects; research and Innovation actions, 26%; SME instrument phase 2, 13%; coordination and support actions, 10%; innovation actions, 10%; ERA-NET Cofunds, 2%; and COFUND (European Joint Programme) action, 0% (only 1 project).

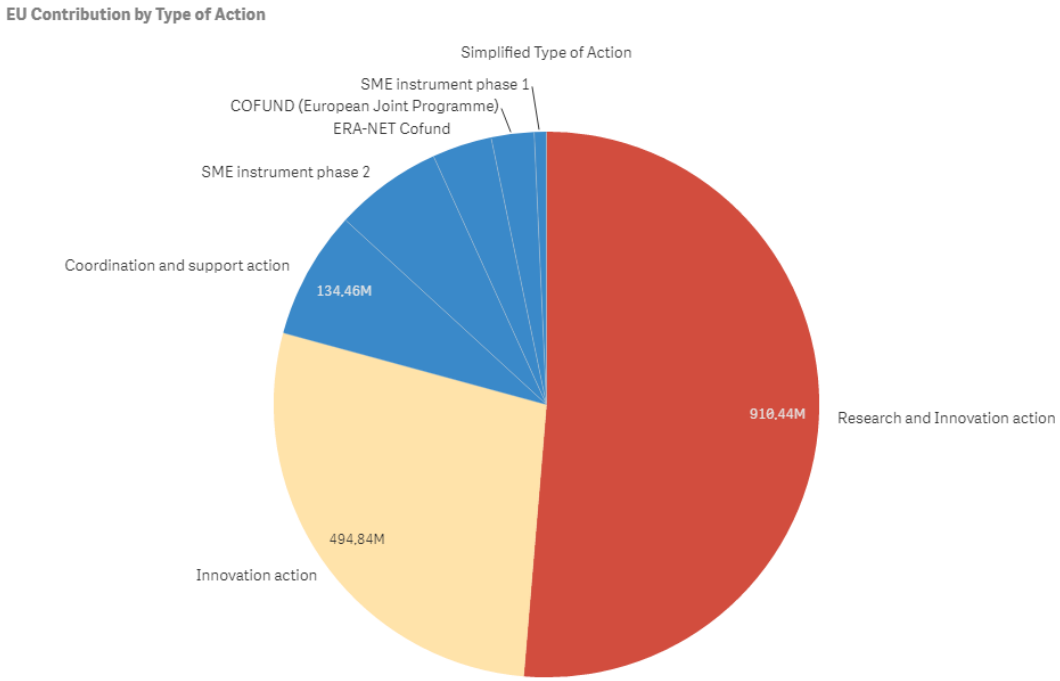
Figure 4**: Number of EU funded FOOD projects by type of action.**



Source: Europa Webgate, accessed 2 July 2018, available at: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/erUXRa/state/analysis

Approximately EUR 3.7 billion were allocated to the FOOD program (EC 2017a) in Horizon 2020. This funding level represents a doubling of the budget for food, agriculture and fisheries, and biotechnology research under Cooperation Theme 2 from Framework Programme 7 (FP7) (EC 2017c). As of 17 January 2018, the success rate on FOOD proposals was 12%, relative to a H2020 average of 11.6% and a FP7 average of 18.5 %) (EC 2017a, p. 86). As of 2 July 2018, a total of EUR 1.77 billion of the FOOD program has been signed (Figure 2). In contrast to the proportions of signed grants, as described above: Research and Innovation Actions (RIAs) comprise 51% of contributions; Innovation Actions (IAs), 28%; Coordination and Support Actions (CSAs), 8%; SME Instrument Phase 2, 6%; ERA-NET Cofunds, 4%; COFUND (European Joint Programme), 3%; and SME Instrument Phase 1, 1%.

Figure 5**: EU expenditure on FOOD Projects by type of action.**



Source: Europa Webgate, accessed 2 July 2018, available at: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/erUXRa/state/analysis

Instruments within the FOOD programme are viewed as being wielded strategically, with RIAs, CSAs and IAs used to address different priorities of any given two-year work programme. Collaboration across projects is further encouraged to tackle complementary issues. This is especially noticeable in use of CSAs to augment RIAs (8). For example, the ISIB-8-2014 call focuses explicitly on knowledge transfer across H2020 and FP7 projects to promote best practices being discovered and advanced and "brought to market faster" (EC 2017c, p. 716).

Geographically, EU-28 countries make up 86.9% of participants, and receive 92.2% of funds. Of this group, the EU-15 countries have 77.2% of participants, 86.6% of funding, and 93.7% of coordinators (EC 2017c). Top participating countries by share of SC2 projects Spain (11%); Italy (10.4%); France (10.1%); Germany (8.4%); United Kingdom (8.1%); the Netherlands (6.9%); and

Belgium (5.7%).[51] As of 2 July 2018, there have been 6,115 participations in SC2 programming, with the largest proportion of participations coming from the private sector (PRC, 34%), followed by research organizations (REC, 27%), higher education (21%); the public sector (8%) and other organizations, including CSOs (OTH 9%).[52] CSOs are the least well represented, along with public sector bodies (EC 2017c, p. 689). Some 34% of the unique participants represent individuals who did not participate in FP7 (excluding SME and JPI), with most newcomers from the private sector (EC 2017c).

4. Current situation of RRI in the program

4.1 RRI in brief

The Societal Challenge 2 programme line should stand to benefit from RRI and Open Agenda approaches. Commitments to Open Innovation and what the EC termed "inclusive innovation" (EC 2013a) are vital to FOOD aspirations to draw from diverse disciplines and sectors for solutions to food nutrition, aquatic and terrestrial resource sustainability, and bio-based sustainable development challenges. Issues of gender inequality are closely related to social and technical dimensions of food systems, as well as research and innovation systems, and thus also should be relevant to FOOD. Because the resources, knowledge, cultures, and technologies associated with FOOD touch people's lives multiple times per day, public engagement—as well as science education and science literacy keys—should be critical to co-construction of visions for food-resource sustainability and bio-based economy sustainable development. The scale of system-wide transformations implicated by FOOD R&I mean that Open to the World approaches, supported by Open Science (and open access) initiatives can support effective coordination and collective action. Finally, the need for local, regional, national, and international action associated with food-resource and bio-based economy sustainability makes attention to governance (RRI-key) vital for long-lived and effective R&I transformation through FOOD programming.

4.2 Desktop findings

4.2.1 Role of RRI on

Policy document level

No	
Yes	Keys: Gender: *Nothing different than what other H2020 Programmes are supposed to implement.* Public Engagement: *Nothing different than what is expected of other H2020 Programmes with regard to dissemination and communication of results.* Open Access: - Less than 1 in 3 projects share all research outputs, with the exception of CSAs at 71% (EC 2017c)

51 Information from Europa Webgate, accessed 2 July 2018, available at: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/PbZJnb/state/analysis

52 Information from Europa Webgate, accessed 2 July 2018, available at: Europa Dashboard: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/PbZJnb/state/analysis

	Ethics: *Nothing different than what other H2020 Programmes are supposed to implement* Science Education and Science Literacy: *Nothing different than what other H2020 Programmes are supposed to implement* Governance: - Explicit efforts are under way in SC2 to enhance the policy viability and response from SC2 research programming. Policy officers from the Commission (e.g., DG-AGRI and DG-MARE are kept in closer contact ('assigned') project officers from the REA on topics and projects. Policy officers and project officers communicate on evaluator selection and briefing, and participation in kick-off and review meetings. SC2 coordination meeting occur more regularly at middle and senior levels; internal meetings include a focus on policy framework updates and project implementation. Dedicated policy review meetings were planned for 2017 rollout. (EC 2017c, p. 711) - "Research and innovation will interface with and support elaboration of a wide spectrum of Union policies and related targets" (EC 2013a, L347/152) O's: Open Science: • More than half of cross-cutting marine and maritime research and 4 of 5 projects in aquatic living resources potential use open source tools and data (EC 2017c, p. 683) Open Innovation: • "The potential of farmers and SMEs to contribute to innovation must be recognised. The approach to the bioeconomy shall take account of the importance of local knowledge and diversity." (EC 2013a, L347/152) • SC2 funded projects target a range of potential users of research outputs, but only reach a smaller number of "immediate users" of results through dissemination and communication efforts (EC 2017a, p 82). • By and large this formulation of moving to more user-centred research and innovation approaches was found to not be widely implemented (in 2016), with the exception of multi-actor projects, especially in agri-food and aquatic resource areas (EC 2017c). • The multi-actor approach, which is called-out as a central part of FOOD programming, is broadly credited with helping SC2 targeting a broad range of potential users of research and innovation activities (EC 2017c, p. 690). "A multi-actor approach will ensure the necessary cross-fertilising interactions between researchers, businesses, farmers/producers, advisors and end-users" (EC 2013a, L347/151). Open to the World: • FOOD has been outperforming H2020 average on international participation. This takes the form of projects with third country

	contributions, with arrangements with US, Canada, G7 S&T ministerial; Atlantic Ocean Research Alliance, etc. (EC 2017c). Implicit: Reflexive: Inclusive: *See open innovation, above* Anticipatory: • "To facilitate governance and monitoring of research and innovation, socio-economic research and forward-looking activities will be performed in relation to the bioeconomy strategy, including development of indicators, data bases, models, foresight and forecast, and impact assessment of initiatives on the economy, society and the environment" (EC 2013a, L347/152) Responsive: *See governance above.*
Explanation	At the policy level, SC2 programming has a mix of levels of awareness of RRI Keys, the Open Agenda, and other areas of RRI. In many cases, the policy-level demonstration of responsibility in research and innovation is expressed without reference to a formal term. Active project mapping by the evaluation expert group (EC 2017c, figure 205), reveals a more nuanced picture of the stakeholders involved when it comes to Open Innovation. CSOs, NGOs, public regulators, standard setting entities, and consumers represent the least-included immediate-users, despite being noted as important final users. Citizen consultation is noted as an especial minority of immediate users targeted by projects—the exception being those projects where "consumer engagement is a key for project success" (EC 2017c, p. 691). Quality of communication and dissemination approaches is variable, as revealed by reviews of project applications. The governance dimensions listed above reflect examples, as well, of how R&I programming can be made more responsive to societal challenges/interests. Evaluators also notes the communication transaction costs of increased collaboration / coordination across DGs in support of this objective (EC 2017c).

Scoping level

No	
Yes	
Explanation	*See analysis of adopted Work Programme documents*

Work program level

No	
Yes	Keys:

	General: • "The concept of Responsible Research and Innovation (RRI) underpins this work programme, aiming to align research and innovation to the values, needs and expectations of society. This means that a wide diversity of stakeholders and actors are engaged to work together in: science education; the definition of research agendas; the conduct of research; the access to research results; and the application of new knowledge in society- in full respect of gender equality, the gender dimension in research and ethics considerations. Whether the focus is on multi-actor involvement or on citizen engagement, the approach chosen should be reflected in the methodological description of project proposals" (EC 2017d, p. 12). • "The concept of Responsible Research and Innovation (RRI) underpins this work programme, aiming to align research and innovation to the values, needs and expectations of society" (EC 2017e, p. 8). Gender: • "Gender dimension of research: This work programme includes topics where it is relevant to look at the gender dimension in research content. Research and innovation activities should explore, analyse, and address possible sex and gender differences and take into account biological characteristics as well as the evolving social and cultural features of women and men, and other relevant factors of diversity (e.g. user/consumer preferences and needs) in a given context. Where relevant, sex and gender analysis should therefore be included in the planned research" (EC 2017d, p. 12). • "This work programme includes topics where it is relevant to look at the gender dimension in research content. Research and innovation activities should explore, analyse, and address possible sex and gender differences" (EC 2017e, p. 8). The text also provides links to external resources and guidance. Public Engagement: • A small number of projects have a specific public awareness and education mission, for example in Work Package (WP) 2016-2017, "BB-08-2017: Strategies for improving the bioeconomy knowledge of the general public: Specific Challenge: The bioeconomy is not a well-known concept among European citizens due to lack of information or information that cannot be understood by the general public. This means that there is little awareness of the importance of the bioeconomy in times of climate change, food insecurity and the tangible benefits, the use of biological resources can bring to our everyday life. There is a strong need identified to engage in structured and coherent communication activities on the bioeconomy research and innovation results. The main tasks of this project are therefore to better understand existing barriers, raise awareness by informing citizens and establish an interactive, two-way dialogue between local research centres, the European Commission and European citizens" (EC 2017d).

	• "Aims at achieving a greater outreach to civil society by involving all the stakeholders and citizens at large through public consultation activities, citizen involvement in projects co-creation and a continued use of the multi-actor approach" (EC 2017e, p. 8). Open Access: *See Open Science* Ethics: • "Whenever possible, the activities should also include a better understanding and handling of the ethical aspects as well as the promotion of the highest ethical standards in the field and among the actors and stakeholders. The most common issues to be considered include personal data protection and privacy, protection of participants and researchers and ensuring informed consent, involvement of vulnerable population, the potential misuse of the research results, fair benefit sharing when developing countries are involved and the protection of the environment" (EC 2015). Science Education and Science Literacy: • A small number of projects have a specific SE/SL objective, e.g., "RUR 13-2017, Building a future science and education system fit to deliver to practice" …with the goal of studying and improving science education initiatives for sustainability in agriculture (EC 2017d). • "All Blue Growth actions shall also contribute to improving science education and ocean literacy through dissemination, outreach and training activities" (EC 2017e, p. 71). Governance: • A range of calls within WP 2016-2017 address aspects of governance in Sustainable Food Security and Rural Renaissance calls, for example, most notably in the Rural Renaissance priority area: "The call is structured around three main areas: 1) new approaches towards policies and governance: activities will be aimed at improving policies and governance at various geographic scales to foster sustainable growth in rural areas. They will cover aspects such as territorial linkages and coherent policy approaches for the management and use of natural resources and for the provision of ecosystem services and public goods" (EC 2017d, p. 125). O's: Open Science: • Guidance documents about the Open research Data Pilot are mentioned explicitly in WP 2014-2015 text. • "A novelty in Horizon 2020 is the Pilot on Open Research Data which aims to improve and maximise access to and re-use of research data generated by projects. Projects funded under the following topics will by default participate in the Pilot on Open Research Data in Horizon 2020" (EC 2017d, p. 14), listing 20 topics spread across all 4 FOOD priority areas.

	• "A further new element in Horizon 2020 is the use of Data Management Plans (DMPs) detailing what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved. The use of a DMP is required for projects participating in the Open Research Data Pilot. Other projects are invited to submit a DMP if relevant for their planned research. Only funded projects are required to submit a DMP" (EC 2017d, p. 15). • "Open science approaches and international cooperation will be further encouraged, maximising the benefits of collaboration with regions outside the EU in particular in view of solving common problems and meeting international commitments" (EC 2017e, p. 7). <u>Open Innovation</u>: • 36% of funds in Sustainable Food Security topics and 28% in sustainable inclusive bioeconomy topics went to multi-actor projects in the 2014 WP (EC 2017c). "Proposals should fall under the concept of 'multi-actor approach'" in the following topics (reaching a total of 185 million in projects out of approximately 425 million in WP 2014-2015. Further, the WP 2014-2015 text identifies a total of 9 out of 50 topics, clustered in the Sustainable Food Security and the Innovative, Sustainable and Inclusive Bioeconomy priorities (EC 2015). • The Blue Growth priority of WP 2014-2015 boosts, "genuinely cross-disciplinary, integrated, systemic approaches – including the socio-economic dimension, as well as the engagement of the broader stakeholder communities" (EC 2015, p. 40). • In WP 2016-2017, multi-actor approach is explicitly flagged in 37 of 90 topics. Sustainable Food Security and Rural Renaissance make up almost all of these 37 flagged topics. As an exception, consider also the bio-based innovation priority area, e.g., "BB-05-2017 Bio-based products mobilization and mutual learning action plan" calls for a multi-actor approach to improve market uptake, and tech and innovation alignment with society. In addition, five Blue Growth calls strongly emphasize interdisciplinary work, and two emphasize transdisciplinary work (EC 2017d). • "A multi- actor approach should be accompanied with the necessary resources and expertise so that it may generate impact and innovative solutions" (EC 2017d, p. 12). • In WP 2018-2020, a total of 27 projects out of 60 are flagged as multi-actor projects, mostly focused within the Sustainable Food Security and Rural Renaissance priority areas. However, again, several other priority areas refer to work that is multi-actor in nature if not in name. For example, CE-SFS-24 is not included in the multi-actor approach topic list, despite this scope: "Proposals shall also include co-creation between social innovation and technological innovation. Following the RRI principles, proposals will ensure that societal actors 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 society" (EC 2017e, p. 40).

	• "Innovation in the SC2 Work Programme will be supported using the interactive innovation model. This approach is developed by the EIP-AGRI and fosters the development of research into practical applications and the creation of new ideas thanks to interactions between actors ("cross-fertilisation") and the sharing of knowledge. The interactive innovation model is implemented in this Societal Challenge through the 'multi-actor approach'." (EC 2017e, p. 7). An entire page of guidance on the multi-actor approach accompanies the introductory text in WP 2018-2020. Open to the World: • "In terms of international cooperation, the 'Blue Growth' Focus Area will support the new Atlantic Ocean Cooperation Research Alliance launched by the Galway Statement in May 2013" (EC 2015, p.39). • "Many of the challenges addressed in this Work Programme are of global nature, requiring the development of global solutions in cooperation with third countries and relevant international organisations or initiatives. International cooperation will be further encouraged and seek to maximise the benefits of collaboration with regions outside the EU in particular in view of solving common problems and meeting international commitments" (EC 2017d p. 11) • "Many of the challenges addressed in this Work Programme are of global nature, requiring the development of global solutions and opening up the innovation process to all active players in cooperation with third countries and relevant international organisations or initiatives." (EC 2017e, p. 6) Implicit: Reflexive: • A variety of expert contracts for evaluation, strategy reviews, stakeholder conferences, and supporting policy analyses, including the Food 2030 framework development process, could promote reflexivity at the programme level (EC 2017d). Inclusive: *see open innovation* Anticipatory: Responsive: • SC2 programming is in general responsive as a challenge-driven programme, and examples of this can be seen more broadly in the text of programme documentation: "Guided by the political drivers of the Commission, including the Jobs and Growth agenda, this Work programme is highly relevant to meeting commitments under the Sustainable Development Goals (SDGs) and the COP 21 Paris Climate Agreement" (EC 2017e, p. 5).
Explanation	When it comes to inclusive approaches to research and innovation, a unique feature of the SC2 programmes is a dedication to multi-actor approaches. The programme has a series of means to engage stakeholders to include

	perspectives into R&I programme development, beyond funding projects. First, consultations inform WP drafting in closed and open sessions; second, expert advising provides input to WP drafting; third, working group and member state inputs via the Programme Committee (PC) and Standing Committee on Agriculture Research (SCAR), in addition to EU-level strategies and roadmaps, also inform SC2 work programming. Multi-actor approach facilitates alignment of program with stakeholder and end-user needs thus, in theory and in some practice (EC 2017c, p. 687). The bioeconomy stakeholder panel and manifesto, offer two examples of this type of engagement.53 For the 2018-2020 Work Programme, the FOOD Programme ran a public consultation in 2016; 20 stakeholder events, from a Bioeconomy summit as well as SCAR conferences and foresight events; to Bioeconomy Stakeholder events; internal DG groups; and 7 participatory SCAR workshops related to strategic programming. This was noticed as a marked improvement to previous FPs, agenda driven seemingly by scientific community rather than needs of potential users and wider society (EC 2017c, p. 688)**.** The analysis of the above dimensions should be tempered by the reality that despite high levels of awareness, in no cases are there separate incentives for explicitly including RRI dimensions in proposals (e.g., no change to evaluation criteria, evaluator or proposer training, or otherwise). Because multi-actor approaches are normalized and incentivized in several of the priority areas and call texts, and inter and trans disciplinary work are also emphasized, it is *possible*, that lack of appropriate team composition for a proposal could be counted against said proposal according to the general "Quality and efficiency of the implementation" criteria. For example, the WP 2016-2017 text states "A multi-actor approach should be accompanied with the necessary resources and expertise so that it may generate impact and innovative solutions" (EC 2017c, p. 10). Verification of this is beyond the scope of the project and/or data made available by the Commission. The case is currently a bit stronger for gender dimensions and interdisciplinary work, for example the 2018-2020 general evaluation criteria state: "Appropriate consideration of interdisciplinary approaches and, where relevant, use of stakeholder knowledge and gender dimension in research and innovation content" (EC 2017g, Section H) Further, there is little to no information provided with regards to why multi-actor approaches are flagged in some priority areas and topics, and not others. For example, "ISIB-3-2015: Unlocking the growth potential of rural areas through enhanced governance and social innovation" is a topic that in appeals directly to inclusive growth and social innovation issues. This topic text includes phrases like, "proposals should establish appropriate methods for the evaluation of social innovation. Attention needs to be given to different learning arrangements (e.g. multi-actor networks, producer-consumer association, hybrid innovative networks, territorial alliances) as well as to innovative governance mechanisms at various levels, and their potential implications for social innovation" (EC 2015, p. 67)", but the project is not flagged as multi-actor, and does not use explicit RRI language.

53 European Bioeconomy Stakeholders Manifesto available at: https://ec.europa.eu/research/bioeconomy/pdf/european_bioeconomy_stakeholders_manifesto.pdf

Call level

No	
Yes	Keys: • "Proposals should address responsible research and innovation aspects by taking account of specific nutritional requirements, dietary behaviours and preferences, sensory aspects, the gender dimension, ethical factors, socio-economic factors and/or cultural aspects" – SFS-16-2015 Tackling malnutrition in the elderly (EC 2015, p. 27). • "LC-SFS-17-2019: Alternative proteins for food and feed. Following the RRI principles, proposals will ensure that societal actors 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 society" (EC 2017e, p. 33). <u>Gender:</u> • DT-SFS-14-2018: Personalized Nutrition … "To ensure the success of the developed actions, consumer engagement and acceptance, gender differences in patterns of nutrition and ethical issues, particularly on the use of personal data, should be taken into account" (EC 2017e, p. 28). <u>Public Engagement:</u> • ISIB-8-2014: Towards an innovative and responsible bioeconomy, which calls explicitly for responsiveness to citizen concerns; addressing ethical concerns; engaging users through education and debate on the bioeconomy. Calls also for fostering "future-oriented multi-stakeholder dialogue (EC 2015, p. 72) • CE-SFS-24-2019: Innovative and citizen-driven food system approaches in cities…"The proposals shall identify several food-related innovative approaches based on citizen science and engagement, to be practiced in cities to foster sustainability of the food system" (EC 2017e, p. 40). <u>Open Access</u>: *See Open Science* <u>Ethics:</u> • DT-SFS-14-2018: Personalized Nutrition … "To ensure the success of the developed actions, consumer engagement and acceptance, gender differences in patterns of nutrition and ethical issues, particularly on the use of personal data, should be taken into account. When applicable, proposals should address requirements from relevant EU regulatory frameworks, including pre-market approval" (EC 2017e, p. 29). <u>Science Education and Science Literacy:</u> • RUR-09-2018: Realising the potential of regional and local bio-based economies … "Proposals shall ensure proper support and guidance in developing regional strategies and roadmaps through participative approaches, adapted to the local conditions and biomass sources.

	These shall also include avenues to address the education and information gap on key issues related to sustainability, to increase R&I capacities and to improve the generation of innovation, making best use of the various funding streams available and establishing synergies with relevant policies and programmes, notably those related to rural and regional development, and related Smart Specialisation Strategy implementing bodies" (EC 2017e, p. 108). Governance: • SFS-33-2018: Support to the implementation of the EU-Africa Research and Innovation Partnership on Food and Nutrition Security & Sustainable Agriculture (FNSSA) … "The partnership is a ten-year flexible research and innovation programme for which a long-term governance mechanism needs to be created." (EC 2017e, p. 57). O's: Open Science: • DT-SFS-26-2019: Food Cloud demonstrators … "The European Open Science Cloud (EOSC) will federate existing and emerging research data infrastructures, and provide researchers with services for Open Research Data (ORD) storage, management, analysis and re-use across disciplines. The move towards a thematic EOSC section for food and nutrition security (FNS) - or Food Cloud - would accelerate and support the ongoing transition to a more Open Science and Open Innovation model for food and nutrition systems, stimulate intra- and interdisciplinary research, and increase the impact and efficiency of research investments and infrastructures" (EC 2017e, p. 43). Open Innovation: • RUR-16-2019: Fuelling the potential of advisors for innovation … "Despite the continued generation of scientific knowledge, its impact and application in practical farming and forestry is disappointing and its innovative impact poor. Although there are some good examples, the EIP-AGRI evaluation study recommends that more advisors need to be involved in interactive innovation projects to fuel cross- fertilisation and implementation of results. Advisors indeed have clear impact on farmers' and foresters' decisions and should play a key role in linking science and practice" (EC 2017e, p. 120). Open to the World: • SFS-32-2018: Supporting microbiome coordination and the International Bioeconomy Forum … "In line with the objectives of the EU strategy for international cooperation in research and innovation, proposals should also aim at supporting similar activities within other IBF working groups. Participation of relevant partners from third countries and international organisations is strongly encouraged" (EC 2017e, p. 56). Implicit: Reflexive:

	Inclusive: Anticipatory: • ISIB-10-2014 Networking of Bioeconomy relevant ERA-NETs, which calls for integration of foresight and bioethical consideration efforts in joint calls—transnational networking and coordination of national research programs (EC 2015). • LC-SFS-15-2018: Future proofing our plants…"Existing and new approaches and technologies should be assessed to best encompass future research and innovation aiming at plant improvement, while developing a holistic approach to exploit the potential of plant research. Following the RRI principles, proposals should ensure that societal actors (researchers, citizens/CSOs, policy makers, businesses, etc.) are brought together to align the forthcoming research programmes with the values, needs, and expectations of society. Gender aspects should also be considered" (EC 2017e, p. 29). Responsive:
Explanation	*NOTE*: *The above represents a few specific examples of topic texts that emphasize aspects of RRI but are not comprehensive. Results summarizing or assessing the attributes of multiple calls/topics across a work programme are in the work-programme-level analysis.*

Project level

No	
Yes	
Explanation	*Please see "Case Examples" in section 4.4*

Proposal Template level

No	
Yes	*See my analysis shared on the VSL: https://vsl.newhorrizon.ihs.ac.at/?page_id=137&view=topic&id=14.* • Of relation to RI/RRI/OOO, I noted the following proposal attributes: elements of anticipation (e.g., related to commenting on obstacles and critical risks to delivering expected impacts); sections requiring consideration of gender; opportunities to expound on ethical issues related to research integrity and responsible conduct of research, and also to more macro-ethical issues (e.g., the section on impact of research); and information on open access considerations.
Explanation	*See my analysis shared on the VSL: https://vsl.newhorrizon.ihs.ac.at/?page_id=137&view=topic&id=14. Excerpt of overarching points, drawing from EC 2014; 2016b; 2017h; 2017i; 2017j; 2017k)* • RIA and CSA templates are nearly identical to each other and remain largely stable over time. Differences between the CSA templates from

	2014 and 2017 mirror those identified in the RIA 2015 and 2017 templates. Small additional changes were made thought the templates for the 2018-2020 work program. • Note that in the guidance on completing ethical self-assessments, the role of the ethicist in the pre-proposal stage is described as follows: "From the beginning of your project, an ethics adviser can help you deal with ethical issues and put in place the procedures to handle them appropriately. If your research includes several ethical concerns or involves several significant or complex ethical issues (such as participation of children from developing countries, 'non-human primates (NHPs)', potential misuse or vulnerable populations) we suggest you appoint an ethics adviser or an ethics advisory board comprising several experts from different backgrounds. The Commission/Agency may also make this an ethics requirement during the selection procedure." One can see here the instrumental logic for participation of social science and humanities against which responsible research and innovation sought/seeks to push against. • Changes between 2014/15 and 2017 versions of the templates reveal the kinds minor modifications that can be carried out in proposal templates. For example, in the ethics tables, addition of language related to Environment & Health and Safety (beyond just the environment); in section 2.2., greater prominence to inclusion of business plans where relevant; more abundant notes to submitters regarding the Pilot on Open Research Data in Horizon 2020; greater specificity on articulate where, who, and how impact will be disseminated and followed-up; in section 3.3, prompts to articulate the specific contributions of project partners to the project. • These differences seem to show how proposal templates can be meaningfully updated in ways that encourage specificity of plans regarding prospective risks, managerial dimensions, and engagement plans. Importantly, several of these changes may be also tied to evaluation guidelines—specifically, the criterion: "quality and efficiency of implementation" that is common to most RIA and CSA actions. While this is often a minority weight in evaluation, it seems one of the few points of leverage for influencing "non-research-content" related change. • For WP 2018-2020, the templates do seem responsive to feedback from the H2020 evaluation related to gender. In addition, the template seems to reflect an increased awareness that 'public/societal engagement' can be central to the conceptual underpinnings of a project, beyond a tack-on activities placed in a communications plan. • How the changes identified actually affect proposal submissions, evaluation scores, and project implementation would require analysis beyond the scope of NewHoRRIzon.

Evaluation level

No	
Yes	Keys: General:

	• WP 2014-2015, RIA, Impact Criterion "Any other environmental and socially important impacts (not already covered above)" (EC 2013b, Section H). • WP 2014-2015, All types of actions, Impact Criterion "The expected impacts listed in the work programme under the relevant topic" (NOTE, only relevant for RRI if a key is mentioned in work programme impact sections) (EC 2013b, Section H). • WPs 2016-2017 and 2018-2020, All types of actions, Impact Criterion "The extent to which the outputs of the project would contribute to each of the expected impacts mentioned in the work programme under the relevant topic" (NOTE, only relevant for RRI if a key is mentioned in work programme impact sections) (EC 2017f, Section H). • WPs 2016-2017 and 2018/2020, Framework partnership agreements, "The extent to which the action plan of the FPA would contribute to each of the expected impacts mentioned in the work programme under the relevant topic" (NOTE, only relevant for RRI if a key is mentioned in work programme impact sections) (EC 2017f; 2017g, Section H). <u>Gender:</u> • WP 2018-2020, RIA, Excellence Criterion, "Appropriate consideration of interdisciplinary approaches and, where relevant, use of stakeholder knowledge and gender dimension in research and innovation content." (EC 2017g, Section H). • In the case of ties, the third-level rule is stated as: "If necessary, any further prioritisation will be based on the following factors, in order: size of budget allocated to SMEs; gender balance among the personnel named in the proposal who will be primarily responsible for carrying out the research and/or innovation activities."(EC 2013b, p. 31; 2017f, p. 34; 2017g, p. 32). <u>Public Engagement:</u> • WP 2014-2015, RIA & CSA, Impact Criterion, "Effectiveness of the proposed measures to exploit and disseminate the project results (including management of IPR), to communicate the project, and to manage research data where relevant." An argument could be made for communication relating to Public Engagement (EC 2013b, Section H). • WPs 2016-2017 and 2018-2020, RIA & CSA, Impact Criterion, "Quality of the proposed measures to: Exploit and disseminate the project results (including management of IPR), and to manage research data where relevant; Communicate the project activities to different target audiences" (EC 2017f, Section H). An argument could be made for communication relating to Public Engagement. <u>Open Access</u>: <u>Ethics:</u> <u>Science Education and Science Literacy:</u>

	Governance: O's: Open Science: Open Innovation: • WP 2014-2015, RIA, Excellence Criterion "Soundness of the concept, including trans-disciplinary considerations, where relevant" (note, removed in later WPs) (EC 2013b, Section H). • WP 2014-2015, All types of actions, Quality and efficiency of the implementation, "Complementarity of the participants within the consortium (when relevant)" (EC 2013b, Section H). • WP 2016-2017, RIA, Excellence Criterion, "Appropriate consideration of interdisciplinary approaches and, where relevant, use of stakeholder knowledge. (EC 2017f, Section H). • WP 2018-2020, RIA, Excellence Criterion, "Appropriate consideration of interdisciplinary approaches and, where relevant, use of stakeholder knowledge and gender dimension in research and innovation content." (EC 2017g, Section H). • WPs 2016-2017 and 2018-2020, Framework partnership agreements, "Complementarity of the partners, and balance of expertise; Potential for long term cooperation among the partners" (EC 2017f; 2017g, Section H). Open to the World: Implicit: Reflexive: Inclusive: Anticipatory: Responsive: • For about 25% of topics in WP 2014-2015, mainly distributed in the Sustainable Food Systems and Innovative and Sustainable and Inclusive Bioeconomy priority areas / calls, stated, "The criterion Impact will be evaluated first, then Excellence and Implementation. If the proposal fails to achieve the threshold for a criterion, the evaluation of the proposal will be stopped." Such prominence of the Impact criterion was discontinued in subsequent years. (EC 2013b, Section H)
Explanation	All criterion above, unless otherwise indicated, from General Annex H to each H2020 Work Programme. With the exception of WP 2014-2015 noted above, all topics in SC2 adhere to the general Annex H for project evaluation criteria. Prominence of the Impact criterion in WP 2014-2015 seemed indicative of a responsiveness aspect of R&I: having a societal challenge program prioritize impact slightly over a traditional

	Excellence criterion seems responsive to the spirit of the Societal Challenge Pillar aspirations. Criteria listed for RIA or CSA types of actions reflect additions rather than full replacements to the "all types of projects" criteria listed in Annex H. Note that for cases where there are ties in projects, Excellence takes priority in RIAs, and Impact in CSAs. In some cases, gender.

4.2.2 General use of RRI

Responsible Research and Innovation

Societal Challenge 2 exists within a robust food, agriculture, aquatic, and bio-economy policy context in Europe. Likely because of this context, as well as the overall positioning of the program in the H2020 Societal Challenge Pillar, there is a strong connection between FOOD programming and the governance key of RRI. According to the founding legislation, FOOD research and innovation, "Will interface with and support elaboration of a wide spectrum of Union policies and related targets" (EC 2013a, L 347/152). As noted in Section 3.1, these connections exist across strategies ranging from the Common Agricultural Policy to the Integrated Maritime Policy to the European Climate Change Programme, and the Strategic Energy Technology Plan.

In the second and third work programmes of SC2, RRI is explicitly called out in the introductory text: "The concept of Responsible Research and Innovation (RRI) underpins this work programme, aiming to align research and innovation to the values, needs and expectations of society" (identical text in WPs 2016-2017 and 2018-2020, pages 12 and 8 respectively in EC 2017d, 2017e). However, RRI was much less likely to be actively identified—as a coherent umbrella concept—at the topic level. One exception, for example, in WP 2018-2020: "LC-SFS-17-2019: Alternative proteins for food and feed. Following the RRI principles, proposals will ensure that societal actors 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 society" (EC 2017e, p. 33).

RRI as a whole seems also less likely to be included in evaluation criteria. All types of actions are expected to account for project contributions to elaborated impacts in work programme documents: as noted in Annex H for WPs 2016-2017 and 2018-2020, one Impact Criterion states "The extent to which the outputs of the project would contribute to each of the expected impacts mentioned in the work programme under the relevant topic" (2017f; 2017g). However, the presence or absence of RRI dimensions in the expected impact sections of each topic of each work programme is beyond the scope of this research. A cursory review of topic language related to expected impacts reveals that RRI-related expected impacts are inconsistent, and not elaborated with a transparent process or clear logic. Further, it is unclear to what extent, if any, an RRI-related impact would receive emphasis or weighting with regard to any other expected impacts for a given topic.

Beyond mention of RRI as a coherent concept, SC2 programming is actively responsive to and seeking to address issues of gender balance, open access (see discussion of Open Science, below), and ethical issues (most ethical concerns however seem related to questions of species and environment, or data management and privacy). In the second and third work programmes in particular, clear mention of gender balance and dimensions are made, as well as direction to external resources and guidance in WP 2018-2020.

After results of the Interim Evaluation flagged lagging progress on gender dimensions, the proposal template for the H2020 Work Programme, as well as the Evaluation Criteria, were changed to emphasize gender dimensions. Template section 1.3.b, "Methodology," now includes a fairly significant change in reference to gender. The new text states: "Where relevant, describe how *the gender dimension*, i.e. sex and/or gender analysis is taken into account in the project's content" (Emphasis original, p. 2 of proposal template). The text itself, as well as the note on the text, clarifies that the gender section is to refer not only to balance in teams, but rather to the content of the research and innovation activities—a difference noted in the H2020 Interim Evaluation and recommended as an area for improvement in the short-term recommendations (EC 2017a, p. 234): "The qualitative analysis of a subset of 111 projects from gender-flagged topics showed the 53% included the gender dimension either well or in part. The notion does not seem to be well understood and is often confused with gender balance in research teams – nor is it always well evaluated" (EC 2017a, p. 173-174). Related, in General Annex H of the H2020 WP 2018-2020, RIAs Excellence Criterion now explicitly states: "Appropriate consideration of interdisciplinary approaches and, where relevant, use of stakeholder knowledge and gender dimension in research and innovation content" (EC 2017g).

Progress to address broader ethical concerns, public engagement, and science education seem less prominent in SC2 programming. A majority of language related to public inclusion or outreach at the work programme and topic-levels speak to a uni-directional view of science and society relationships (despite saying "two-way dialogue" after a paragraph of one-way communication deficit). For example, topic BB-08-2017: Strategies for improving the bioeconomy knowledge of the general public, states: "The bioeconomy is not a well-known concept among European citizens due to lack of information or information that cannot be understood by the general public. This means that there is little awareness of the importance of the bioeconomy in times of climate change, food insecurity and the tangible benefits the use of biological resources can bring to our everyday life" (EC 2017e).

More recently, WP 2018-2020 has articulated the aim to achieve, "a greater outreach to civil society by involving all the stakeholders and citizens at large through public consultation activities, citizen involvement in projects co-creation and a continued use of the multi-actor approach" (EC 2017f, p. 8). Regarding science education and science literacy, only one priority area, Blue Growth, and only in the 2018/2020 Work Program, explicitly mentions science education: "All Blue Growth actions shall also contribute to improving science education and ocean literacy through dissemination, outreach and training activities" (EC 2017f, p. 71).

Open Science, Open Innovation, Open to the World

The Open Agenda features more coherently and consistently in FOOD Programming. The original legislation for H2020 states that for the FOOD program, "The potential of farmers and SMEs to contribute to innovation must be recognised. The approach to the bioeconomy shall take account of the importance of local knowledge and diversity" (EC 2013a, L347/152). Further, the international policy context and interconnections across terrestrial, aquatic, and bioeconomic value chains makes the FOOD programme a robust site of Open Innovation.

According to the Interim Evaluation, SC2 outperforms the H2020 average on international participation, calculated from projects with third country contributions; arrangements with US, Canada and G7 S&T ministerial bodies; and participation in international endeavours like the Atlantic Ocean Research Alliance, etc. (EC 2017c). International participation is prioritized in each Work Programme of FOOD, for example, with emphasis as demonstrated by sayings like, "Many of the challenges addressed in this Work Programme are of global nature, requiring the development of global solutions and opening up the innovation process to all active players in cooperation with third

countries and relevant international organisations or initiatives" (EC 2017f, p. 6). In terms of specific topic language, SFS-32-2018: Supporting microbiome coordination and the International: Bioeconomy Forum, states: "In line with the objectives of the EU strategy for international cooperation in research and innovation, proposals should also aim at supporting similar activities within other IBF working groups. Participation of relevant partners from third countries and international organisations is strongly encouraged" (EC 2017f, p. 56).

Policy-level foundations for the Open Agenda in Societal Challenge can be traced throughout all three Work Programmes. Regarding Open Science, the Open Research Data Pilot is mentioned from WP 2014-2015; in WP 2016-2017, some 20 topics were placed in the Open pilot by default. Further, WP 2018-2020 states: "Open science approaches and international cooperation will be further encouraged, maximising the benefits of collaboration with regions outside the EU in particular in view of solving common problems and meeting international commitments" (EC 2017e, p. 7). Such emphases trace all the way to topics, for example DT-SFS-26-2019: Food Cloud demonstrators, which states, "The European Open Science Cloud (EOSC) will federate existing and emerging research data infrastructures, and provide researchers with services for Open Research Data (ORD) storage, management, analysis and re-use across disciplines. The move towards a thematic EOSC section for food and nutrition security (FNS) - or Food Cloud - would accelerate and support the ongoing transition to a more Open Science and Open Innovation model for food and nutrition systems, stimulate intra- and interdisciplinary research, and increase the impact and efficiency of research investments and infrastructures" (EC 2017e, p. 43). The criterion for quality and efficiency of the implementation likely helps ensure these two Open Agenda items are followed through.

Open Innovation, "Inclusive innovation," and Multi-Actor Approaches

Unique to the FOOD programme is the formulation of a multi-actor approach to "inclusive innovation." "Multi-actor approach" is a general term used by the Commission, and is included in the founding H2020 legislation, to refer to what might conventionally be described as trans-disciplinary research: "A multi-actor approach will ensure the necessary cross-fertilising interactions between researchers, businesses, farmers/producers, advisors and end-users" (EC 2013a, L347/151). In the most recent Work Programme, such interactivity is promoted to foster, "the development of research into practical applications and the creation of new ideas thanks to interactions between actors ("cross-fertilisation") and the sharing of knowledge. The interactive innovation model is implemented in this Societal Challenge through the 'multi-actor approach'" (EC 2017e, p. 7).

The inclusivity championed by the multi-actor approach in FOOD programming is very similar to the thrust of Open Innovation, which has been defined by the commission as: collaboration "combining the power of ideas and knowledge from different actors (whether private, public or civil society/third sector) to co-create new products and find solutions to societal needs" (EC 2016a, p. 14). Language referencing multi-actor approaches throughout WP 2018-2020 Work, for example, mirrors this Open Innovation spirit:

- "including a range of actors to ensure that knowledge and needs from various sectors such as research, plant health services and the farming/forestry sector are brought together" (EC 2017e, p. 19);
- "sub-topics A and B should fall under the concept of the multi-actor approach, ensuring that all the stakeholders, from farmers to consumers and regulators, will contribute to the building of new animal welfare approaches to further add value to EU foods of animal origin" (EC 2017e, p. 24);

- "bringing in the complementary expertise of private sector and civil society representatives of relevance to the scope" (EC 2017e, p. 100).

Open Innovation is perhaps the strongest cross-cutting societal dimension in FOOD programming precisely because of the promotion of the multi-actor approach. Across all work programme, almost one-quarter of all topics were flagged for multi-actor approaches. Most of these topics are found in Sustainable Food Security priority areas. Here again the structure of the FOOD programme is instructive: connections among DG-RTD and AGRI have meant that the European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) is a centre-piece of capacity-building for inclusive innovation for the FOOD community.

The EIP-AGRI, "brings together innovation actors (farmers, advisers, researchers, businesses, NGOs and others) at EU level and within the rural development programmes (RDPs). Together they form an EU-wide EIP network. EIP Operational Groups can be funded under the RDPs, are project-based and tackle a certain (practical) problem or opportunity which may lead to an innovation. The Operational Group approach makes the best use of different types of knowledge (practical, scientific, technical, organisational, etc.) in an interactive way."[54] As a further example, EIP-AGRI is explicitly called-out as a supporting resource to the FOOD community in WP 2018-2020 (EC 2017e, p. 5, p. 7, p. 9). Beyond these formally flagged multi-actor topics, many other SC2 topics include language about interdisciplinary or transdisciplinary approaches, as well as stakeholder participation. For example, the Blue Growth priority of the 2014-2015 WP states, "genuinely cross-disciplinary, integrated, systemic approaches – including the socio- economic dimension, as well as the engagement of the broader stakeholder communities" (EC 2015, p. 40).

4.2.3 RRI beyond the keys

The challenge-oriented approach of FOOD programming lends itself to broader forms of responsibility in research and innovation not currently required by the Commission. Most notably among these are the 'normative anchors' approach advocated by von Schomberg (2013); the procedural dimensions of anticipation, reflexivity, and responsiveness advocated by Stilgoe et al., 2013 (inclusiveness being covered by multi-actor approaches dominating SC2 programming); and the procedural dimension of coordination (Foley et al., 2016).

Introductory texts to FOOD R&I in the founding H2020 regulation, as well as in each Work Programme, position SC2 investments as a response to sustainability challenges facing humanity and the planet. As indicated in WP 2018-2020 recently, "SC2 Work Programme focuses on the sustainable management of land and waters to secure healthy food as well as on the delivery of public goods such as biodiversity and clean water. Furthermore, it supports innovative food and marine industries, the bioeconomy and dynamic rural areas" (EC 2017e, p. 5). These goals, drawn from European Treaty aspirations for sustainable development, function directly as "normative anchor points" that, as von Schomberg 2013 articulates, "provide a legitimate basis for defining the type of impacts, or the "right" impacts that research and innovation should pursue." Such legitimacy of funding purpose for 'right impacts' is a central form of responsibility that SC2 embodies. This legitimacy also underpins SC2 R&I as procedurally responsive to societal interests. As noted in the logic of in WP 2018-2020, FOOD is "guided by the political drivers of the Commission, including the Jobs and Growth agenda, this Work programme is highly relevant to meeting commitments under the Sustainable Development Goals (SDGs) and the COP 21 Paris Climate Agreement" (EC 2017e, p. 5).

54 Information on EIP-AGRI available at: https://ec.europa.eu/eip/agriculture/en/about

Procedural dimensions of responsibility in research and innovation are also observable in FOOD programming. At the policy level, the programme has direction to facilitate forward-looking activities "in relation to the bioeconomy strategy, including development of indicators, databases, models, foresight and forecast, and impact assessment of initiatives on the economy, society and the environment" (EC 2013a L347/152)—a clear indication of an anticipatory stance. Work Programme development evolves from a variety of inputs from diverse stakeholder groups through advisory bodies, public consultations, and the strategic advice of bodies like the Standing Committee on Agriculture Research (SCAR) (c.f. EC SCAR 2015). Specific calls also take anticipatory positions, for example LC-SFS-15-2018: Future proofing our plants, which states, "Existing and new approaches and technologies should be assessed to best encompass future research and innovation aiming at plant improvement, while developing a holistic approach to exploit the potential of plant research. Following the RRI principles, proposals should ensure that societal actors (researchers, citizens/CSOs, policy makers, businesses, etc.) are brought together to align the forthcoming research programmes with the values, needs, and expectations of society. Gender aspects should also be considered" (EC 2017e, p. 29).

Beyond responsiveness to normative anchors and anticipation, a variety of expert contracts for evaluation, strategy reviews, stakeholder conferences, and supporting policy analyses, including the Food 2030 policy framework development process, create opportunities for reflexivity at the programme level (EC 2017d). The original H2020 legislation charge for FOOD states: "It shall also pursue a broad approach to innovation ranging from technological, non-technological, organisational, economic and social innovation to, for instance, ways for technology transfer, novel business models, branding and services" (EC 2013a, L347/152). Such openness to non-technological forms of innovation in political, social, and economic orders is a vital element for responsible innovation—the capacity to reflect on whether a course of development is itself desirable, and if the means of achieving such development are acceptable (Rip 2014; von Schomberg 2013).

A final form of responsible research and innovation beyond the EC keys can be found in the mechanisms of coordination supported by the program. As Foley et al (2016) note, "Coordination entails planning, inviting, and fostering environments that bring together stakeholders in activities that support new arrangements between organizations included in, and sometimes previously excluded from, innovation governance" (p. 6). Coordination is a vital activity for attaining goals espoused by groups of people (c.f., Ostrom 1990). Provision of resources and incentives for coordination is a vital attribute for responsible execution of R&I in broad societal interests (c.f., Bozeman and Sarewitz 2010).

A major modification of SC2 in H2020 from its predecessor framework program 7 (FP7) can be seen in the coordination response in light of the European Common Agricultural Policy. The second pillar of the CAP prioritizes activities related to knowledge transfer and innovation (EC 2017c). Substantively, this has meant a restructuring of FOOD to be shared between DG Research and Innovation (DG-RTD) and DG Agriculture and Rural Development (DG AGRI) (EC 2017c). As noted above, DG-RTD, AGRI, MARE coordinate policy-level exchange to ensure stronger alignment between SC2 R&I programming and EC policy objectives. Related, emphasis on a 'multi-actor approach' in all projects related to agriculture support cross-value-chain coordination. Administrative and social infrastructures like EIP-AGRI support networking and knowledge sharing and exchange to mobilize central and marginal actors in sustainable food security and rural renaissance research.

EIP-AGRI influences are important because the focus groups bring stakeholders and sector experts together to identify and develop programme plans, as well as coordinate delivery of research results to various stakeholder groups (EC 2017e). In research and innovation funding more

specifically, ERA-Net Co-funds in SC2 (and across H2020) promote coordination of R&I among member states and associated countries. Coordination and Support Actions like BioSTEP foster collection and dissemination of best-practices vital to stakeholder and participatory engagement training in bioeconomy-based innovation and development.[55] SC2 Coordination and Support Actions also mobilize networks of national contact points to promote pan-European learning and research translation for FOOD programming.[56] While research has not yet been funded to evaluate precisely how these investments contribute to programmatic effectiveness, coordination activities are explicitly identified by the Interim Evaluation as positive R&I contributions (EC 2017c, p. 708).

4.2.4 Theoretical frameworks of R&I applied in the program line

The FOOD R&I portfolio includes "basic" research, "applied" research, and "knowledge transfer" activities, all focused on issues of food security and bio-economic activity (EC 2013a). Stipulations for the challenge-based approach are to be technologically agonistic and open to non-technological, social organizations and public-sector innovations in addition to technological ones. The program is to span not only all phases of research, but also market development related to pilot testing, design, "end-user driven innovation," and standardisation (EC 2013a, L 347/124). Such a division, enshrined in the founding legislation of H2020, speaks to a conceptualization of technology as separate from society, rather than socially constructed (c.f. Bijker, Hughes, and Pinch 1984), and of knowledge as independent of, rather than shaping, and shaped by social orders (c.f., Jasanoff 2004).

Despite this implicit perspective of technology and innovation as if separable from social construction or co-production, founding text of the FOOD program also explicitly states priorities for supporting knowledge exchange, stakeholder involvement, and pilot and demonstration activities (EC 2013a) (i.e., societal embeddedness). Various programme topics attend to social dimensions of consumer choice and preferences, as well as social aspects of innovation more generally. Calls related to assessments have highly anticipatory language, relating to social and economic dimensions of research subjects. Further, FOOD R&I is situated squarely as tackling urgent, long-term, complex sustainability challenges. As such there are roots anchoring and shoots sprouting from the programme that speak to an attention to the post-normal nature of the FOOD enterprise (Funtowicz and Ravetz 1993). Involvement of diverse bio-economy stakeholders, advisors, and other communities of extended expertise in the shaping of SC2 programme further speak to the embrace of a post-normal mode of research required for FOOD activities.

While the programme seeks to tackle sustainability challenges in the post-normal mode, it still also hews very closely to a standard set of linear and market-based perspectives on ways that technology and innovation (may) create value for society. Research and innovation are talked about as providing "knowledge, tools, service and innovations" for the achievement of agronomic and environmental goals of the programme (EC 2011d). An illustration of this market-based, instrumental orientation of FOOD programming can be found in WP 2016-2017 text introducing Blue Growth priorities, where the justification for EU intervention in R&I is spoken of in terms of promoting lab to market transitions and being more effective in pursuit of exploiting marine and maritime resources. No mention is made in this introductory text about inclusive innovation or responsible research and innovation (although a paragraph is subsequently devoted to cooperation on and open access regarding data products and information).

The march toward market justification and application can be seen in how SC2 programming has shifted in H2020 by stepping toward higher technological readiness levels (TRLs) (88% of projects in SC2 have been assessed at TRL 5 or above, according to the Interim Evaluation (EC 2017c). All of

55 BioSTEP project information on CORDIS available at: https://cordis.europa.eu/project/rcn/194808_en.html
56 See for example: https://cordis.europa.eu/project/rcn/194799_en.html

this is understandable given position H2020 within the Innovation Union arm of the Europe 2020 strategy for smart, sustainable and inclusive growth…but reveals a major difference between inclusive innovation approaches, justified in ways they can enhance efficiency and uptake of R&I knowledge and practices, and RRI approaches, justified as promoting broader alignment among science, technologies, and societal values.

The linear model of technology development (c.f. Douglas 2009) espoused by the programme is visible in the Interim Evaluation of H2020, as well as in the way FOOD programme topics speak about communication and public understanding of science. The Interim Evaluation reported that while EC programme managers and evaluators viewed SC2 activities as being in line with the Societal Challenge Pillar focus on innovation over fundamental research, stakeholders of the program seemed to voice concern with this point. The Interim Evaluation noted that stakeholder perceptions of innovation as being "at the expense" of fundamental research is the result of a, "lack of understanding … as regards the new structure of Horizon 2020, wherein frontier research is supported under pillar 1 (Excellent science)' (EC 20187c, p. 713). This passage exemplifies that even as programme officers and programme advisors begin to embrace the needs and new approaches of challenge-driven research, cultures of science within the R&I in communities remain more closely familiar to traditional modes of scientific research and governance (c.f., Polanyi 1962 on the idea of a "Republic of Science").

Disparate views on public understandings of science are also visible in the programme. As a prime example, BB-08-2017: Strategies for improving the bioeconomy knowledge of the general public, is a topic that primarily speaks of communication and understanding as a unidirectional, deficit-based endeavour (c.f., Sturgis and Allum 2004 in the majority of the challenge text):

> "*Specific Challenge: The bioeconomy is not a well-known concept among European citizens due to lack of information or information that cannot be understood by the general public. This means that there is little awareness of the importance of the bioeconomy in times of climate change, food insecurity and the tangible benefits the use of biological resources can bring to our everyday life. There is a strong need identified to engage in structured and coherent communication activities on the bioeconomy research and innovation results. The main tasks of this project are therefore to better understand existing barriers, raise awareness by informing citizens and establish an interactive, two-way dialogue between local research centres, the European Commission and European citizens."*

Only in the final third of the final sentence is any indication given two-way communication with publics is possible. Recognition of the potential value of such exchange is also not accounted for in the topic text.

4.2.5 Overall assessment of RRI in the programme line (from desktop research):

Category	Value	Description
A	High awareness: • Gender • Open Access and Open Science • Open Innovation • Governance (Rural Renaissance programming)	• RRI as concept is (implicitly or explicitly) present in most documents on all levels; • RRI keys and O's are used and referred to in several documents; • Governance structures reflect societal embeddedness; • Upstream/Downstream engagement is present on multiple levels

B	Some awareness • Ethics • Public Engagement • Science Education and Science Literacy (Blue Growth programming)	• RRI as concept is(implicitly or explicitly) present in some documents; • Some RRI keys and O's are used and referred to in any document; • There is some process of better social embeddedness through governance or engagement
C	Limited awareness • Science Education and Science Literacy (other programme areas) • Governance (other programme areas) • Reflexivity / anticipation as responsible innovation concepts beyond the RRI keys	• Responsibility or ethical awareness is referred to in any document • Any RRI key is mentioned; • There is reference to the need for social embeddedness of the research at hand.
D	No awareness	• RRI as concept is not present in any document; • No RRI key is mentioned implicitly or explicitly; • There is no reference to societal embeddedness or civic engagement;

4.3 Interview findings

4.3.1 Shared understanding of RRI

In this section, we report on the perspectives synthesized from the interviews described in section 3, Methods, above.

Overall awareness of the umbrella term "Responsible Research and Innovation" (RRI), as defined by the European Commission, was very low (only 3 of 17 individuals had heard of the term before, and one of these was a NCP). Despite limited awareness of the term "RRI," all parties were aware of issues related to gender equality, ethics, and open access, and were taking steps to address these. Further, there was a strong view expressed by SC2 interviewees that the overall orientation of the FOOD program was important and responsible in-and-of-itself because it is responsive to larger challenges associated with food system sustainability in society. There is a widely shared appreciation of how FOOD, as a Societal Challenge programme, is embedded in a larger European policy context supportive of inclusive approaches to research and innovation. Among SC2 participants and stakeholders, especially those connected to Sustainable Food Security Funding, this is embodied by the multi-actor approach.

Regarding the keys of RRI put forth by the Commission:

- Activities to support Gender Equality most often took the form of attention to the gender balance of project teams and work package or task leaders. There was an impression that addressing the gender dimensions of research, more broadly, remains a challenge for the community.

- Activities related to Ethics were often conflated with Open Science goals, for example transparent and compliant approaches to data management. Broader ethical issues potentially associated with FOOD R&I were rarely raised by interviewees.
- Activities related to Open Access most commonly involved project commitments to fund green and gold levels of open publication. Additional actions to support open access included establishing long-term plans for data accessibility after the life of a project.
- Awareness of the remaining keys (science literacy and public engagement) was low, with science education and science literacy rarely commented upon.
- Where public engagement was commented upon, it was most often in relation to dissemination and communication planning and involved one-way "pushes" of information to people/consumers (see discussion above regarding deficit models of public understanding).

4.3.2 Beyond RRI

Related to Open Innovation, the multi-actor approach was well understood and appreciated by SC2 interviewees—especially those involved in Sustainable Food Security and Rural Renaissance priority areas. The multi-actor approach in SC2 supports inclusion of stakeholders spanning the bioeconomy value chain, from industrialists and policy makers to farmers, consumers, and various sector workers. At the programme level, stakeholder input from a range of actors inform research priorities and topics. At the project level, stakeholder participation ranges from external advising to involvement from the conception and start of projects.

Interviewee experiences with implementing multi-actor approaches to Open Innovation varied. In some cases, projects reported difficulty reaching industry partners. In other projects, interviewees reported difficulty reaching farmers; and in others still, reaching CSOs or NGOs. In general, stakeholders interviewed articulated a dissatisfaction with the ability of funded projects to offer a clear value-add to justify extended multi-actor participation and suggested the need for additional resources for training, demonstration, and other potential incentives related to Open Innovation.

Finally, there was a general sense of a lack of spaces for conversations to reflect, as a community, about multi-actor approaches or RRI more generally. The absence of spaces for these conversations created a lack of clarity about whether RRI or multi-actor approaches were appropriate for all cases, all the time, and uncertainty on when and how to have policy and R&I relevant conversations about these questions.

4.3.3 Assessment of RRI in the programme line (based on interviews)

Category	Value	Description
A	High Awareness • Gender • Open Innovation	• RRI as concept well understood by all stakeholders; • RRI keys and O's are used and referred to by most stakeholders; • Operationalization of RRI already present
B	Some awareness • Public Engagement • Open Access / Open Science • Governance	• RRI as concept understood by some stakeholders; • Some RRI keys and O's are referred to by some stakeholders;

		• The need for mainstreaming through operationalization is referred to by some stakeholders
C	Limited awareness • RRI as a concept • Ethics • Science Education and Science Literacy	• Vague awareness of RRI as concept by a few stakeholders; • Any RRI key referred to by some stakeholders; • Some ideas of operationalization of RRI present
D	No awareness • Concepts of responsible innovation beyond the keys	• RRI as concept is not present; • No RRI key is mentioned; • No reference to or explicit refusal of societal embeddedness or civic engagement;

4.4 Case briefs

Below, four cases of Societal Challenge 2 projects and supporting infrastructure are presented. Each case presents the project title, corresponding topic, and presence or absence of RRI in said topic. In addition, a brief overview is presented on how the project situates itself relative to RRI and the Open Agenda—either explicitly or implicitly. Data sources for each case draw from the CORDIS database and immediately available project web-pages. Cases were selected based exemplifying different dimensions of RRI at the project level, or for contributing to larger research and innovation infrastructure conducive to RRI more generally.

4.4.1 BioSTEP Project Case

BioSTEP, full project title, Promoting stakeholder engagement and public awareness for a participative governance of the European bioeconomy, was a Coordination and Support Action funded from 2015 to 2018 for approximately EUR 1.76 Million.[57, 58] The topic announcement was *ISIB-08a-2014 - Engaging society, reaching end users and linking with policy makers for a participative governance of the bioeconomy*, and explicitly called for proposals to help with, "Ensuring a responsible and participative governance" as well as responding to citizen needs and concerns and integrating national and regional multi-stakeholder bioeconomy platforms and tools.[59] As such, the call implicitly relates to RRI keys on public engagement and governance, as well as Open Innovation.

BioSTEP positioned itself as a project directly concerned with multi-stakeholder dialogue on the social, economic and environmental impacts associated with the bioeconomy from an anticipatory perspective for participatory governance objectives.[60] The project explicitly sought to engage with actors across the range of society, from policy and industry to CSOs and citizens, seeking to understand values and end-user perspectives, activities, and governance activities, as well as challenges with bioeconomy governance. Such broad and inclusive participation relate strongly to anticipatory and reflexive dimensions of RRI beyond the EC keys, as well as public engagement and

57 Project entry in CORDIS available at: https://cordis.europa.eu/project/rcn/194808_en.html
58 Funding information from Europa Webgate, accessed on 5 July 2018, available at: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/erUXRa/state/analysis
59 Topic text available at: https://cordis.europa.eu/programme/rcn/664778_en.html
60 Periodic reporting for period 1 – BioSTEP, available at: https://cordis.europa.eu/result/rcn/198231_en.html

broader ethical reflections associated with EC keys. In addition, the project webpage explicitly raises ethical questions related to bioeconomy development, "The societal transformation towards a bioeconomy raises questions about the ethical foundations as well as the political and institutional framework conditions, in short, the normative resources of such a comprehensive change. How can a change be justified and legitimised in its political implementation that has been established in the interest of future generations, driven by economic needs and at the same time based on fundamental ethical considerations?"[61]

Public deliverables include a variety of resources of value to the larger bioeconomy R&I community, including: a summary report on impacts of the bioeconomy; actor and network maps; a range of case studies on bioeconomy strategies around Europe; results of stakeholder consultations; and best practices, lessons learned and recommendations for stakeholder and citizen engagement in bioeconomy research and innovation.[62]

4.4.2 BioHorizon Network Case

BioHorizon, full project title, Cooperation between NCPs for Horizon 2020 Societal Challenge 2 on "Food security, Sustainable Agriculture, Marine and Maritime Research and the Bioeconomy" and the Key Enabling Technology (KET) 'Biotechnology', is an ongoing Coordination and Support Action funded from 2015 through February 2019 for approximately EUR 2.0 million.[63, 64] The topic announcement was *ISIB-09-2014 - Supporting National Contact Points for Horizon 2020 Societal Challenge 2 on 'Food Security, Sustainable Agriculture, Marine and Maritime Research and the Bioeconomy' and the Key Enabling Technology (KET) 'Biotechnology'*, and explicitly called for proposals to identify and share "good practices and raising the general standard of support to programme applicants, taking into account the diversity of actors that make up the constituency of" SC2.[65] Of relevance to RRI, the call explicitly "should not duplicate actions foreseen in the NCP network for quality standards and horizontal issues under 'Science with and for Society'," fencing-off RRI from the scope of proposals and focus of the resulting network.

The webpage of the BioHorizon project is not searchable, and most content is held on an internal, log-in-protected participant page for NCPs only, making appraisal of RRI dimensions referenced in handbooks, trainings, webinars, e-mentoring, etc. difficult. However, interviews with FOOD NCPs revealed that no formal trainings have been coordinated by BioHorizon related to RRI—although trainings are being conducted on impact pathway development, as well as dissemination and communication: cross-cutting activities that fall outside the "science with and for society" embargo placed in the topic text. Example BioHorizon newsfeed updates feature: advertising for brokerage events to promote researcher and industry mixing and proposal writing tips; information about upcoming calls; specific information on resources available (like a new guide on IP and Contracts[66]); sharing resources from other networks, for example an NCP Net4Society resource on integration of socio-economic sciences and humanities in H2020 calls; information on the Open Data Portal.

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61 From "The Transition to a Sustainable Bio-based Economy" section of the background page of BioSTEP: http://www.bio-step.eu/background/what-is-bioeconomy/
62 A complete list of BioSTEP deliverables available at: http://www.bio-step.eu/results/public-deliverables/
63 Project entry in CORDIS available at: https://cordis.europa.eu/project/rcn/194799_en.html
64 Funding information from Europa Webgate, accessed on 5 July 2018, available at: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/erUXRa/state/analysis
65 Topic text available at: https://cordis.europa.eu/programme/rcn/664779_en.html
66 From the News page on BioHorizon's website, available at: http://www.ncp-biohorizon.net/news?cmd=showDetail&id=209&page=0

The BioHorizon project focuses on service provision tailored to the "complex and multidisciplinary" aspects of the SC2 community, as well as the widening participation aspirations of the Commission. Primary activities include networking, capacity building, mentoring, knowledge sharing with R&I clients, and coordinated NCP training.[67] The website states that one of the objectives of the project is to hold workshops on bioeconomy stakeholders and multidisciplinary involvement, suggesting facilitation of Open Innovation dimensions associated with multi-actor approaches when appropriate—however this can only be inferred based on the context of the project and programme, rather than verified. While not explicitly associated with RRI keys or other cross-cutting dimensions of H2020, by constraint of the topic text, the ambitions and activities do align with the implicit need for coordination in R&I systems for responsible innovation, as identified by Foley et al (2016).

4.4.3 STAR-ProBio Project Case

STAR-ProBio, full project title, Sustainability Transition Assessment and Research of Bio-based Products, is an ongoing Research and Innovation Action funded from 2017 to April 2020 for approximately EUR 4.98 Million.[68, 69] The topic announcement was *BB-01-2016 - Sustainability schemes for the bio-based economy*, and explicitly called for proposals to build economic and social dimensions into sustainability and life cycle assessments of bio-based products.[70] Topic objectives included to enable acceptance and applicability of assessment methods for regulatory and policy communities, as well as to "ensure market pull for bio-based products" through standard and certification and labelling schemes. Although no explicit mention of RRI or the Open Agenda were mentioned in the topic, implicitly, the call suggests a need for inclusive and Open Innovation.

The project webpage details work package activities, inclusive of a future Ethics deliverable, as well as a Communication, Dissemination, Networking and Outreach deliverable (relating to public engagement and Open Innovation approaches, implicitly).[71] Detailed in STAR-ProBio D10.3 are audiences of internal and external panel events, focus groups, and workshops with scientists, researchers, policy makers, businesses, business associations, and standardization and certification and NGOs. Such broad approaches to engagement speak to implicit alignment with Open Innovation, inclusive, multi-actor approaches to the R&I. The project recognizes these societal engagements as vital to effective scoping, development, and validation of their assessment model development. The project participates in a cooperation across bioeconomy projects funded by the EU, European Bioeconomy Network (EuBioNet), "to maximise the efforts, increasing the knowledge sharing, networking, mutual learning, coordination of joint activities and events,"[72] an implicit activity aligned with responsible research and innovation beyond the RRI keys.

4.4.4 FIT4FOOD2030 Project Case

FIT4FOOD 2030, full project title, Fostering Integration and Transformation for FOOD 2030, is an ongoing Coordination and Support Action funded from 2017 to October 2020 for approximately EUR

67 Periodic reporting for period 1 –BioHorizon, available at: https://cordis.europa.eu/result/rcn/194996_en.html
68 Project entry in CORDIS available at: https://cordis.europa.eu/project/rcn/210168_en.html
69 Funding information from Europa Webgate, accessed on 5 July 2018, available at: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/erUXRa/state/analysis
70 Topic text available at: https://cordis.europa.eu/programme/rcn/702068_en.html
71 STAR-ProBio Deliverable D10.3, Deliverable D10.3: First year report on communication, dissemination and publication activities + Appendix, available at: http://www.star-probio.eu/wp-content/uploads/2017/04/STAR-ProBio_D10.3_First-year-report-communication-dissemination-publication-activities_finalAppendix.pdf
72 Information on EuBioNet available at: http://eubionet.eu/

4.00 Million.[73, 74] The topic announcement was *SFS-18-2017 - Support to the development and implementation of FOOD 2030 - a European research and innovation policy framework for food and nutrition security.*[75] The call gave proposals the specific purpose to foster "multi-actor engagement and awareness-raising" in support of developing a "new policy framework to better structure, connect and scale-up Research and Innovation for Food and Nutrition Security, in Europe, and with global outreach.[76] RRI is explicitly identified as central to proposing project: "This CSA will have the duration of three years and will be implemented as a Mobilisation and Mutual Learning (MML) action plan fostering the concept of Responsible Research and Innovation (RRI)."[77] The topic call takes an explicitly inclusive and future-oriented stance (suggestive of implicit dimension of RRI beyond the keys), calling not only for policy, researcher industry, consumer, and arts communities but also general publics, youth and children. Further, the call is responsive to various urban, national, regional, and global food challenges (e.g., Milan Urban Food Policy Pact cities).

FIT4FOOD2030's aims and objectives, as listed on the website, include "future-proofing", "multi-stakeholder" mobilization of people for sustainable food nutrition and security in Europe.[78] RRI and RRI keys are mentioned explicitly across the drop-down text of the "Project Activities" page of the website, as well as RRI and Open Science being explicitly mentioned in the concepts and methods page.[79] Examples across work packages[80] include:

- a foundational methodology work package on "Designing and instigating a network approach for a multi-actor, multi-level, transformative network" (Open Innovation);
- a "strategic intelligence" gathering work package on food systems and R&I policy frameworks looks explicitly at "governance of food policies and EU food systems R&I in a global context" (governance);
- a future-oriented road-mapping work package that seeks "to foster the dialogue around the urgency, possible good practices and pathways for applications of the RRI concept to food system transformation" (RRI);
- an explicit RRI-competence-building work package to, "design and deliver a set of transformative hands-on future oriented trainings on food systems responsible research and innovation (RR&I) for Primary, Secondary and University level students and professionals" (RRI);
- a reflexive learning work package to monitor and evaluate the entire project in support of "responsible research and innovation (RRI) and other ethics issues, activities for the further development and implementation of the FOOD 2030 policy framework" (RRI).

Beyond website text, the FIT4FOOD2030 project webpage documents concrete activities conducted in support of RRI. Project surveys of European citizens, and European Commission public consultations on the revised Bioeconomy strategy are advertised. A variety of future-of-food visioning workshops with diverse sets of stakeholders as well as publics, have been held across cities

73 Project entry in CORDIS available at: https://cordis.europa.eu/project/rcn/212409_en.html
74 Funding information from Europa Webgate, accessed on 5 July 2018, available at: https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e/sheet/erUXRa/state/analysis
75 Topic text available at: https://cordis.europa.eu/programme/rcn/702306_en.html
76 Topic text available at: https://cordis.europa.eu/programme/rcn/702306_en.html
77 Topic text available at: https://cordis.europa.eu/programme/rcn/702306_en.html
78 FIT4FOOD2030 Aims & Objectives, available at: https://fit4food2030.eu/about/
79 FIT4FOOD2030 Concepts & Methods, available at: https://fit4food2030.eu/about/concepts-methods/
80 FIT4FOOD2030 Project Activities excerpts from: https://fit4food2030.eu/project-activities/

in Europe (e.g., Amsterdam and Budapest), as well. Public consultations (held in local language) were co-designed through participatory, multi-stakeholder engagements with the project.[81]

5. Conclusions

Bright Spots

Societal Challenge 2 programming adopts RRI and Open Agenda approaches to R&I to varying degrees of success. Through its commitment to multi-actor approaches, the programme excels at promoting inclusive and Open Innovation approaches not only in projects, but also in work programme agenda setting and development. SC2 governance (RRI key), through co-management by DG-RTD and DG-AGRI, seems to make the programme especially responsive to the interests and priorities of a diverse stakeholder community. Such responsiveness can be seen in changes to FOOD work programme priorities and calls over time. In addition, the programme overall is responsive to food-resources and bio-based sustainability challenges of European society. Programmatic responsiveness is visible in how the establishing legislation for SC2 in H2020, as well as each successive Work Programme, explicitly identifies relevant European policy initiatives. More recently, responsiveness is also visible in reference to addressing UN Sustainable Development Goals through FOOD R&I. Awareness of and attention to gender balance is also clear (although work to address gender dimensions lags behind balance issues, as found across H2020 (EC 2017a)), especially in the most recent WP 2018-2020. Issues associated with open access, Open Science, Open to the World, and data management and protection (ethics key) have been present throughout FOOD programming, as well.

Challenges

Despite the strong progress related to the Open Agenda and governance, ethics, and gender keys, FOOD programming could improve along other dimensions of RRI. Only certain programmatic priorities seem to consistently respond to public engagement (e.g., Rural Renaissance priority) and science education and science literacy keys (e.g., Blue Growth priority). Ethical reflection seems rather narrow, focused most commonly on data and privacy or inter-species bio-ethics rather than the full range of issues implicated by food-resource and bio-based sustainability concerns of the FOOD programme. Stakeholder engagement (related to Open Innovation) across the full 'value-chain' and R&I system that FOOD programming touches is inconsistent, with topic foci or project foci often making certain sectors difficult to target (e.g., sometimes farmers, sometimes labour organizations, sometimes retail chains, sometimes consumer groups, sometimes industry). Further analysis and research beyond the scope of this diagnosis would be needed to ascertain, as well, whether only particular types of FOOD projects are adopting and implementing RRI and Open Agenda activities (e.g., are Coordination and Support Actions over-represented, relative to Research and Innovation Actions, Innovation Actions, or SME instruments?).

The diagnosis of RRI and the Open Agenda adoption reveals several challenges with implementation. First, the Programme seems to send mixed-message with regards to clear direction for RRI and Open Agenda adoption. While Work Programme introductory texts clearly emphasize RRI, similar language is often absent from topic texts. Further, it is not clear to what extent evaluation criteria consistently incentivize inclusion of the full range of RRI and Open Agenda activities. At present, criteria seem most likely to incentivize attention to gender, Open Agenda, and inclusive innovation dimensions. Related, resources for proposal writers and evaluators to learn

81 Visioning co-design activities showcased here: https://www.essrg.hu/en/towards-future-proofing-our-local-food-system-the-birth-of-the-fit4food-budapest-community/ and here: https://fit4food2030.eu/city-lab-budapest-co-creating-a-vision-of-a-future-proof-food-system/

about RRI on the H2020 Online Manual are non-existent under the search for "RRI"—rather, participants have to look to disaggregated sections on topics related to gender, ethics, open access, data management, communication and dissemination, etc.[82]

Second, language used to refer to collaborative multi-actor work is inconsistent across the program. For example, in Blue Growth or Bioeconomy calls, projects are more often referred to as participatory, inter- or trans-disciplinary, or fostering involvement of diverse sectors, rather than being "multi-actor." This may relate to the prominence of "multi-actor approaches," being supported by DG-AGRI in Sustainable Food Security and Rural Renaissance priority areas. Inconsistent language to refer to such—broadly—inclusive innovation practices (noting that Open Innovation is not a term commonly used either) suggests that there is not as much coordination and learning across the heterogenous SC2 priorities as there could be to help effectively realize programmatic and EC aspirations.

Third, the goals of inclusive innovation and responsible research and innovation are not necessarily aligned. Multi-actor approaches related to inclusive innovation have the objective of advancing the relevance of project analyses and uptake of project outcomes. By contrast, RRI has the more general objective of aligning research and innovation practices with societal values, needs, and expectations. Without general guidance on when and why RRI or inclusive innovation activities are prioritized—and how the two approaches can be related for mutual-benefit—ambiguity arising from these slightly different goals may hamper the potential benefits of FOOD programming.

Recommendations

1) **Support RRI through existing, robust networks of FOOD Programming.** The multi-actor approach of SC2 provides a strong foundation upon which challenge-based, problem-solving approaches to research and innovation are advanced in Europe. Existing networks developed through National Contact Points (NCPs) and the European Innovation Partnership for Agriculture (EIP-AGRI) represent valuable assets that could be maintained, strengthened, and supplemented to advance RRI keys (and further support multi-actor approaches across diverse strands of SC2 programming). Rather than "forcing" a "top-down" approach to RRI within SC2, the FOOD programme could incentivize NCPs and EIP-AGRI to augment their existing work with efforts related to RRI, for example developing and offering trainings, focus groups, webinars, and other capacity building events related to gender and ethics dimensions of research, public engagement, and science education.

2) **Support RRI through more explicit evaluation criteria**. Work Programme text and topic evaluation criteria were identified by interviewees as very strong motivators of change for the research and innovation community. Priority aspects of RRI and/or multi-actor approaches could be more effectively encouraged when highlighted in topic text and reinforced criteria. Changes to text and criteria mobilize NCPs and to build Member State and Associated Country capacity to respond to calls. Interviewees noted that training evaluators and also increasing the priority of RRI in interim and final evaluation activities could further strengthen efforts to advance priorities like RRI and the Open Agenda.

3) **Promote experimentation and learning about RRI implementation.** ERA-Net Cofunds provide a natural laboratory for testing approaches to research and innovation funding. In addition, they offer Member State and Associated Countries (MS/AC) opportunities to build capacity to experiment with new and creative funding approaches, as well as common

82 Research and Innovation Participant Portal H2020 Online Manual, available at: http://ec.europa.eu/research/participants/docs/h2020-funding-guide/index_en.htm

priorities. The Commission could continue to support learning enterprises (like ERA-Learn), and devote specific attention fostering learning from ERA-Net Cofunds around implementation of RRI and/or Open Agenda activities in SC2. Examples of such work might include providing additional funds to ERA-nets or offer RRI or Open Agenda capacity-building in advance of calls; include these dimensions in general eligibility criteria (in addition to evaluation criteria); offer additional funds to ERA-Nets that successfully implement RRI and Open Agendas; and conduct MS/AC workshops with NCPs.

6. Literature, links, resources

Beyond the above footnoted resources, the following texts were analysed and cited and appear in alphabetical order:

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Douglas, H. (2009) Science, policy, and the value-free ideal. University of Pittsburgh Press.

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European Commission (2011b) Proposal for a Regulation of the European Parliament and of the Council on Horizon 2020 – The Framework Programme for Research and innovation (2014-2020), COM(2011) 809 Final.

European Commission (2011c) Proposal for a Regulation of the European Parliament and of the Council laying down the rules for the participation and dissemination in 'Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020)', COM(2011) 810 Final.

European Commission (2011d) Proposal for a Council Decision establishing the Specific Programme implementing Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020), COM(2011) 811 Final

European Commission (2013a) REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC

European Commission (2013b) HORIZON 2020 WORK PROGRAMME 2014–2015: 18. General Annexes. Decision C (2013)8631 of 10 December 2013

European Commission (2014) Coordination and Support Actions (CSA) Administrative forms (Part A) Research proposal (Part B). Version 1.3 4 December 2014

European Commission (2015) HORIZON 2020: WORK PROGRAMME 2014 – 2015: 9. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy. Revised. Decision C (2015)2453 of 17 April 2015

European Commission Standing Committee on Agricultural Research (2015) Sustainable Agriculture, Forestry and Fisheries in the Bioeconomy - A Challenge for Europe: 4th SCAR Foresight Exercise. Kovacs, B (Ed.). Luxembourg: Publications Office of the European Union

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European Commission (2017b) Commission staff working document: in-depth interim evaluation of Horizon 2020: Annex I (SWD(2017) 220 final

European Commission (2017c) Commission staff working document: interim evaluation of Horizon 2020: Annex 2 (SWD(2017) 221 final

European Commission (2017d) HORIZON 2020: WORK PROGRAMME 2016 – 2017: 9. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy. Decision C(2017)2468 of 24 April 2017

European Commission (2017e) HORIZON 2020: WORK PROGRAMME 2018 – 2020: 9. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy. Decision C(2017)7124 of 27 October 2017

European Commission (2017f). HORIZON 2020 WORK PROGRAMME 2016–2017: 20. General Annexes. Decision C(2017)2468 of 24 April 2017

European Commission (2017g). HORIZON 2020 WORK PROGRAMME 2018–2020: 19. General Annexes. Decision C(2017)7124 of 27 October 2017

European Commission (2017h) H2020 Programme Proposal template 2016-2017 Administrative forms (Part A) Project proposal (Part B) Research and Innovation Actions (RIA) Innovation Actions (IA). Version 3.1 11 January 2017.

European Commission (2017i) H2020 Programme Proposal template 2018-2020 Administrative forms (Part A) Project proposal (Part B) Research and Innovation Actions (RIA) Innovation Actions (IA). Version 3.2 27 October 2017

European Commission (2017j) H2020 Programme Proposal template 2016-2017 Administrative forms (Part A) Project proposal (Part B) Coordination and Support Actions (CSA). Version 3.1 11 January 2017.

European Commission (2017k) H2020 Programme Proposal template 2018-2020 Administrative forms (Part A) Project proposal (Part B) Coordination and Support Actions (CSA). Version 3.2 27 October 2017

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Annex

Interview Protocol

The rationale behind the questions

The interview schedule provides a guide for the interviews and a framework that allows comparable information/data to be collected. The interview focusses on the 4 domains that are of interest to the diagnosis of RRI in the programme lines: the challenges they face regarding social-ethical issues, the current practices in dealing with these challenges, and the drivers and barriers they experience in dealing with these challenges. The questions are framed in an open manner to encourage a more open responses. Moreover, by not using RRI terminology (except for the last section) respondents are neither implicitly accused of not being responsible, nor required to have background knowledge of RRI.

Opening prompt/ Briefing

- A brief introduction/briefing specifying why the interviewee has been recruited for the interview (i.e. in what role at which organization, and as an expert of what?).
- A brief clarification of what we mean by societal and ethical challenges:

By societal challenges we mean major society-wide concerns that an individual (or organisation) may encounter such as climate change, and the aging population. These may overlap with the 7 societal challenge that receive specific attention in R&I policy and funding programmes by the EC: 1) health 2) food security 3) energy 4) transport 5) climate and environment 6) inclusive societies 7) secured societies.

By ethical challenges, we refer to two general kinds of situations. First, where an individual (or organization) faces a dilemma, for example in professional practice. These are cases where someone may be asked to balance conflicting thoughts and feelings about what he or she "should" do in a situation, and what he or she is being asked to do. Second, when we as a society face a dilemma in allocating resources or making policy choices. These are cases where different courses of actions seem to force a shifting balance among values that a society holds. A classic example here is balancing basic rights and freedoms with security and privacy needs.

Challenges

What are the main societal and ethical challenges of relevance to your work as [fill in]?

Current Practice

How do you address these ethical and societal challenges in your [project/organisation]?

- What strategies or methods do you deploy/are in place?
- With whom do you collaborate on such challenges?
- Stakeholders engagement/ ethics/ gender/ forecasting/ scenarios/ etc.

Enablers

Are there any resources that you find helpful in dealing with such challenges in your [project/organisation]?

- Support / resources / guidelines / skills, expertise, experience / financial / etc.

Barriers

Are there any factors that prevent you from dealing with such challenges in your [project/organisation]?

- Lack of time, incentive or expertise / not an issue / not a requirement / etc.

Application of RRI Keys

Can you comment on the application of the following features of Responsible Research and Innovation in your [project/organization]?

- Do you apply … in your [project/organization]?

Key		Elaboration on how/where
K1-Public engagement	☐No	☐Yes, …
K2-Gender equality	☐No	☐Yes, …
K3-Science Literacy/Education	☐No	☐Yes, …
K4-Open Access (open science)	☐No	☐Yes, …
K5-Ethics	☐No	☐Yes, …
K6-Governance	☐No	☐Yes, …

Closing question

Is there anybody you would recommend for us to contact concerning the topic if this interview?

- Thanks for the interview and the valuable points you have raised. We would very much like to stay in touch with you in further course of our project.

NewHoRRIzon Diagnosis Report

Social Lab No. 9

Secure, Clean and Efficient Energy

Grant Agreement No.	**741402**
Project Start Date	May 1st, 2017
Duration of project	48 months
Version	1.0
Authors	Maria Schrammel Lisa Marie Seebacher

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1. Executive Summary

The H2020 programme line *Secure, Clean and Efficient Energy* is embedded in the funding realm of *Societal Challenges.* It is a broad field that aims at addressing technical and social issues in a broad range of different topics. Calls range from "reducing energy consumption and carbon footprint", "alternative fuels and mobile energy sources", to "robust decision making and public engagement" and "market uptake of energy and ICT innovation" – the projects in this programme line are equally multifaceted.

The following analysis elaborates on the role of *RRI* in this programme line. A desktop analysis scrutinised the most recent H2020 work programmes and calls, scoping papers, evaluation guidelines, proposal templates and winning projects on energy. Additionally ten expert interviews were conducted and thematically analysed alongside the *RRI* key dimensions and process-requirements.

As a result, differences between the supposedly framing policy level, work programme level and call and project level became clear rather soon. On policy level, some documents (e.g. the *European Energy Security Strategy* and the *Policy Framework for Climate and Energy* in the period from 2020 to 2030) do not reflect any awareness on *RRI*. Others (e.g. the SET plan and the *Clean Energy for all Europeans Package*) show a higher awareness. Public Engagement is the most explicitly mentioned key on the level of framing documents. In addition, the scoping paper of the programme line shows some awareness on *RRI*. Thus, the *3 Os*, especially *Open innovation* and *Open to the World* are important cross cutting issues for the strategic orientation 2018 – 2020. Besides open access, the scoping paper emphasizes increasing *Citizen Participation and Involvement*, *Gender* and *Science Education* for different age groups. Speaking of a "smart citizen-centred energy system" underlines the assumption that citizen engagement and bottom up approaches play an important role.

At work programme level, *RRI* is explicitly named and required. The *Energy* programme line is inherently interlinked with the concept of *RRI* since its aim directly addresses society and its aspired energy transition. Again, public engagement is the most prominent key. On call level, however, *RRI* is not reflected as a holistic concept, single keys are addressed by different projects instead. Only remarkably few calls actively require one or more *RRI* keys. Technical calls show no awareness at all compared to user/consumer oriented calls, which show some awareness on *RRI.* The comparison of *RRI* awareness on programme and call level is mirrored in all three time slots equally. Projects clearly reflect the awareness requested on call level and show low awareness of *RRI*, with 70 % of the analysed contents not mentioning one *RRI* key.

These insights are supported by the expert interviews. Neither at policy nor at project level *is RRI* known as holistic and overall applicable concept. Instead, most *RRI* keys are seen in relation to social sciences perspectives, while the realm of technology and natural sciences in the energy sector is merely seen as touching upon ethical issues related to data security. Research projects in the realm of Smart Cities represent notable exceptions in this regard – the overarching consideration and application of participatory research which interlinks several *RRI* dimensions at once might be considered as best-practice example within the programme line of *Secure, Clean and Efficient Energy*.

What is needed to better implement *RRI* in the programme line? Guidelines and specific trainings combined with financial and time resources were emphasised as most supportive resources in order to conduct research in a more holistic and responsible way. A supportive network of researchers as public entities, industries and civil society organisations as well as political commitment to the needed energy transition might support the process of overcoming blocking research traditions.

2. Scope of this document

This document is not an official deliverable. It is for internal use only and hence informing the social lab number 9, as other social labs within the NewHoRRIzon project. It should give an insight in the extent the current programme line of *Secure, Clean and Efficient Energy* addresses *RRI*. Building on a comprehensive desk research and a series of expert interviews, the results provide information for preliminary diagnosis. The diagnosis lays out the starting point for the work in the social lab and provides a baseline for evaluation. Further, by offering research input and data for the consortium, collected in a systematic way, it provides the ground for cross-thematic comparisons on the wider project-level.

3. Methods

The following diagnosis report bases on a substantive desk research. In the wake of this analysis the most recent H2020 work programmes and calls, scoping papers, evaluation guidelines, proposal templates and winning projects on energy have been scrutinised. By using qualitative data mining software (MaxQda) these documents have been coded with regards to explicitly mentioning *RRI* in general, the six *RRI*-Keys (*Science Education, Public Engagement, Open Access, Governance, Gender, Ethics*), *RRI* specific process requirements (*responsive/adaptive, open/transparent, anticipation/reflection, diverse/inclusive*) as well as the *3 Os* (*Open Science*, *Open Innovation*, *Open to the World*). Further, also the reflection of SDGs has been explored in the analysis. Thus, both the explicit as well as implicit dimensions of *RRI*'s consideration could have been covered.

In addition to this document analysis, expert interviews were conducted. The ten respective interviewees were selected based on their expertise as policy makers, NCPs for the *Energy* programme line or as being involved in highly *RRI* ranked projects. In reference to Grounded Theory as many interviews had been conducted as necessary to reach saturated data. The interviews were transcribed and thematically analysed by using MaxQda. Coding happened based on the aforementioned categories. Additionally, in-vivo codes were used whenever important dimensions exceeded the framework of analysis.

3.1 General scope of the program

The programme *Secure, Clean and Efficient Energy* is the third of seven predefined *Societal Challenges* that receive funding in H2020. In order to succeed in the transition to a competitive energy system, various challenges, such as climate change, increasingly scarce resources on the one hand and growing needs of energy and resources on the other, to name just a few of them, need to be tackled. According to the EC, the Energy Challenge is structured around the following seven specific objectives and research areas:

- Reducing energy consumption and carbon footprint
- Low-cost, low-carbon electricity supply
- Alternative fuels and mobile energy sources
- A single, smart European electricity grid
- New knowledge and technologies
- Robust decision making and public engagement
- Market uptake of energy and ICT innovation

The EU allocated € 5.931 M to non-nuclear energy research for the period 2014-2020.

3.2 What is your programme about?

At EU level, the *Energy* programme line is affiliated with two different Directorate-Generals (DGs) of the European Commission, namely DG for Energy (DG ENERGY) and the DG for Research and Innovation (DG RTD).

The main priorities within the programme *Secure, Clean and Efficient Energy* address Energy Efficiency, Low Carbon Technologies and Smart Cities & Communities. The following summary is based on the H2020 Work Programmes document for *Secure, Clean and Efficient Energy* of 2016-2017 as well as the updated version of 2018-2020.

The recently set out EU-policy package *Clean Energy for all Europeans* outlines 'energy efficiency first', putting Europe in a leading position with regard to renewables, and a fair deal for consumers as its three top-priorities. In particular, the areas of energy security, energy efficiency and an integrated European energy market need to be thoroughly researched. This should contribute to the "moderation of demand, a decarbonisation of the economy as well as increased efforts as regards research, innovation and competitiveness" (EC, 2017b, p. 9). The work programme further underlines, that € 1 bn is dedicated to supporting energy-related research and innovation activities. "The recent Work Programmes are key instruments to progress towards a European Energy Union which provides EU consumers – households and businesses – "with secure, sustainable, competitive and affordable energy" (EC, 2017b, p. 10). Therefore, Europe's energy system needs transformation. Main milestones considered are the EU's energy and climate targets set for 2030 and its attempts to build "a low-carbon, climate resilient future" (EC, 2017c, p. 13). These goals also substantiate Europe's leading role in the fight against climate change.

The Work Programme *Secure, Clean and Efficient Energy* will "put emphasis on enabling the participation of consumers in the energy transition and improving the efficiency of the energy system, especially as regards the building stock and developing the next generation of renewable energy technologies and their integration in the energy system" (EC, 2017b, p. 9).

The programme of 2016-2017 divides the three main priorities in two focus areas – Energy Efficiency and Competitive Low-Carbon Energy – and the last area "Smart and Sustainable Cities" being included in the cross-cutting part of the programme. This programme covers the full innovation cycle (from proof of concept to market uptake). Additionally, the follow-up Work Programme of 2018-2020 puts a stronger focus on digitisation as a driver of energy-transformation and introduces a range of financial incentives to steer innovative action and scientific collaboration. The Work Programmes exhibit an *RRI*-themed approach as they aim at a broader engagement of stakeholders by including citizens and communities in more significant roles: "The transformation of the energy system encompasses technological, societal, cultural, economic and environmental aspects and calls for a more important role for citizens and communities" (EC, 2017b, p. 10). However, energy related research is not only to be opened to the public. Production and Supply Chains are complementary to the efforts set to secure Europe's technological leadership, which is why also the participation of industries in the programme is crucial. Especially representatives of industry operating SMEs are actively addressed. Further, they argued: "This systematic approach is in line with the Horizon 2020 Responsible Research and Innovation (*RRI*) cross cutting issue, engaging society, integrating the gender and ethical dimensions, ensuring the access to research outcomes and encouraging formal and informal science education" (EC, 2017b, p. 10). Energy equally is a crosscutting issue. Thus, there are synergies with other relevant areas, such as information and communication technologies and material-related research.

The Work Programmes further support international cooperation with strategic partner countries. Global technology leaders are to contribute to the global efforts to mitigate climate change and reduce

CO2 emissions. This is in line with the EU's strategy for international cooperation in research and innovation. This strategy promotes common principles, which deal with responsible research and innovation: "[…] The Union is well placed to play a leading role in promoting common principles for the conduct of international research and innovation activities in order to create a level playing field in which researchers and innovators from across the globe feel confident to engage with each other. These principles will deal with issues such as responsible research and innovation, research integrity; peer review of proposals; promotion of the role of women in science and the gender dimension in research, research and innovation; research careers […]; fair equitable treatment of IPR; and open access to publicly funded research publications" (COM (2012) 496).

Activities funded under Societal Challenge 3 *Secure, Clean and Efficient Energy* are also expected to have an impact on the implementation of the UN Sustainable Development Goals (UNDP, 2015) (SDGs). The main goals addressed are SDG 7 "Ensure access to affordable, reliable, sustainable and modern energy for all", SDG 11 "Make cities inclusive, safe, resilient and sustainable" and SDG 13 "Take urgent action to combat climate change and its impacts". Another main goal is the Paris agreement under the UN Framework Convention on Climate Change, adopted at the 21st Conference of the Parties in Paris of 12th of December 2015 (COP 21, 2015).

The dimension of *Ethics* is explicitly tackled in the Work Programme of 2016-2017: "All activities should demonstrate a good understanding of ethical aspects and promote the highest ethical standards in the field". The Work Programme of 2018-2020, however, seemingly got rid of these considerations, as ethical aspects are not even explicitly mentioned once. If projects participate in the Open Research Data Pilot, the use of a Data Management Plan (DMP) is required, unless the participants use their possibility to opt-out of these obligations.

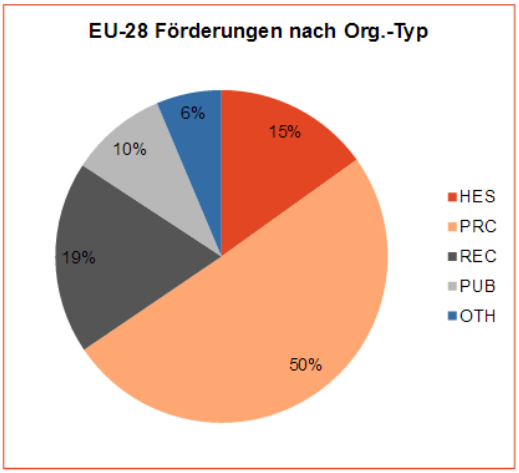
The Programme further encourages synergies between H2020 and other European funds, such as European Structural Investment Funds (ESIF) or the European Regional Development Fund (ERDF).

For the calls of 2016-2017 a total budget of €699.64 m was allocated. Therein €104 m were funding for the subtopic "Energy Efficiency" and €422.89 m for "Low-carbon energy". The rest was allocated for other actions. Within Energy Efficiency 25 calls were tendered. Within Low-Carbon Energy 36 calls were tendered. Other actions included e.g. prices for CO2 reuse or for combined heat and power and for different assessments or data bases and platforms and many more (not to be outlined in detail here (EC, 2017b)). With regard to the 2018-2020 programme, €650.82 m are scheduled for 2018, €749.28 m for 2019, €805.38 m for 2020. The by far biggest share of the provided budget - €534.30 m for 2018, €589.65 m for 2019 and €642.81 m for 2020 respectively -is again allocated to "Energy efficiency", followed by grants available for public procurements (33.58 – 36.28 – 31.93 m) and financial instruments (0 – 50–50m) (EC, 2017c).

For the last call 2014-2015 1.532 projects were submitted and 247 projects were funded in 2016 under the programme line *Secure, Clean and Efficient Energy*. This is a success rate of 14.5 %. In total the amount was € 620.114.627.

According to the statistics by funding type, half of the organisations receiving funding stem from the private sector, 19 % is received by research organisation (REC), 15 % by universities (HES) the rest being shared between public bodies and further applicants.

Figure 6. EU-28 Funding by type of organisation (EC DG R&I, 2015)



Top 10 Organisationen mit Vertrag (inkl. ex aequo)

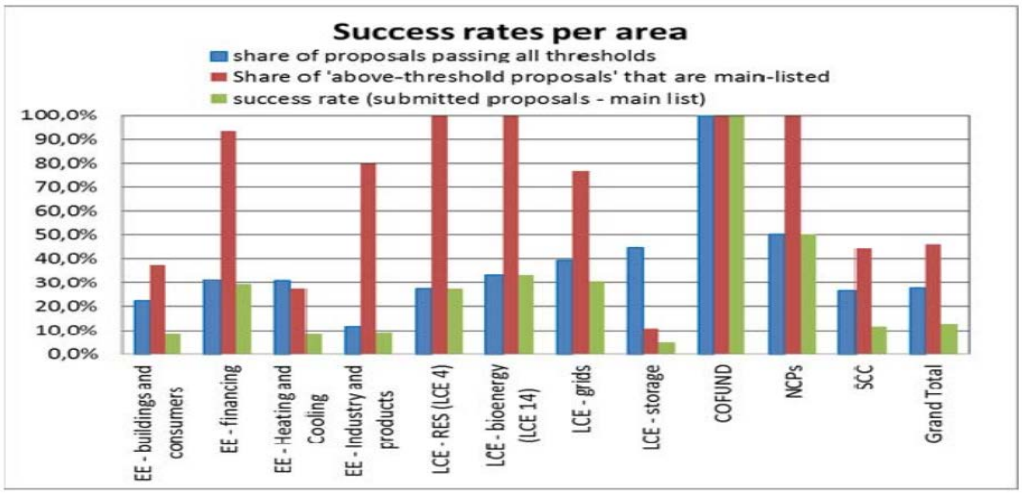
EU-28		
HES		
Organisation	**Land**	**bewilligte Beteiligung**
POLITECNICO DI MILANO	Italien	7
AALBORG UNIVERSITET	Dänemark	6
RHEINISCH WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN	Deutschland	6
TECHNISCHE UNIVERSITEIT EINDHOVEN	Niederlande	5
UNIVERSITAET STUTTGART	Deutschland	5
UNIVERSITAT POLITECNICA DE CATALUNYA	Spanien	5
RIGAS TEHNISKA UNIVERSITATE	Lettland	5
IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE	Vereinigtes Königreich	4
THE UNIVERSITY OF MANCHESTER	Vereinigtes Königreich	4
TECHNISCHE UNIVERSITAET WIEN	Österreich	4
DANMARKS TEKNISKE UNIVERSITET	Dänemark	4

Figure 7 Top 10 Contracting Organisations (EC DG R&I, 2015)

C-Energy2020 summarized the importance of the programme line as follows:

"The Energy Societal Challenge in H2020, the EU R&I funding programme 2014-20, is **one of the most important in terms of earmarked budget** (€ 5,9 bn) over the next 7 years. This reflects the special attention the European Commission puts on the shift towards an energy secure, competitive, climate resilient and low-carbon economy. This energy transition is underpinned by the **EU 2020 and 2030 energy and climate objectives** and is part of the longer term EU strategy of emissions reduction by 2050 (80-95% compared to 1990 levels). The launch of the **European Energy Union** package in February 2015 confirmed that energy is a top priority for the European Commission that set the ambitious goal for the EU to become **'the world number one in renewable energies'** (Mazzon, 2013, p. 1)"

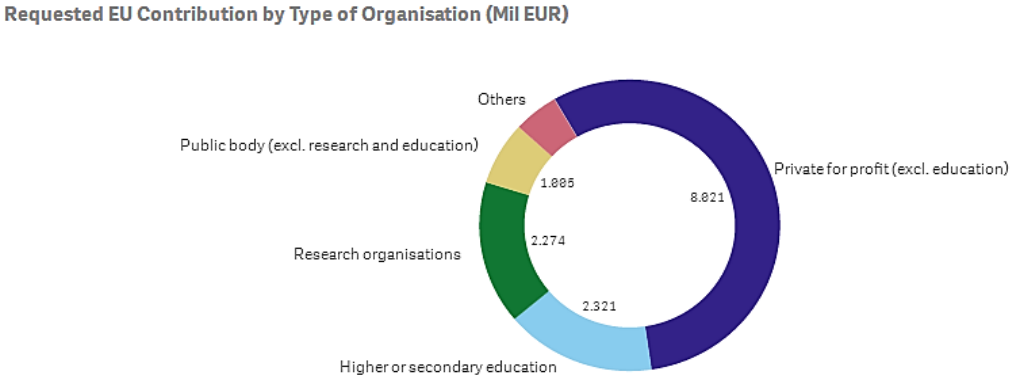
Figure 8. Success rates per area in 2014



Source: EC DG R&I, 2015

The H2020 Participant Portal lists 34.298 applications in the programme line of which 7.447 and hence nearly 22 % thereof were considered eligible and reached a success rate of 11 %. The requested EU contribution made up € 14,32 G and represents 6,86 % of the total requested H2020 contributions. (EC, 2017d) More than half of the contributions were requested by the private for profit sector (56 %), followed by Higher or secondary education (16.2 %) and Research organisations (15.9%).

Figure 9. Requested EU Contribution by Organisation Type (M EUR) up to 2017



Source: EC, 2017d.

Most applications were hand in by Spain (4256), about every second of which was held eligible making up for 2300 eligible proposals. In terms of applications and eligibility, Italy is ranking second with a total of 4.183 applications and 2.299 being eligible. Despite having made less applications, German organisations requested the largest share of EU contributions, namely in total €1.854.538.913. (EC, 2017d).

4. Current situation of RRI in the programme

4.1 *RRI* potential in brief

The Societal Challenge 3 *Secure, Clean and Efficient Energy* follows an inclusive multi stakeholder approach to reach the goals of societal transformation. Therefore, the work programme needs to follow an *RRI* approach to better conduct research with and for society. *RRI* is the baseline of successful research and innovation when it comes to solving grand challenges, such as guaranteeing *Secure, Clean and Efficient Energy*. The six keys are the base activities guiding a process in the direction of engaging and solution-oriented research.

4.2 Desktop findings:

This section gives insight in the awareness on *RRI* on the following levels.

- Policy document level
- Scoping level
- Work program level
- Call-level
- Evaluation guidelines
- Project level (winning projects)

4.2.1 Role of *RRI* on

Policy document level

No	
Yes	Keys: limited awareness Os: no awareness Implicit: limited awareness
Explanation	Keys: *Public Engagement, Governance* Neither the *European Energy Security Strategy* of 2014 (EC, 2014b), nor the *Policy Framework for climate and energy* in the period from 2020 to 2030(EC, 2014a) reflect any awareness of *RRI*. Against this background the *SET Plan* (EC SETIS, 2014) and the *Clean Energy for all Europeans Package* (EC, 2016) show a higher awareness of *RRI*. Despite substantive stakeholder inclusion in setting up both of these policy papers, *RRI* is hardly addressed. *Public Engagement* is the most explicitly mentioned key in the *SET Plan*. It is mostly used in reference to consumers as crucial and non-negligible stakeholders of the aspired successful energy transition. Citizens in general, however, are not addressed. "Energy consumers, such as households, public authorities, large or small enterprises, should therefore be considered at the heart of the energy system and become active market players. They should benefit from the innovative technologies, services and products offered by the market" (EC SETIS, 2014, p. 6). The so-called "Integrated Challenge 1" of the SET-Roadmap is hence named "Active consumer at the centre of the energy system", the two included themes (1: "Engaging consumers through better understanding, information and market transformation" and 2: "Activating consumers through innovative technologies, products and services") particularly aim at consumers as both active and passive stakeholders of the energy market. Besides, also governance and the need to "ensure effective multi-level governance, enabling the interaction between all relevant stakeholders" (EC SETIS, 2014, p. 25) is mentioned in the context of smart cities. The roadmap, however, does not mention one single key explicitly. Similarly, the *Clean Energy For all Europeans Package* stresses the need for "**multi-stakeholder action** from civil society and regional and local level" in which "cities, regions, business, social partners and other stakeholders need to get actively involved in the discussions on energy transition" (EC, 2016, p. 11), albeit not addressing one single *RRI* key explicitly. *Os*: None of the *Os* is mentioned in any of the analysed policy papers. Implicit: At an implicit level, the cross-utilisation and the accessibility of findings within the programme line is opted for. Further, sustainable solutions are aimed for; however, none of the SDGs is directly addressed.

Scoping level

No	
Yes	Keys: some awareness Os: some awareness Implicit: some awareness
Explanation	Keys: *Public Engagement, Gender Equality, Science Education, Open Access* *Os*: *Open to the World, Open Innovation* Implicit: *Inclusion, Diversity, Outcome Oriented* – solutions to SDGs as a main aspect of *RRI*, *Stakeholder Engagement* and *Stakeholder Consultation*, supporting Prosumerism. *Open Innovation* as well as *Open to the World* are mentioned as important cross cutting issues for the strategic orientation 2018-2020 (EC, 2017e). However, not only openness aspects could be found in the scoping paper. Increasing citizen participation and involvement seems to be a highly important aspect. The scoping paper shows a clear focus on three areas: "Technology development to target Secure, Clean and Efficient Energy", "targeting industry and business to support a competitive EU and create new job opportunities", and "the end user". When it comes to end users, there is a strong focus on empowering them, involving citizens, and supporting prosumerism. Next to *Public Engagement*, *Gender* and (*Science) Education* for all different age groups are mentioned as important aspects to be considered. The scoping paper speaks from a "smart citizen-centred energy system" which also leads to the assumption that citizen engagement and bottom up approaches play an important role. Moreover, citizens engagement, SSH and *Gender* issues are stated as "key research aspects" in the programme line (EC, 2017e, p. 5). Active participation of consumers is also addressed by supporting digitalisation within the calls. "Based on the integration of ICTs, the energy sector will transition from an asset-centric sector to a consumer-centric one, by enabling new business models, services and processes, appropriate and secure data management and also new actors in a newly designed energy market" (EC, 2017e, p. 4). Also SSH is mentioned as important crosscutting issue. This can also be related to aspects of *RRI*. The strongest aspect in this respect clearly is *Public Engagement*, but also *Gender* and requirements such as *Diversity* or *Inclusion* are supposed to be main considerations. The crosscutting issue "Education, Training and Skills" has an obvious link to *RRI*'s key dimension *Science Education*. The scoping paper says in that regard: "The transformation of the energy system requires a fundamental

	change in how society relates to the production, distribution and use of energy. […] The Energy Challenge will therefore address the improvement of education and training for people in different age groups and professions" (EC, 2017e, p. 4). Another important aspect is the programme's aim to address SDGs, especially SDG 7 and SDG 13. Considering that *RRI* is also outcome oriented finding solutions to grand challenges and reaching the United Nations SDGs, an implicit connection to *RRI* can be identified in this regard.

Work program level

No	
Yes	Keys: some awareness Os: some awareness Implicit: some awareness
Explanation	Keys: *Public Engagement, Gender, Open Access, Governance, Ethics* *Os*: *3 Os* as important concept, *Open Innovation, Open to the World* Implicit: SDGs *RRI* is explicitly referred to as a concept in the programme line. Since the *Energy* programme line aims at addressing society it is inherently interlinked with the concept of *RRI*. The introductions to all sub chapters of the programme line highlight or at least refer to *RRI* as a concept to follow within each project funded. With regard to specific keys, mainly *Public Engagement* and hence the participation of civil society which is deemed crucial in terms of the aspired energy transition, is tackled. "In line with the policy priorities, this work programme part puts a particular emphasis on enabling consumers to actively participate in the energy transition which is facilitated through the progressing digitisation" (EC, 2017c, p. 10). Further, also the concept of *Governance* is present in the programme line and mainly refers to the desirability to establish working multi-level structures of implementation. In addition, the *3 Os* are explicitly stated. They are as reflected in the programme line as *RRI* itself *Open Science* and *Open Innovation* are deemed particularly relevant to create "more opportunities, especially for smaller companies, to bring research results to the marketplace" (EC, 2017c, p. 10). Scientific accountability (SDGs) is deemed particularly important; also, the notion of research being of societal relevance in terms of pushing forward a behavioural shift in society is outlined as a goal. At an implicit level, *RRI* is reflected in the inclusion of the relevant sustainable development goals i.e. goal 7 (Ensure access to affordable, reliable, sustainable

	and modern energy for all), goal 11 (Make cities inclusive, safe, resilient and sustainable) and goal 13 (Take urgent action to combat climate change and its impacts).

Call level

No	
Yes	Keys: limited awareness *Os*: limited awareness Implicit: limited awareness
Explanation	Even though the introduction of the programme lines emphasize *RRI* and the *3 Os*, the calls themselves do not necessarily directly name or address *RRI* as a whole nor single aspects of it. Only very few calls of WP 2018-2020 address *Gender*, *Public Engagement*, *Open Access*, *Science Education* and *Governance*. *Ethics* is never directly addressed as such. *RRI* as a whole is not explicitly addressed in the calls, but could implicitly be asked for. Considering all calls of the WP 2018-2020, all *RRI* keys can be identified. At individual call level, however, only one call actively addresses three keys at once, others touch upon a maximum of two *RRI* key dimensions. *Ethics* is not explicitly, but only implicitly addressed. Privacy and partly ownership are challenges to be addressed. Moreover, some calls explicitly ask for collaboration with SSH to address societal questions strengthening *Gender* aspects or *Public Engagement.* The *3 Os* are less prominent than the *RRI* keys and are considered as mere aspect of *Open Access*. Whenever *Open Innovation* is addressed, *RRI* could implicitly be addressed as a concept. **<u>Detailed Examples from Specific Calls:</u>** <u>LC-SC3-EE-2-2018-2019: Integrated home renovation services</u> *Open Access:* Implementation and upscaling of economically viable business models, ultimately running without the need for public subsidies. Data evidence made available to market actors. Proof of the replication of these initiatives by other market actors; (EC, 2017c). *Public Engagement* and *Multi-Stakeholder Approach*: Strong and trustworthy partnerships with local actors (e.g. SMEs, ESCOs, financial institutions, energy agencies, NGOs) and quality of the proposed services recognized by market actors; (EC, 2017c).

	LC-SC3-EE-16-2018-2019-2020: Supporting public authorities to implement the Energy Union *Public Engagement:* Innovative ways to enable public engagement in the energy transition, developing interface capacities within public authorities to engage with civil society; (EC, 2017c). Deliver large-scale and action-oriented peer-to-peer learning programmes targeting cities and/or regions, with a strong replication potential European-wide. […] Programmes should deliver public entrepreneurs able to drive the sustainable energy transition in their respective territories within the Covenant Mayors and beyond. (EC, 2017c). LC-SC3-RES-28-2018-2019-2020: Market Uptake support *Public Engagement:* Lead to substantial and measurable reductions for project developments, whilst still fully addressing the needs for environmental impact assessments and public engagement; (EC, 2017c). LC-SC3-EE-11-2018-2019-2020: Aggregation - Project Development Assistance *Stakeholder Engagement:* deliver organisational innovation in the financial engineering (e.g. on-bill financing schemes, guarantee funds, or factoring funds) and/or in the mobilisation of the investment programme (e.g. bundling, pooling or stakeholder engagement) (EC, 2017c). 31. Research & Innovation communication activities *Public Engagement:* The purpose of this action is to support the development and implementation of Communication strategies and activities, boost greater stakeholder engagement and inform an even wider audience in the area of EU Energy Research and Innovation policies in general and SET Plan Strategy in particular (EC, 2017c). This call addresses *Engagement*, but does not touch upon other keys of *RRI* and reveals the importance of this key within the programme line *Energy* is important due to user or target group specific goals and innovations and policy recommendations. LC-SC3-EC-2-2018-2019-2020: Mitigating household energy poverty *Gender*: Actions should contribute to actively alleviating energy poverty and developing a better understanding of the types and needs of energy poor households and

	how to identify them, taking into account gender differences where relevant, building on any existing initiatives such as the European Energy Poverty Observatory. (EC, 2017c). Challenges addressed: Energy Efficiency Obligation Schemes can also be used to promote social aims, such as tackling energy poverty. *Public Engagement*: Required involvement of at least 5.000 consumers per million Euro of EU funding. (EC, 2017c). --> This call addresses *Gender* and *Engagement/Involvement* in a target group specific and policy oriented manner (EC, 2017c). <u>LC-SC3-EC-3-2020 - Consumer engagement and demand response</u> Already the title aims at engaging consumers. The citizens are put in the centre of this call, which already shows an *RRI* approach: The EU's energy policy package "Clean Energy for all Europeans" (adopted by the Commission on 30 November 2016) puts the citizen in the centre of the EU's energy system (EC, 2017c). *Ethics* and privacy questions: Proposals should demonstrate a good knowledge and compatibility with current regulations, available or emerging standards and interoperability issues applying to their technologies, in particular in connection to ongoing work in the Smart Grid Task Force and its Experts Groups in the field of Standardization (e.g. follow-up activities to the CEN-CLC-ETSI M/490), regulatory environment for privacy, data protection, data management and alignment of data formats (e.g. the work of the ad-hoc group on “My Energy Data” and its respective follow-up), cyber security, smart grid deployment, infrastructure and industrial policy (EC, 2017c). --> other *RRI* aspects such as *Ethics* are still not explicitly but implicitly mentioned. Based on the introduction of the programme line, it can be assumed that the *RRI* approach could be helpful to successfully set this action. <u>LC-SC3-ES-4-2018-2020: Decarbonising energy systems of geographical Islands</u> *Gender*: Projects should also deliver: • Effective business models for sustainable solutions; […] gender and socio-economics (Social Sciences and Humanities); (EC, 2017c) *Outcome Orientation*:

	• Contributions to environmental sustainability, in particular in view of the specificities of • islands ecosystems. --> Repeatedly, only some dimensions of the concept of *RRI* can be found. In this case *Gender*, but also challenges regarding environment are essential. This can be linked to SDGs or the grand challenges, which can also be one main aspect of *RRI* in terms of responsible outcomes. (EC, 2017c). <u>LC-SC3-SCC-1-2018-2019-2020: Smart Cities and Communities</u> Outcome orientation: SDGs The EU is committed to implementing the 2030 Agenda for Sustainable Development, including Sustainable Development Goal 11 ("Make cities inclusive, safe, resilient and sustainable"). (EC, 2017c). *Public Engagement:* Make local communities and local governments (particularly city planning departments) an active and integral part of the solution, increase their energy awareness and ensure their sense of ownership of the smart solutions. This should ensure sustainability of Positive Energy Blocks/Districts; --> implicitly engagement of local communities plays an important role here. This can be seen under the aspect of public engagement. (EC, 2017c). *Gender:* Projects should also deliver: • Effective business models for sustainable solutions; • Practical recommendations arising from project experience on: • […] gender and socio-economics (Social Sciences and Humanities); (EC, 2017c). *Ethics:* Make local communities and local governments (particularly city planning departments) an active and integral part of the solution, increase their energy awareness and ensure their sense of ownership of the smart solutions. This should ensure sustainability of Positive Energy Blocks/Districts; (EC, 2017c). <u>LC-SC3-EE-3-2019-2020: Stimulating demand for sustainable energy skills in the construction sector</u> *Science Education*: The objective is to increase the number of skilled building professionals and/or blue collar workers across the building design, operation and maintenance value chain (designers, architects, engineers, building managers, technicians, installers, blue collar workers including apprentices, and other building professionals), with a specific focus on the engagement of SMEs. (EC, 2017c).

	Initiatives reinforcing the link between skills/education and energy performance/quality of construction e.g. tools showing the reduction of the performance gap as result of an increase quality of the works. (EC, 2017c). *Public Engagement:* Partnerships with producers and retailers of construction products (e.g. DIY stores) to raise awareness of the salesforce and of consumers about energy efficient products, skilled workers and good practice in construction/renovation --> collaboration with DIY stores could be a way of engagement (EC, 2017c). --> *Engagement* is the key, which is mostly connected with another one, as also this example shows. <u>LC-SC3-CC-5-2018: Research, innovation and educational capacities for energy transition (EC, 2017c).</u> *Science Education*: Therefore, curricula and programmes, including the modules organised in operating environment, need to be upgraded or new ones developed. (EC, 2017c). --> collaboration with universities Collaboration with SSH --> could this better enable an *RRI* approach? Proposals will combine the relevant scientific and technological elements of these fields with relevant social sciences and humanities in a way that is balanced (EC, 2017c). 1. Annual subscription to the International Partnership for Energy Efficiency Cooperation (IPEEC) *Science Education:* strengthening information, education and training for energy consumers; *Public Engagement:* building stakeholder capacity by improving contacts between national, regional and local authorities and other relevant partners and stakeholders, exchanging views and sharing knowledge and experience (EC, 2017c). <u>LC-SC3-CC-3-2019: Support for the opening of low-carbon energy research databases in Europe</u> *Open Access:* The European Open Science Cloud initiative aims to maximise the incentives for sharing data and to increase the capacity to exploit them, to ensure that data can be used as widely as possible (EC, 2017c).

	The challenge is to promote the opening of research databases for low-carbon energy in Europe, and to support a European-level approach to defining the development of future research data bases; this action focuses on the area of low-carbon energy. (EC, 2017c). Recommendations that will be produced by the ongoing study on "Opportunities and barriers for opening of research databases in low-carbon energy research" should be taken into account. *Open Science:* Proposals should also follow developments of the European Open Science Cloud initiative, and plan to cooperate with and complement this activity. (EC, 2017c). Expected impact: • Development of a critical mass of open research databases in Europe, and of researchers equipped with the know-how for the deployment, maintenance and exploitation of these. • Easy and open access to these databases and to tools for their elaboration and exploitation, leading to increased efficiency of research investments. (EC, 2017c). 8. Research oriented data sets and open access database2 --> no detailed description on this call. --> these calls are strongly linked to the *3 Os*. *Open Science* and *Open Data* and accessibility are the main aspects. As a keyword, *Ethics* is not to be found in the calls. However, privacy and ownership questions as well as implicit ethical aspects are addressed. <u>LC-SC3-EC-1-2018-2019-2020: The role of consumers in changing the market through informed decision and collective actions</u> *Public Engagement* and *Ethics*: A precondition for active demand is for consumers to be aware of their own potential to permanently or temporarily reduce energy consumption; (EC, 2017c). Although collective actions on energy efficiency have emerged in recent years, a lack of awareness on the potential benefits of such actions, together with regulatory barriers, continues to hamper their full development and uptake. (EC, 2017c).

	Proposed actions should also take issues of consumer data ownership and data privacy into account, where relevant. The proposed actions are invited to build on experiences and lessons learned in other relevant projects and programmes. (EC, 2017c).

Project level

No	
Yes	Keys: Limited Awareness *Os*: n.a. Implicit: n.a.
Explanation	Keys: *Open Access, Ethics, Gender Equality, Public Engagement, Science Education, Governance* Based on the analysis of project data on CORDIS by CWTS there is limited awareness of *RRI* in Energy related H2020 projects. 507 of 720 projects in the programme line and hence more than 70 % of the analysed projects does not even mention one *RRI*-key. Three of the eight highest ranked projects with regard to *RRI* are interconnected and address smart cities. The highest ranked project is SMARTER TOGETHER, which heavily focuses on *Open Access*, but also explicitly mentions *Public Engagement* and *Gender Equality*. Further, also C-ENERGY 2020, SET-IT, Flex4Grid, CITYKEYS, ESPRESSO, SESZEP and MOBISTYLE achieve an above average *RRI*-score within the respective programme line.

Evaluation level

No	
Yes	Keys: limited awareness *Os:* limited awareness Implicit: limited awareness
Explanation	Keys: *Public Engagement, Gender* The EC's Interim Evaluation of the programme line mostly attributes the key *Public Engagement* to industrial participants, who are the only properly included non-strictly scientific actors in this realm (EC, 2017a, pp. 731–816). The Interim Evaluation of the Programme explicitly refers to the changed and more significant role of consumers (and citizens) in the framework. The understanding of this inclusion, however, is harshly limited. Consumers are to be passively understood in their behaviour (which is the only reason, why *Gender* is more explicitly mentioned, outside of the realm of the composition of research teams), in order to achieve the transition to the aspired "efficient,

	consumer-centred energy system" (EC, 2017a, p. 733). Accordingly, the understanding that comes with *Science for and with Society* is limited to the "**direct benefit for citizens and consumers** through more efficient and clean energy technologies and solutions; reduced energy prices; increased security, flexibility and resilience of the energy system; and less emissions for a healthier life" (EC, 2017a, p. 773). Prosumers are the only ones who are attributed a slightly more active role in science creation. Os: *3 Os, Open Science, Open Innovation, Open to the World* The *3 Os* are only mentioned once. At a more implicit level in particular *Open Science, Open Innovation* and the creation of a multi-disciplinary European Research Area, which is able to accessibly share their findings and use synergies is, however, are present. Implicit: At an implicit level, *RRI* is only attributed a minor and not explicitly mentioned role in the realm of evaluation. While the SDGs are touched upon, most references to *RRI* can be found at particular project levels. Further, the process requirements of RRI, which should be included in the research processes, are not tackled. All of the analysed presentations given at theme specific H2020 Info Days (Grids Storage, Smart Cities and Communities, Energy Virtual Info Day) organised by the European Commission completely lack any consideration of *RRI*.

4.2.2 General use of RRI

- ***Is RRI (in any form) traceable as a vision in the program line?***

The programme line *Secure, Clean and Efficient Energy* shows awareness of *RRI*. Each introduction of the programme lines (2016-2017 and 2018-2020) emphasizes the *RRI* approach and its importance. In addition, the *3 Os* are visibly addressed. However, the analysis on a call level demonstrated a rather limited awareness of the concept. As a holistic approach addressing more than one key dimension at once, *RRI* is not traceable within the calls at all. Nevertheless, all keys could be identified on their own on different call levels (2018 – 2020). Considering the programme line and all of the calls at once, RRI can be identified. The following keys are explicitly named: *Public Engagement, Gender, (Science) Education*, and *Open Access*. Notwithstanding *Ethics* is no explicit topic in the *Energy* programme line, it can be implicitly identified within some calls.

- ***Is RRI reflected in the challenge to be addressed? (as opposed to looking for a "technology fix" to the challenge)?***

The programme line *Energy* actively addressed societal challenges, as *Secure, Clean and Efficient Energy* is part of them. For example, the SDGs, and in particular SDG 7, 11 and 13 are repeatedly emphasized and addressed within the programme line's calls. Most of the calls addressing one or more of the *RRI* keys aim at user behavioural change or resource efficiency on user side. Therefore, *Public Engagement* or user engagement can be emphasized as most important key within the programme line *Energy*. Connected to this, *Gender* plays a role and is actively addressed in some calls.

- ***Is RRI (or any other underlying principle thereof) reflected in the theoretical considerations of the work programme or the calls or substantially influencing the way R&I in the program line carried out?***

No.

- ***Is RRI (via keys) present only as a tick-box exercise or is it more substantial? If yes, how?***

Public Engagement and stakeholder engagement form an active part of the actions in the programme line. In addition, *Open Access* is an action, which needs to be implemented, as every H2020 research project is open-access by default. *Gender* rather seems being an add-on, which is mentioned very briefly in the calls. Only one call can be identified which actively addresses *Gender* as part of their research. Education is included in some calls and an essential part of them. However, it does not aim at *Science Education* in an *RRI* sense but rather focuses on increasing numbers of skills in adult education in general. The key *Ethics* can only be found implicitly when it comes to data protection and ownership. However, *Ethics* is a tick-boxing task on proposal template level.

Please give an overall assessment of how

- ***Keys***

All 6 keys are addressed within the calls with a maximum of 3 within one call. Thus, *RRI* as holistic concept is not mirrored within this programme line. *Ethics* is only implicitly addressed.

- ***Os***

Just like the keys of *RRI* the *3 Os* are emphasized in the introduction of the programme line but cannot be traced on call level. There are very few calls addressing openness in general. Moreover, *Open Access* as *RRI* key could not clearly be distinguished from the *3 Os*.

- ***Other RRI (societal impact) related concepts***

Responsibility is important on an outcome level. Thus, this programme line attaches importance to the SDGs, and collaboration with other funding lines to find solutions to these challenges. Therefore, the calls are very outcome oriented and some focus on user involvement and collaboration between user, researcher and policy makers.

4.2.3 RRI beyond the keys

RRI is mainly boiled down to stakeholder engagement and used to address the challenge of an aspired energy system transformation. The concept is hence not reflected as holistic approach.

There is no theoretical framework addressing *RRI* within this programme line.

4.3 Interview findings

Also at the level of the expert interviews, *RRI* is not reflected as a holistic concept neither at policy nor project level. Not all interviewees share the sensed obligation to pay attention to *RRI* dimensions. Most of the *RRI* keys are seen in relation to social sciences perspectives, while the realm of technology and natural sciences in the energy sector is merely seen as touching upon ethical issues related to data security. At this aggregated level, no overarching transformation of the relationship between science and society can be identified. Nevertheless, most *RRI* keys are somehow present in the interviewees' everyday work and understanding with the *Engagement of Non-Scientific Actors* and *Ethics* being the most common dimensions. Smart city projects seem to establish best practice

examples of conducting participatory research that does not only touch upon single keys but interlinks several *RRI* dimensions at once.

The expert interviews hence mostly supported the findings of the desktop analysis, but further probed potential enablers and barriers for the realisation of responsible research and innovation. Guidelines and specific trainings combined with financial and time resources were emphasised as most supportive resources. A supportive network with researchers as well as public entities, industries and civil society organisations as well as political commitment to the needed energy transition can support the process to overcome currently hindering attitudes and research traditions.

4.3.1 Shared understanding of RRI

Public Engagement

At an interview level, *Public Engagement* is the most prominent key. The reasons for engaging non-scientific stakeholders, as well as the groups involved and the degree of engagement vary to a large extend. In general, *Public Engagement* mostly happens within the realm of applied research, and is hardly found in basic research projects (Int. 9).

Motivations*:* The *Secure, Clean and Efficient Energy* programme line aims at the transformation of energy production, energy provision and its use. Since technological changes need to be implemented by energy consumers, research projects in this programme line often try to involve end-users as stakeholders in the research process (Int. 5). Mostly, this form of *Public Engagement* comes in with interdisciplinary approaches, with social science perspectives being included in the research process, to anticipatively and responsively investigate upon values, fears, and wishes of the affected (Int. 2, Int. 5, Int. 7). Since this interdisciplinarity is required at call level and connected to funding, an inclusion of a social sciences and humanities perspective, does not automatically lead to a change of research attitude, as one interviewee (Int. 2) emphasizes.

Stakeholder inclusion in the research process is further perceived as important success factor fostering acceptance of locally transformative energy projects, e.g. related to renewables (Int. 9) or smart cities (Int. 1, Int. 7, Int. 8). The creation of ownership seems to be an important factor in this regard (Int. 9).

However, another level of *Public Engagement* is reached by research projects aiming at mutual learning processes through mutually meaningful dialogues. By finding a common language, unique perspectives and knowledge can be linked and benefitted from (Int. 7). By the means of picking up people in their daily routines and by exhibiting flexible and adaptive approaches in reaching different stakeholder groups, a high level of inclusiveness might be reached (Int. 8). These mutual learning processes further enable governance of learning processes (Int. 8).

Who is involved: Depending on the motivation for engaging non-scientific stakeholders, different target groups are reached out to. Most projects foster a multi-stakeholder approach comprising at least two (mostly industry and public sector) or more several different non-scientific stakeholder groups (Int. 7).

The industry sector, companies and engineers are important stakeholders for most of the projects in the programme line. However, they do not seem to be easily reached and motivated to participate in the process (Int. 3, Int. 5, Int. 6, Int. 7).

Also, the public sector and other public entities as well as specific experts, such as city developers seem to be involved on a regular basis (Int. 1, Int. 7).

Further, private energy consumers, or private house owners are commonly engaged (Int. 7, Int. 8). As some technological innovations also offer possibilities to be directly adapted by single individual users, for example producing their own energy through photovoltaic panels, the *Energy* programme line is said to foster democratic and inclusive potential, which possibly extends beyond European and Global North contexts (Int. 9).

The education sector is further mentioned as specifically targeted area, albeit not commonly addressed in research projects (Int. 5). Targeting citizens beyond merely targeting them as consumers is – in case it is fostered at all – mostly tried through engaging civil society groups (Int. 6). Lastly, citizens and in particular the locally affected population might be specifically reached out to (Int. 1, Int. 7, Int. 9). They are more difficult to reach than already organised groups – also activities technically open to everyone often end up engaging those who are already somehow involved in other networks and projects (Int. 1). Their role in the process faces institutional barriers – for example, private individuals are not entitled to become consortium partners (Int. 6).

Outreach Activities: The specific activities set again vary with the stakeholder groups involved and underlying motivations thereof. Commonly specific networks are set up, to connect different groups with each other. This might, for example, happen on the level of linking researchers with the industry sector (Int. 4) or interlinking inhabitants of a targeted area (Int. 6). These networks seem to ease outreach activities. Depending on the specific set-up, the role of network participants might range from only receiving information (Int. 4), to pro-actively feeding their own information in the platform to contribute on the project's data collection, evaluation and simultaneously enabling individual learning and possibly adaption processes (Int. 6). Some projects also facilitate outreach activities through organising exhibitions and offering workshops (Int. 4, Int. 10), establish info-desks mobile info-containers or other platforms that offer opportunities for open and transparent discussions about the use of data and dialogues at eye-level with different civil society actors (Int. 8, Int. 10). Also, the evaluation of these activities was named as important factor in *Public Engagement* processes – the use of questionnaires and panels proved to be a valuable source of information, despite not strictly following scientific quality criteria (Int. 1).

Science Education

Science Education seems to be seen as differently relevant and applicable to specific projects, possibly mediated by local scientific traditions and understandings (Int. 1). Currently, scientific literacy is no mainstreamed component of all Energy calls. Rather, there is a specific H2020 programme line addressing *Science Education* (Int. 2). Within the *Energy* programme line, there are specific calls that aim at *Science Education*, while others do not urge for scientific literacy activities (Int. 5, Int. 9).

Application of *Science Education*: Some interview partners do not feel that this component should be integrated – neither in their projects, nor in the overall programme line (Int. 4, Int. 7). Contrastingly, other interviewees emphasise the importance of *Science Education* to "communicate the project, its activities and the results to "the everyday life". "… how this is also like benefitting the future, the future generations […]"(Int. 1) in order to foster acceptance and the adaptions of new solutions (Int. 3).

Forms of *Science Education*: Implementations thereof most often seem to take place as an exchange between students and industries to foster technological development (Int. 5). Also summer schools (Int. 5), visualisation platforms (Int. 6) or organised information days (Int. 9) are practical examples of fostering *Science Education* at a project level. Instead of fostering *Science Education* necessarily themselves, some projects produce strategies for doing so, e.g. roadmaps targeting high school education on energy (Int. 5). *Science Education*, however, can also foster a mutual learning process, and thereby more actively contribute to the overall research process. Establishing, for

example, low-threshold exchange platforms, which provide space for commonly agreeing on what is talked about, what is done and the format this is going to happen in (Int. 8)is an example thereof

Gender

Within the programme line, *Gender Equality* is perceived and addressed differently. While some interviewees exhibit a broad understanding and perception of gendered inequalities, and relate this dimension to the level of the research team as well as to the research done (Int. 1, Int. 3, Int. 8., Int. 9), others do not share this awareness or research practices (Int. 4, Int. 6). Overall, there are neither gender plans or strategies nor specific 'gender-experts' recruited or involved in the research process (Int. 5).

Gender Equality in research: *Gender* equality is not mainstreamed at a call-level, but rather to be found as component of the SSH-specific calls relating to end-users and consumer characteristics (Int. 3, Int. 9). In case that *Gender Equality* is addressed at project level, it most often seems to be part of a broader approach seeking for diversity or intersectional approaches, considering further components of structural inequality such as cultural affiliation or age (Int.1, Int. 6, Int. 8). In contrast, other projects do not particularly focus on *Gender*, with some interviewees not being aware of this dimension applying to their research (Int. 4, Int. 6).

Researchers' team: Another dimension of *Gender Equality* is paid attention to with regard to the balance among the researchers. Most coordinators are said to pay attention to reach a gender-balanced team (Int. 5). However, especially the realm of engineering is male-dominated and it is difficult to strike a balance there (Int. 5).

Ethics

Ethical challenges and necessary ethical considerations are not flagged at a call level (Int. 2). While there seems to be the general expectation on behalf of project officers to tackle ethical considerations (Int. 1), not every research project is necessarily seen to touch upon ethical questions going beyond data protection and scientific integrity (Int. 3, Int. 4).

Data Protection: Most of the interviewees relate ethical considerations in their research to aspects of data protection and privacy (Int. 3, Int. 5, Int. 7, Int. 8, Int. 10). They try to strike the balance between data accuracy and privacy of their respondents and further only publish aggregated data (Int. 10). A letter of consent ensures "people understand what is going on" (Int. 10). An EC checklist on data protection as well as a working group of H2020 energy projects working on data privacy is supporting these endeavours (Int. 6, Int. 10). Further, scientific standards and research integrity are to be maintained (Int. 7).

Ethics beyond Data Protection: Whether or not data protection is seen as only ethical challenge in the programme line, it seems dependent on the meta-theoretical perspective of technological research in general. Partly, technological research is not perceived as bearing any ethical dimensions. In this perspective, ethical considerations have to be made in case social sciences and humanities and hence people are directly involved in the research process (Int. 2, Int. 3). They are then obligated to respect the right to the physical and mental integrity of a person, the right to non-discrimination and the need to ensure high levels of human health protection (Int. 7). There is, however, also the other perspective, which urges the ethical dimension of technological research processes in order to seek for socially acceptable solutions that respect the values and preferences of the stakeholders involved (Int. 1). By considering the social consequences of research processes and results, openness and transparency are sought to be maintained (Int. 1).

Open Access

Not all projects do provide for full open access of all of their data and results. The provision of *Open Access* seems to vary with perceived obligations, motivations and a balancing of several intervening factors.

Open Access Provision: All Horizon 2020 projects have to provide for *Open Access* of their research results and outputs. This obligation is also felt in the programme line of *Secure, Clean and Efficient Energy* (Int. 5). Despite this regulation, there are no clear strategies for doing so (Int. 1). In the end, not all projects are able to provide full open-access for experts and civil society alike (Int. 1, Int. 4). The full provision of *Open Access* is on the one hand seen desirable (Int. 1, Int. 3), and on the other hand not deemed as important as in other programme lines (Int. 3).

Reasons for *Open Access: Open Access* provision is providing for efficiency in order not to "reinvent the wheel" (Int. 9). Many technological solutions have already been invented and need to be accessible in order to get used by the broader public (Int. 9, Int. 3). Against this background, also companies profit from open-access data and the possibility for technological spin-offs to other areas e.g. power storage from e-cars to electricity producing houses needs to be maintained (Int. 1, Int. 9). Further, opening access to all of the project's information, output and data enables a validation of results. Hence, it is providing for transparency and sustaining scientific integrity (Int. 1).

Restrictions for *Open Access*: While there is the overarching obligation to provide for open-access of the results, not all projects do so – currently, about 90 % succeed in providing for *Open Access* for experts and NCPs (Int. 1, Int. 4), less do so with regard to general accessibility for everyone (Int. 6). Restrictions are to be found in the realms of financial resources – providing open-access requires funding that is not always readily available (Int. 1). Further, data privacy and security is to be maintained (Int. 4, Int. 6, Int. 8), while on the same hand competitive advantages of industries included in the projects have to be secured (Int. 3).

Governance

With regard to governance, an *RRI* approach was urged not to be an add-on, but rather a dimension, which has to be considered from the very beginning at every stage of the research process (Int. 2). Multi-stakeholder involvement is deemed necessary at least when it comes to monitoring and evaluating progress made in the research project. *RRI* monitoring was, however, partly considered being necessarily qualitative in nature and hence in need of social sciences perspectives (Int. 3). The projects' sustainability might be safeguarded by distributing learning results to other organisational levels beyond the project scope (Int. 8). Established institutional frameworks, such as for example public funds, and created networks play an important role in keeping success stories alive (Int. 10).

Enablers & Barriers

The non-availability of enablers simultaneously forms barriers for the implementation of *RRI* in the programme line. Potential enablers might be guidelines and specific trainings backed by financial and time resources to reach for participatory and holistic approaches. A supportive network as well as political commitment to the needed energy transition can support the process to overcome currently hindering attitudes and research traditions. All of them are going to be elaborated in more detail in the following paragraphs.

Attitude: Despite not every stakeholder in the research process being aware of *RRI* and all its dimensions, there seems to be the general assumption at EU-levels of *RRI* being already a well-known concept (Int. 1). This attitude further hinders from tackling existent knowledge and skill gaps concerning the implementation and applicability of *RRI* (Int. 8). Regionally different research practices

as well as strongly hierarchized research organisations might be additional barriers preventing *RRI* from being implemented (Int. 1). Changing the way science is done, however, requires a break with old research traditions. Awareness on *RRI*'s importance and dimensions need to be raised and *RRI* needs to be turned into the new standard everybody needs to follow, no exceptions made (Int. 1).

At the level of funding agencies as well as other stakeholders engaged in research, the application of a short-term business-case logic on research projects comes with strictly predetermined outcomes and expected short-term profits (Int. 4, Int. 8). These conceptions, however, do not fit participatory research designs, nor long-term transformative multi-stakeholder and multi-governance research realities and present a barrier that needs to be replaced by a broader definition (Int. 8).

Resources: Resources are crucial for changing the way research is done and are decisive with regard to time and financial dimensions that have to be considered at a call, proposal and project level. Further, guidelines are deemed necessary.

Concerning the time dimension, participatory and holistic research designs require higher time budgets (Int. 5, Int. 8). It seems to take a lot of time to find and engage appropriate industry partners (Int. 4), but this is even more the case with regard to reaching private individuals that are not already organised or engaged at other levels (Int. 1, Int. 4).

Financial means set the barriers for actions to be taken and are also regarded decisive for open-access provision of research findings (Int. 1, Int. 6). Lacking financial means prevent from large-scale applications of existing technological innovations beyond the immediate research project's scope (Int. 9). Insufficient financial resources might hinder from specifically engaging skilled experts in the research projects who could keep an eye on RRIs implementation as well as to provide support and guides on how this might be done (Int. 1).

The availability of guides and templates of how to implement RRI in general could foster a common understanding of necessary steps and dimensions. They could support those institutions, who do not yet have this expertise at an internal level (Int. 1, Int. 4). These timelines need to be adaptive enough to be applicable to the diverse field of research organisations and practices (Int. 5).

Knowledge and Skills: Supporting available knowledge and skills with regard to RRI application and implementation go beyond the establishment of guidelines.

By fostering multi-stakeholder approaches, researchers are faced with challenges of setting up organisational and governance learning processes themselves. There is the need to know about how to deal with the arising complexity, who to involve at what stage and in what detail and how to deal with necessarily to be made quick decision processes (Int. 8).

In general, there is the need to create skills in working and dealing with plurality in both scientific as well as non-scientific realms. With regard to the first, finding a common language and agreeing on an aligned set of values and priorities between different scientific disciplines is regarded crucial in order to enable a fruitful collaboration (Int. 2, Int. 8). With regard to the second aspect, also a common language and working communication paths need to be found for fostering dialogue between scientific and non-scientific stakeholders. Different perspectives on already established common grounds need to be scrutinised in order to foster mutually beneficial co-operations (Int. 8). Necessarily, different capabilities of societal actors need to be learnt about, in order to inclusively engage civil society actors in a meaningful way (Int. 8). Internal RRI trainings and education were named as potential enablers (Int. 1).

An open public discourse on grand societal challenges and – more specifically – the urge to face climate change and the needed energy transition based on scientific and transparent results could raise the general public awareness and interest in engaging in research processes (Int. 9).

Policies: A political commitment to decarbonisation and a fossil-free future would substantially provide the ground for related research endeavours (Int. 9). A political institutionalisation of a democratisation in the research process could, in combination with the appropriate funding provision, strengthen the role of *Public Engagement* in the research process in general (Int. 5, Int. 9).

What is more, institutional barriers at both international as well as national levels need to be removed. With regard to the first dimension, individuals are currently not allowed to become consortium partners in Horizon 2020 projects and are thereby denied equal standing with researchers (Int. 6). At a national level, it is partly difficult for individuals to implement technological innovations in case they are not part of particular research project contexts. While the creation of ownership was seen as a major success factor for the long-term sustainability of projects results, this seems to be counteracted by existing regulations, with regulations on energy production for self-use being one example thereof (Int. 9). Also specific funding regulations and taxation schemes were seen as barriers to engage private individuals more broadly in the research context (Int. 6, Int. 9).

Networks: Networking was emphasised being a particular beneficial resource in holistic research projects. The inclusion of local governance structures and the close collaboration with major industries, such as local energy providers, were seen as major supporters (Int. 5, Int. 6, Int. 10). On the one hand, the early on co-operation with existing local communities was deemed crucial for the research process (Int. 6). On the other hand, setting up own communities and networks might equally be recommendable. (Int. 7). No project exists in a vacuum, tearing from the experiences of other projects and best practice examples were further emphasised as important supporting factors (Int. 6, Int. 7).

4.3.2 Beyond RRI

Research in the programme line *Secure, Clean and Efficient Energy* is settled within the broader context societal grand challenges and SDGs. More specifically, the aspired transition of the system of energy production, provision and use lies at its centre. Climate change, growing world population and rising energy demands in the Global North and the Global South alike are setting the scene for needed new solutions (Int. 7, Int. 9, Int. 10). The inter- and intra-generational habitability are at stake (Int. 9), calling for sustainability at economical, environmental and social level not to leave anyone behind (Int.1, Int. 6, Int. 10). Technological innovations are pushed forward as solutions that are to be up-taken by markets and public authorities alike (Int. 4, Int. 9).

As one interviewee however emphasises, often the most efficient measures are not highly technological, but rather social in nature (Int. 8). Accordingly, the loss of possibilities for face two face dialogues and communications is a further challenge, the programme line touches upon, since the social acceptability of technological changes and innovations is key in the aspired transformation (Int. 3, Int. 5, Int. 10).

4.4. Case briefs

The following case studies analyse three of the eight highest ranked projects on an RRI scale based on the results of CWTS CORDIS analysis. Since three of the eight projects concern smart cities, the field of smart cities seems to be particularly receivable for RRI-ideas and components. With this hypothesis in mind, these three projects – SMARTER TOGETHER, CITYkeys and ESPRESSO are looked at in more detail.

4.4.1 SMARTER TOGETHER - Smart and Inclusive Solutions for a Better Life in Urban Districts

The SMARTER TOGETHER project is realised as call SCC-01-2015, Smart Cities and Communities solutions integrating energy, transport, ICT sectors through lighthouse (large-scale demonstration) projects. According to CWTS analysis, it is the highest ranked of 720 analysed projects with regard to RRI. Its aim is to introduce smart technologies and to overall increase the sustainability and citizens' quality of life. The project aims at "user-centric innovation by involving even more people and stakeholders in the co-creation and design of new services and solutions" (SMARTER TOGETHER, 2018) to experiment with low energy districts, increasing renewable energy systems, implement new e-mobility solutions. Existing data networks are used as open data platforms to be feed and used by locals. Finally, it is a clear project's objective to create business models to "turn the demonstration activities into economically sustainable and replicable solutions for other cities". (SMARTER TOGETHER, 2018)

The project is implemented in three lighthouse cities, namely Lyon, whose main stakeholder SPL Confluence also leads the project, Munich, where mainly the city of Munich is concerned and Vienna, where the City of Vienna and MA 25 thereof is the leading organisation. (SMARTER TOGETHER, 2018). Additionally, Santiago de Compostella, Sofia and Venice are included in the project as follower cities, Kyiv and Yokohama, both known for manifold different implemented smart technologies, are further engaged as observer cities (SMARTER TOGETHER, 2018).

The project started at in February 2016 and is to last until the end of January 2021. Currently, the project is in its third year. The three lighthouse cities set different priorities and hence exhibit diverging approaches to achieve their common aims. Co-creation and *Public Engagement* via living labs are, however, overarching goals of all lighthouse cities.

At a general level RRI is not explicitly addressed as a holistic concept in the project. Its various keys and processes, however, are very well addressed in all of the three lighthouse cities.

Public Engagement: *Public Engagement* happens at different stages in the project. Already the long title of SMARTER TOGETHER ('Smart and Inclusive Solutions for a Better Life in Urban Districts') hints at the aspired inclusiveness of the project. Thereby, low-threshold connections to locals as well as other project partners, public officials and further stakeholders are sought (SMARTER TOGETHER, 2017b, p. 9.)In Lyon Confluence a club of inhabitants was created to test the new activities related to the project, Vienna works with a mobile info-container to inform citizens in the district about the projects aim, to collect wishes and criticism and in general feedback and to share knowledge in mutual conversations. Munich has set up its living lab, which offers the space for creative workshops and collective learning. (SMARTER TOGETHER, 2017b, p. 9) In all lighthouse cities, public communication of envisaged changes forms an important part of the project (SMARTER TOGETHER, 2017b, p. 34).

Within the HORIZON 2020 Lighthouse Project SMARTER TOGETHER, knowledge exchange and peer-to-peer learning play a key role in order to involve various stakeholders, enable exchange of ideas and best practices and to co-creatively develop solutions to existing challenges. Thus, Work Package 2 (WP2) is dedicated to the co-creation of smart city solutions and Task 2.1 (T2.1) aims at developing a knowledge exchange network as well as an iterative peer-to-peer learning process. (SMARTER TOGETHER, 2017a, p. 7).

Science Education: Through *Public Engagement* not only (smart) solutions are co-created, but also non formal education processes are fostered partly in the very processes of citizens' engagement, partly through thereby delivered outputs, such as data visualisation platforms to monitor the production of renewable energy within the district and their own energy consumption. In particular,

the Viennese project team aims at low-level entry points through offering face to face dialogue situations to create awareness why smart solutions are needed in a first place.

Gender Equality: The society is addressed in its diversity. The project does not specifically aim at *Gender Equality*, the deliverables do not specifically refer to *Gender* as single important component either. However, due to *General Public Engagement*, different stakeholders' needs are addressed specifically, which pays its toll to *Gender Equality* as well (SMARTER TOGETHER, 2017a, p. 17).

Open Access: The data generated in the projects are mostly openly available, most of the projects' outputs are accessible online for everyone, some data is restricted for experts' use only. The *3 Os* are, similarly to *RRI*, not explicitly mentioned in the project's outputs, however, in particular *Open Science* and *Open Innovation* are followed up on during the course of the project, through the various levels stakeholder engagement.

Ethics: Also ethical considerations are made – who is to be involved, how and why? Data privacy is carefully handled with, the project coordinators aim at long term sustainable solutions rather than short-term profits. In line with this argument, the city of Vienna for example tries to foster governance learning to spread knowledge gained in the project (such as the need for cross-sectional and cross-district approach) to other, not directly involved organisations and departments to offer long-lasting learning effects not only on the level of society but also at organisational level.

In general, SMARTER TOGETHER seems to be a lighthouse project with regard to RRI's possible implementation. All of the different components are addressed in the everyday work of the project.

4.4.2 CITYkeys - Smart City performance measurement system

According to the analysis of project data on CORDIS by CWTS, CITYkeys equally ranges among the highest eight projects with regard to *RRI* awareness. The project developed and validated key performance indicators and data collection procedures for the common and transparent monitoring as well as the comparability of smart city solutions across European cities. The project ran 2 years and ended in February 2017. All deliverables and publications are open access. Moreover, the results and key performance indicators are openly accessible and easy to find. CITYkeys's system uses open data formats, standards and initiatives, as emphasized on their website.

The projects sustainability is given by the ESPRESSO project using the CITYkeys' KPIs. Also, the European Telecommunications Standards Institute used them to create its TS103463 technical specification "Key Performance Indicators for Sustainable Digital Multiservice Cities".

Besides *Open Access, Stakeholder* and *Public Engagement* are highly important for the project and for the smart cities' goals. All cities participating agreed that what a smart city looks like: "A smart city uses innovative technology; combines energy, mobility and infrastructure; increases performance and efficiency; increases the participation of citizens; enables innovation and improves the social and economic fabric of the city."(Bosch et al., 2017, p. 6) The project aims at improving cities for citizens in terms of better environment and quality of life, tackling the social and economic challenges and focussing on innovation and jobs creation. "Useful for the cities means tackling social issues at the same time as making the city more efficient and sustainable, more competitive and financially robust." (Bosch et al., 2017, p. 7)

Indicators target the following fields:

- People: Health, Safety, Access to (other) services, Education, Diversity and Social cohesion, Quality of housing and the built environment

- Planet: Energy and Mitigation, Materials, water and land, Climate resilience, Pollution and waste, Ecosystem
- Prosperity: Employment, Equity, Green Economy, Economic performance, Innovation, Competitiveness and attractiveness
- Governance: Organisation, Community involvement, Multi-level governance
- Propagation: Scalability and replicability, Factors of success,

All five keys are essential in the project, however, some could have been improved. Time and lack of resources are reasons for it.

Public Engagement: The project is/was introduced in local cities at local events. The project aimed at raising awareness on the topic. Additionally workshops were conducted which were open to everybody. However, it was the project's experience, that it is hard to reach out to the broader public and be able to actively engage them. Most of the times, only the people that are already actively involved, are reached.

Gender Equality: *Gender* was not an aspect and goal of the project. However, it played a role as people see things differently. Within the project activities it was always an aim to engage male and female participants equally. Additionally, *Gender* was not seen as distinct aspect. The project followed and intersectional approach in their research methodologies.

Science Education: Education was emphasised by the city partners. Communication of results to the "every day life" was a main goal of the city partners.

Open Access: Open Access was an important aspect of the project. It was a wish to have all publications open access. Also companies were strongly supporting this approach. High costs for open access journals were still challenging.

Ethics: Already at the early beginning the question about ethics was raised. Data usage was a main aspect in this regard. The project followed an ethical plan regarding data privacy and also a *Gender Quality and Diversity Strategy*. Templates and guidelines were needed to avoid different understandings and interpretations.

In summary, the project showed that the single key dimensions of RRI are actively addressed and part of the research approach of the project. However, there is no RRI governance structure or any RRI experts involved. These aspects are cross cutting and the individual experts work therefore together.

4.4.3 ESPRESSO – systemic standardisation approach to Empower Smart citieS and cOmmunities

ESPRESSO – systemic standardisation approach to Empower Smart cities and Communities – was a two year project starting in the beginning of 2016 and lasting until end of 2017. According to CORDIS project data analysis by CWTS it ranges among the eight most RRI aware projects of the *Energy* programme line. The main target of the project was to ensure the interoperability of Smart City solutions. This will help cities avoiding entry barriers or vendor lock-in through promoting common meta-data structures and interoperable (open) interfaces instead of proprietary ones. Therefore, the project created a conceptual Smart City information framework based on open standards. ESPRESSO followed a case study based approach. Social acceptance of the developed solutions is of high importance. To ensure this, the project sets up a stakeholder communication network, which enables "an early dialogue between standards development organizations, technology providers, and technology consumers to avoid a mismatch between the design of technology solutions and cities' and citizens' needs"(ESPRESSO, 2017a).

In general, there seems to be some awareness of *RRI*, which, however, seems to be based on existing project and standard inputs rather than specific efforts of ESPRESSO. There is however, the general acknowledgement that "sustainability, resilience, smart –community and city, very much need to be connected in order to provide a more complete understanding –as they do undoubtedly relate to each other" (Bareño, Lindner, Kempen, Klien, & Dambruch, 2016, p. 10). With regard to particular keys, Open Access is clearly the most present, however, also *Public Engagement* and public education are partly present in the project's work and effort. The deliverable "Products and best practices for Smart City" does not even mention one RRI key (Facchin & De Lathouwer, 2017).

Public Engagement: Citizens' involvement is part of already existing standards for smart cities. Therefore, citizens are partly included in the project. Potentially every visitor of the project homepage can somehow contribute to ESPRESSO, either as citizen or part of a community, or become a SmaCStak, a part of a network interlinking standardised smart city initiatives.(ESPRESSO, 2017b) ESPRESSO thereby aims at creating a "Smart City Stakeholder community" involving a large pool of user groups (Facchin, De Lathouwer, & Conci, 2016), citizens, however, being a subordinate group. Webinars organised in ESPRESSO partly address best practice examples of smart cities and smart city projects and include *Public Engagement* as a key for them being best practice (Fabisch, 2016). Additionally, Tartu, one of the two pilot cities of ESPRESSO, established a living lab in order to collect "end-user feedback" (Dimitriu et al., 2017, p. 56).

Gender Equality is hardly tackled in the realm of inclusive societies and not directly addressed.

Science Education: All of the project's deliverables are openly accessible, also the eleven webinars on smart cities, which target interested stakeholders and can be regarded as action with regards to scientific literacy. "Smart Education: addressing the societal demands and needs of the future through classroom latest technologies, fostering data literacy, innovative teaching systems, e-learning, institutional integration" (Dimitriu et al., 2017, p. 21).

Open Access is the clearest addressed RRI-key within the ESPRESSO-Project. All of the project's deliverables are openly accessible, also the eleven webinars, which were organised in the course of the project, are online and freely watchable. Further, the ESPRESSO Content Portal acts as openly accessible container of training material on Smart City standards using CITYkeys indicators people, planet, prosperity, governance and propagation.

Ethics is only mentioned in the realm of data protection in light of an aspired all open data policy. Through "private by design standards" they aspire to "build trust and resilience in smart cities and open data".(Fabisch, 2016)

5. Conclusion

The analysis of the programme line *Secure, Clean and Efficient Energy* shows that *RRI* has not yet succeeded in becoming part of everyday practices in energy research. The examination of relevant documents on policy level as well as the ten conducted expert interviews indicate *RRI* merely being represented through individual, non-interlinked keys rather than as holistic and overarching concept.

On policy level, some documents (e.g. the *European Energy Security Strategy and the Policy Framework for climate and energy* in the period from 2020 to 2030) do not reflect any awareness on *RRI*. Others (e.g. the *SET plan* and the *Clean Energy for all Europeans Package*) do consider its dimensions more fully. *Public Engagement* is the most explicitly mentioned key on the level of framing documents. By the means of increasing *Citizen Participation*, *Science Education* for different age groups, and the consideration of *Gender dimensions*, the energy system is to become "smart citizen-centred". The *3 Os*, especially *Open Innovation* and *Open to the World* are important cross cutting issues of strategic orientation 2018 – 2020.

The work programmes of 2016-2017 and 2018-2020 explicitly refer to *RRI* as key dimension of the programme line, with *Public Engagement* being the most prominently mentioned key. On call level, however, *RRI* awareness is no longer reflected as a holistic concept. There are only remarkably few calls 2018-2020 that actively require the consideration of one or more RRI keys. Technical calls show a lack of RRI awareness compared to user/consumer oriented calls, which show some awareness on RRI. *Public Engagement* is the most prominent identified dimension of *RRI* in the programme line. Industries and the public sector are the most frequently included non-scientific stakeholders. Civil society actors are not addressed as such, but mostly targeted in their role as energy consumers and end-users. Since energy-use is to be changed, social science perspectives are more and more included in the programme line to investigate on the end-users' behaviour. Thereby, *Gender* is one dimension of energy customers' heterogeneity and incorporated as one dimension of a wider perceived diversity. Apart from this consideration, *Gender Equality* is also reflected with regard to the research team composition. Similarly, *Ethics* is not particularly included in the *Energy* programme line, since energy related research still seems to be seen as void of touching upon ethical dimensions in a broader sense. Hence, ethical considerations are mostly made with regard to data protection.

Projects clearly reflect the awareness requested on call level. Thus, it can be summarized that there is limited awareness of *RRI* in energy related H2020 projects. More than two thirds of all analysed projects do not even address one RRI dimension.

These insights are also backend by the expert interviews. At this aggregated level, no overarching transformation of the relationship between science and society can be identified. Research projects in the realm of Smart Cities constitute notable exceptions in this regard – the overarching consideration and application of participatory research, which interlinks several RRI dimensions at once, might be considered as best-practice example within the programme line of *Secure, Clean and Efficient Energy.*

The expert interviews hence mostly support the findings of the desktop analysis, but further probe potential enablers and barriers for the realisation of RRI. Guidelines and specific trainings combined with financial and time resources were emphasised as most supportive resources. The projects' sustainability might be safeguarded by distributing learning results to other organisational levels beyond the project scope. Established institutional frameworks, such as for example public funds and created networks, play an important role in keeping success stories alive. A supportive network with researchers as well as public entities, industries and civil society organisations and political commitment to the needed energy transition can support the process to overcome currently hindering attitudes and research traditions.

6. Timeline for Diagnosis

Month	Task(s)
4	Start of Diagnosis
4	Get to know the program line
5	Identify relevant stakeholders/experts for interviews
6-7	Interviews with experts (in total 15-.20)
7-10	Transcribe interviews, analysis
10	Finalizing Report
15	DX.1 due in M15 – ensure you send your reports to WP lead on time

7. Literature, links, resources

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NewHoRRIzon Diagnosis Report

Social Lab Nr. 10

“Smart, Green and Integrated Transport”

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1. Executive Summary

This diagnosis report analyses the H2020 Program Line "Smart, Green and Integrated Transport" and also taking into account the information gathered from the expert interviews.[83] The research revolves around Responsible Research and Innovation and its keys (Ethics, Gender, Open Access, Public Engagement, Science Education), as well as the three O's (Open Science, Open Innovation, Open to the World). The term "Responsible Research and Innovation" (RRI) only appears once within all reviewed documents: In the stakeholder consultation document in May 2016 for the preparation of Work Program 2018-2020. **This underlines the assessment that RRI cannot be found as an overarching and coherent concept within the program line.**

Instead, we encountered a situation where some of the RRI-keys and the three O's appear within the different documents, but their scope is often quite limited. The aforementioned stakeholder consultation document and the Work Program for 2018-2020 have the most depth in this regard, indicating that the importance of RRI and the three O's within the Program Line is increasing. **The conclusion of this diagnosis is that all of the RRI-keys and the three O's are at least implicitly present within "Smart, Green and Integrated Transport", but they do often times lack *depth*, *clear definitions* and *reflections upon their scope*.**

Therefore, this diagnosis (also) summarizes some of the implicit assumptions and associations connected to RRI-relevant terms and concepts within these documents.

2. Scope of this document

This document is an analysis of the Programme Line "Smart, Green and Integrated Transport" (SGIT). Overall, four Work Programs, two Stakeholder Consultation Documents, four (strategic) Policy Documents and two Scoping Papers have been reviewed. Furthermore, 21 experts have been interviewed. Regarding the role of RRI within the Programme Line and its specific levels, this diagnosis came to the following conclusion:

Level	**Awareness of RRI**
Work Programs and Calls	Limited/some awareness
Scoping level	Limited awareness
Policy level	Limited awareness
Stakeholder Consultation	Some awareness
Shift2Rail Work Program	No awareness
Interviews	Some awareness
Overall	**Limited awareness**

3. Methods

The methods used are desktop research and qualitative content analysis.

For the desktop research, information was gathered on various levels: Internet sites, work programmes, scoping papers, stakeholder consultation processes and calls were all taken into consideration. The gathered documents were analysed through a qualitative content analysis with open, sequential coding. As a first step, the majority of one work programme (and the calls included) was analysed in depth to get an overview of the argumentative structure within the document. The underlying assumption being that both, work programmes and calls, follow the same line of thinking.

83 Overall, four Work Programs, two Stakeholder Consultation Documents, four (strategic) Policy Documents and two Scoping Papers have been reviewed. Furthermore, 21 experts have been interviewed.

By analysing the context of specific passages and working out the relationships between the codes, narratives were created. When looking at other documents, the categories used and narratives created built the basis to further concretize the conclusions and restructure the narratives accordingly – this process happened using atlas.ti to narrow down the sheer amount of material to relevant passages revolving around key words.

20 interviews[84] were conducted with selected stakeholders from different fields: National Contact Points, industry, small and medium-sized enterprises, policy, funding and research. The interview partners were selected during the desktop research process and then contacted via e-mail. Their input was recorded and written down into memos, which are summaries and interpretations of the points raised in the interview and which were underlined with relevant quotes from the interviewee.

We used a preliminary stakeholder matrix for stakeholder selection. The aim of the stakeholder construct was to assist the selection of diverse stakeholders representing the moral, the social epistemic and the power-political aspects of the social to better assess the embeddedness of the research and innovation process in SGIT in society through proper and diverse stakeholder inclusion. Groups representing moral claims in the research and innovation process are NGOs, CSOs and social enterprises (Moral claims – MC); epistemic claims would be addressed by stakeholders with diverse types of theoretical or practical knowledge, expertise and experience (Epistemic claims); while power discourses are animated by funding agencies, policy or industry representatives, NCPs familiar with the governance structures, management processes and policy discourses framing technical-social visions (Power claims – PC). The goal of such moral, epistemic and power diversity is to have a broad repository of opinions on what research and innovation in SGIT is appropriate, legitimate, and desirable as well as open up the research and innovation process to the deepest possible societal scrutiny.

The interview phase happened along the document analysis, which meant that the narratives concluded from the document analysis could be brought into the interviews and the interviews simultaneously contributed to adjust our focus in the document analysis.

3.1. General scope of the program

The Transport Challenge ‘Smart, Green and Integrated Transport’ is part of Horizon 2020’s societal challenges and ‘aims to boost the competitiveness of the European transport industries and achieve a European transport system that is resource-efficient, climate-and-environmentally-friendly, safe and seamless for the benefit of all citizens, the economy and society’[85].

Mobility is seen as a major driver of ‘employment, economic growth, prosperity and global trade’ and it also ‘provides vital links between people and communities’ (European Commission 2014a, p. 13). However, there are also a number of transport-related problems, such as congestion, road safety and atmospheric pollution (European Commission 2014a, p. 13), which is why Horizon 2020 is also supposed to address this issues, by ‘contributing to the creation of a sustainable transport system that is fit for a modern, competitive Europe’ (European Commission 2014a, p.13).

84 Within those 20 interviews, a number of 21 experts were interviewed.
85 https://ec.europa.eu/programmes/horizon2020/en/h2020-section/smart-green-and-integrated-transport

This is also taken into consideration when designing the work programmes, which are all structured into four broad lines of activities (European Commission 2013, p. 5; European Commission 2015, p. 6; European Commission 2017d, p. 7), which are aiming at:

- Resource efficient transport that respects the environment. The aim is to minimize transport's systems' impact on climate and the environment.
- Better mobility, less congestion, more safety and security. The aim is to reconcile the growing mobility needs with improved transport fluidity.
- Global leadership for the European transport industry. The aim is to reinforce the competitiveness and performance of the European transport manufacturing industries and related services.
- Socio-economic and behavioural research and forward looking activities for policy making. The aim is to support improved policy making which is necessary to promote innovation and meet the challenged raised by transport, including the internalization of external costs, and the societal needs related to it.

The contents of the work programmes are also in line with the major EU policy orientations. The Scoping Paper of Work Programme 2016-2017 specifically mentions the following (European Commission 2014b, p. 1), which can be seen as having a decisive impact on the program's orientation:

- 'Europe 2020 – A strategy for smart, sustainable and inclusive growth', including the 'Innovation Union' flagship initiative.
- 'White Paper – Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system'.
- 'A 2030 framework for climate and energy policies' and 'An Integrated Industrial Policy for the Globalisation Era'.

The Work Programmes of 2016-2017 and 2018-2020 are also expected to contribute to reaching the climate targets of the Paris Agreement and have an impact on the implementation of the United Nations Sustainable Development Goals (European Commission 2015, p. 11; European Commission 2017d, p. 6).

Overall, the program has 'a two-fold aim: addressing key challenges that Europe faces, and making our industry more competitive and cooperative through transferring these solutions and standards worldwide, as other regions are confronted with similar challenges' (European Commission 2015, p. 8).

The mentioned Work Programmes and the calls they contain are only one part of Smart, Green and Integrated Transport. While they play a major role, half of the budget of the program is used for Joint Technology Initiatives (further details on the structure and budget distribution of the program can be found in Chapter 3.3).

This is why the calls of the Work Programmes have been defined taking into account the 'Clean Sky 2', 'SESAR', 'Shift2Rail' and 'Fuel Cells and Hydrogen 2' Joint Undertakings (European Commission 2013, p. 6; European Commission 2015, p. 7; European Commission 2017d, p. 8). In addition, the European Global Navigation Satellite System (European GNSS) 'will provide new opportunities for the localisation and the guidance of vehicles (European Commission 2013, p. 11;

European Commission 2015, p. 7) and also 'provide new opportunities particularly in relation to advanced technologies for automation, connectivity and digitisation' (European Commission 2017d, p. 8). This Smart, Green and Integrated Transport also contributes financially to the European GNSS (specifically Galileo).

3.2. What is your program about?

The program is a funding program addressing research and innovation institutions, as well as SMEs who are often explicitly encouraged to participate throughout the Work Programs. Both, the Work Programme 2014-2015 (European Commission 2013, p. 89) and the Work Programme 2016-2017 (European Commission 2015, p. 114) mention that the 'European sector must have the capacity to deliver the best products and services, in a time and cost efficient manner, in order to preserve its leadership and create new jobs, as well as to tackle the environmental and mobility defies'. The role of SMEs is seen as critical, as they are 'key players in the supply chains' (ibid.) and are 'pivotal for delivering the innovations needed for greater sustainable and smarter mobility, better accessibility and logistics serving business and citizens, and this higher economic growth' (European Commission 2015, p. 114).

This is why the Work Programs contribute to the SME Instrument and the Fast Track to Innovation Pilot, which are both Programs of the Executive Agency for Small and Medium-sized Enterprises (EASME)[86].

'Funding priorities will be geared towards the present and future needs of citizens, business and EU markets, and strive to maximise value for the transport sector, the wider economy and ultimately, the people' (European Commission 2015, p. 6; European Commission 2017d, p. 6). The goal is to create 'new opportunities for sustainable growth and employment' (ibid.).

3.3. What is the size and structure of your program in terms of budget, applications and projects?

3.3.1. Structure and budget

The program is structured into Work Programmes and the Work Programmes are structured into Calls. Additionally to the Work Programmes, half of the budget is spent on the Joint Technology Initiatives (JTI) 'SESAR', 'Clean Sky 2', Fuel Cells and Hydrogen 2' and 'Shift2Rail'. These joint undertakings are 'partnerships with the industry and Member States'[87]. Furthermore, Smart Green and Integrated Transport has also contributed to the European GNSS, specifically Galileo. In the Work Programme 2018-2020, the European Geostationary Navigation Overlay System (EGNOS) gets frequently mentioned along Galileo, which means that a future contribution from the Programme to the EGNOS is expected.

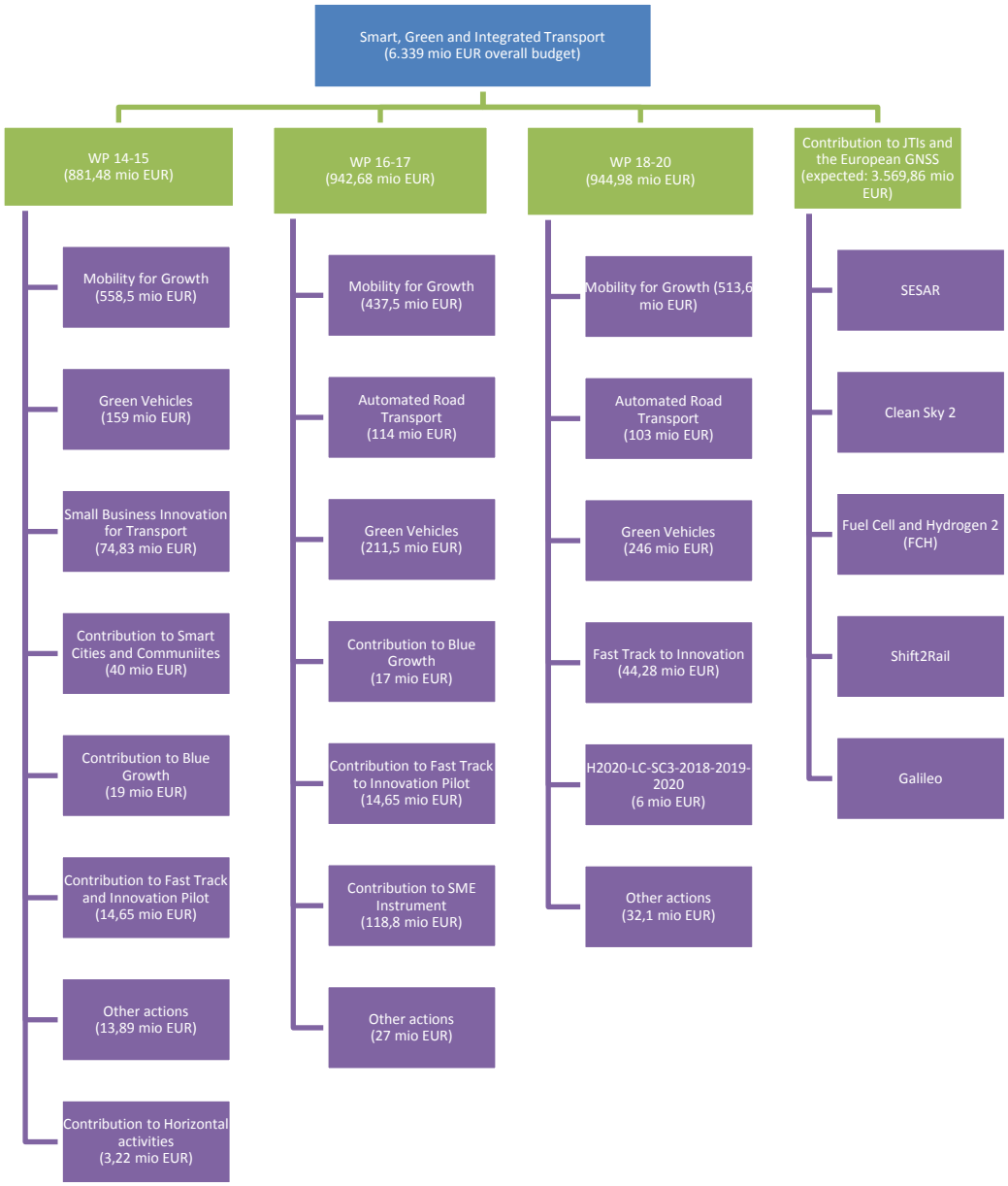
Figure 10 provides an overview of the distribution of the budget and the structure of the Programme. Although it should be mentioned that all numbers are estimated, as they are either based on the expected expenses in the specific Work Programmes or derived from those numbers (European Commission 2013, p. 98-99; European Commission 2015, p. 128-129; European

86 https://ec.europa.eu/easme/en/about-easme

87 http://ec.europa.eu/programmes/horizon2020/en/area/partnerships-industry-and-member-states

Commission 2017d, p. 108-109). The entire budget is spent on specific calls, meaning that the parts marked purple in Figure 1 could be further specified by listing the specific calls[88] they comprise.

Figure 10: Structure and Budget[89]



88 These calls are referred to as 'topics' within the Work Programmes.

89 Sources for the overall budget: https://ec.europa.eu/programmes/horizon2020/en/h2020-section/smart-green-and-integrated-transport and the contributions outside of the Work Programmes (e.g. their calls): http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/index.html#c,calls=level3/t/EU.1./0/1/1/default-group&level4/t/EU.1.1./0/1/1/default-group&level4/t/EU.1.2./0/1/1/default-group&level4/t/EU.1.3./0/1/1/default-group&level4/t/EU.1.4./0/1/1/default-group&level3/t/EU.2./0/1/1/default-group&level4/t/EU.2.1./0/1/1/default-group&level5/t/EU.2.1.1./0/1/1/default-group&level5/t/EU.2.1.2./0/1/1/default-group&level5/t/EU.2.1.3./0/1/1/default-group&level5/t/EU.2.1.4./0/1/1/default-group&level5/t/EU.2.1.5./0/1/1/default-group&level5/t/EU.2.1.6./0/1/1/default-group&level4/t/EU.2.2./0/1/1/default-group&level4/t/EU.2.3./0/1/1/default-group&level3/t/EU.3./0/1/1/default-group&level4/t/EU.3.1./0/1/1/default-group&level4/t/EU.3.2./0/1/1/default-group&level4/t/EU.3.3./0/1/1/default-group&level4/t/EU.3.4./1/1/1/default-group&level4/t/EU.3.5./0/1/1/default-group&level4/t/EU.3.6./0/1/1/default-group&level4/t/EU.3.7./0/1/1/default-group&level3/t/EU.4./0/1/1/default-

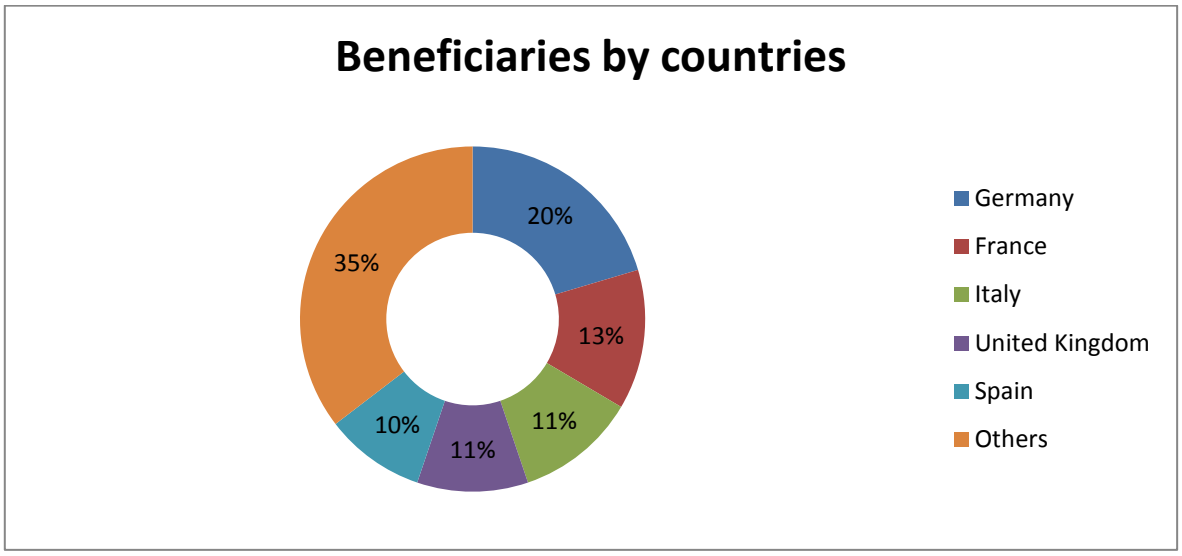
3.3.2. Submitted proposals, applications and characteristics of the beneficiaries[90]

As of the 7th December 2017 the Programme Line encompasses:

- 20.602 applications, out of which 8.696 got rejected,
- 5.857 eligible proposals, out of which 4.812 were non-successful, leaving 1.045 retained proposals,
- 941 signed grants with 2.025 mio EUR net contribution from H2020,
- 6.359 total participants, out of which 1.539 are SMEs (24,20%) receiving 501,8 mio EUR of the EU contributions (24,76%).

The biggest beneficiary from Smart, Green and Integrated Transport is Germany, receiving 20,4% of the spent money, followed by France (13,1%), Italy (11,3%), UK (10,4%) and Spain (9,4%). This five countries combined received a total of 64,6% of the spent budget.

Figure 11: Beneficiaries by countries

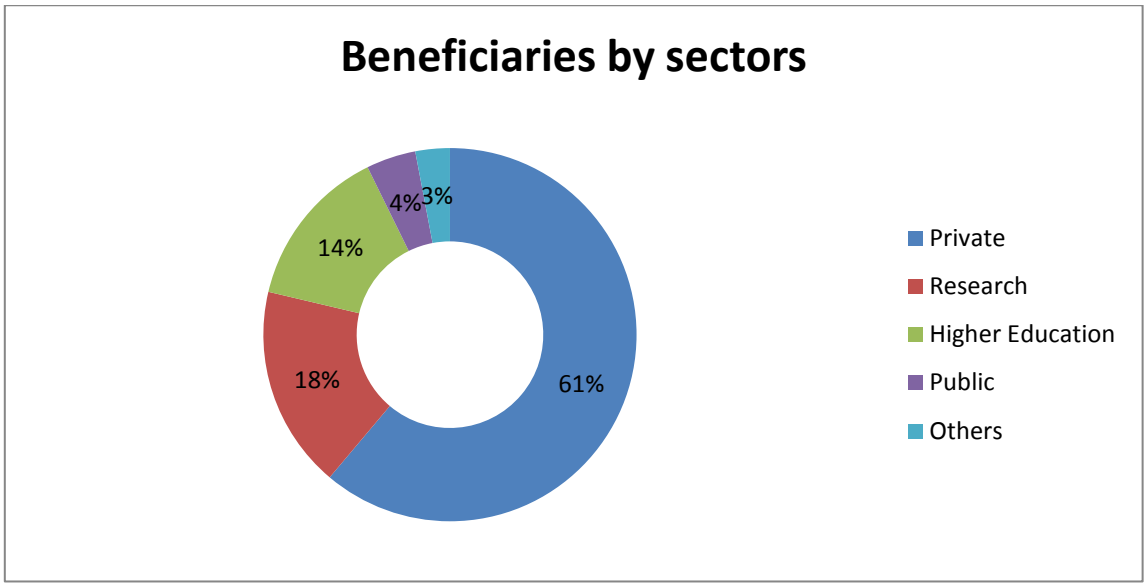


Looking into the project participations (net contribution to specific sectors) leads to the conclusion that the private sector benefits the most from the Programme, receiving over 60% of the already spent budget (1,24 billion EUR). The research sector received 355,73 mio EUR, Higher education 284,55 mio, the public sector 87,11 mio and other sectors 60,48 mio.

group&level3/t/EU.5./0/1/1/default-group&level3/t/EU.7./0/1/1/default-group&level2/t/Euratom/0/1/1/default-group&hasForthcomingTopics/t/true/1/1/0/default-group&hasOpenTopics/t/true/1/1/0/default-group&allClosedTopics/t/true/1/1/0/default-group&+PublicationDate/asc

90 The data in this section has been gathered using the online tools provided on the participant portal of the EU: http://ec.europa.eu/research/participants/portal/desktop/en/projectresults/index.html. It also be mentioned that some numbers might not always line up perfectly, this is due to round-off errors.

Figure 12: Beneficiaries by sectors



According to the Interim Evaluation, "the 2014-2015 and 2016-2017 Work Programmes of Smart, Green and Integrated Transport sees a concentration in funding absorbed by beneficiaries established in large industrialised Countries, […] with EU-13 Countries accounting for a small share of both funding received and participations" (European Commission 2017a, p. 825). Furthermore, there were only "26 participations from entities established in third countries", "receiving a total EU contribution of EUR 1.6 million (representing 0.16% of the total EU contribution), a very substantial decrease compared to FP7, where the EU contribution to Third Countries beneficiaries in transport exceeded 1% of the total EU contribution" (European Commission 2017a, p. 825).

3.3.3. Stakeholders

The following Stakeholders were involved in the creation of the Work Program from 2016-2017. The preparation of the Work Programme "was based inter alia on a continuous exchange with stakeholders including Transport European Technology platforms and industrial associations. A targeted consultation took place between May and July 2014"[91]. Stakeholders marked bold are considered important. This has two reasons: First, they gave input in diverse areas. Second, they are explicitly mentioned in the Work Programs of Smart, Green and Integrated Transport.

- **Transport Advisory Group** (H2020 Advisory Group specific to Smart, Green and Integrated Transport): Experts[92] (***Stakeholder group: EC***)

Aeronautics and air transport:

- **Advisory Council for Aviation Research and Innovation in Europe (ACARE)**: 40 member organizations and associations from the manufacturing industry, airlines, airports, service providers, regulators, research establishments and academia[93] (***Stakeholder group: EC***)
- **Clean Sky 2** (European research program) (***Stakeholder group: EC***)

91 https://ec.europa.eu/programmes/horizon2020/node/1583
92 http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=2969
93 http://www.acare4europe.org/about-acare

- **Single European Sky Air Traffic Management Research (SESAR)** (***Stakeholder group: EC***)

Rail transport:

- **European Rail Research Advisory Council (ERRAC)** (***Stakeholder group: EC***)
- **Shift2Rail**(***Stakeholder group: EC***)

Road transport:

- Competitive Automotive Regulatory System for the 21st century (CARS21) – High Level Group (***Stakeholder group: PC***)
- **Fuel Cell and Hydrogen 2 Joint Undertaking** (public-private partnership supporting research, technological research and demonstration) (***Stakeholder group: EC***)
- **European Road Transport Research Advisory Council (ERTRAC)** (***Stakeholder group: PC***)
- **European Green Vehicles Initiative** (contractual public private partnership) (***Stakeholder group: EC***)
- **European Conference of Transport Research Institutes (ECTRI)** (***Stakeholder group: PC***)

Waterborne transport:

- **Waterborne Technology Platform** (***Stakeholder group: EC***)
- Platform for the implementation of NAIADES (PLATINA) (***Stakeholder group: EC***)
- European Sustainable Shipping Forum (ESSF) (***Stakeholder group: PC***)

Urban transport:

- Intelligent Transport Systems:
  - **ERTRAC** (***Stakeholder group: PC***)
  - **European Transport Research Alliance (ETRA)** (***Stakeholder group: PC***)
  - European Road Transport Telematrics Implementation Co-ordination Organisation (ERTICO-ITS Europe) (***Stakeholder group: PC***)
- Infrastructure:
  - Joint taskforce of **ERTRAC**, **ERRAC**, **Waterborne**, **ACARE** and ECTP (European Construction Technology Platform) (***Stakeholder group: PC***)
  - **Innovation & Networks Executive Agency (INEA)**: INEA provides high-level program management expertise to infrastructure, research and innovation projects in the fields of transport, energy and telecommunications. Its aim is to implement parts of EU programs (like H2020 and the legacy program TEN-T)94 (***Stakeholder group: PC***)

94 https://ec.europa.eu/transport/themes/infrastructure/inea_en

- Logistics:
  - Alliance for Logistics Innovation through collaboration in Europe – European Technology Platform (ALICE – ETP) (***Stakeholder group: PC***)
  - **ECTRI** (***Stakeholder group: PC***)
  - **ERTRAC** (***Stakeholder group: PC***)

Socio-economic and behavioural aspects:

- Copenhagen Research Forum (***Stakeholder group: EC***)
- League of European Research Universities (LERU) (***Stakeholder group: PC***)
- **ECTRI**

Cross-cutting issues:

- **ECTRI**
- **ETRA**

In both, WP14-15 and WP17-16, the 'Clean Sky 2', 'SESAR', 'Shift2Rail' and 'Fuel Cells and Hydrogen 2' Joint Untertakings get mentioned quite early, underlining their significance. **European GNSS** can be seen as a major stakeholder too, as it will provide new opportunities for the localization and the guidance of vehicles (European Commission 2013, p.6 and European Commission 2015, p.7).

Furthermore, a number of relevant stakeholders are mentioned in the "Horizon 2020 support to Smart, Green and Integrated transport. Studies and reports" (European Commission 2017c, p. 45) document, where the authors explicitly mention:

- technology platforms (e.g. ERTRAC, ERRAC, Waterborne, ACARE, and ECTP),
- support actions (e.g. ALICE),
- association (e.g. POLIS, ECTRI, FEHRL, EREA, ECVIA), key SMEs (e.g. ERTICO),
- JU's and industry associations (e.g. IMG, ACEA, ACEM),
- modal representative associations (e.g. FIM, FIA),
- large or key participants in projects,
- and member states.

4. Current situation of RRI in the program

4.1. RRI in brief

The relevancy of RRI for the programme line is quite limited. While all of the RRI-keys and the three O's are at least implicitly present within "Smart, Green and Integrated Transport", they do often times lack *depth*, *clear definitions* and *reflections upon their scope*. This leads to a situation where RRI-keys and the three O's are addressed to a limited extent.

However, the latest Work Programme indicates a shift towards RRI, but it is unclear at this point whether old assumptions will prevail or new views can emerge that change current perceptions.

4.2. Desktop findings:

Work program level and call level[95]

No	
Yes	**Limited awareness / Some awareness** The term "Responsible Research and Innovation" never appears within the Work Programs, however, at least some awareness can be found in the latest Work Program 2018-2020. Keys: Ethics primarily plays a role in information and communication technologies (ICT), automation, intelligent transport systems (ITS) and safety. It is seen as a "challenge" whenever "public acceptance" needs to be achieved for the dissemination of specific technologies. Gender plays a marginal role within the Work Programs and is seen as a factor that has to be taken into consideration for the end-user-compatibility of technology. It is therefore perceived to be just another demographic factor amongst others. These issues remain throughout all Work Programs, although there is a call addressing gender-issues considerably more in depth in Work Program 2018-2020, potentially leading the way for a more gender-inclusive approach within the program line. Open Access plays less of a role in terms of scientific results, but instead focuses on getting open access to data that is necessary for the realization of the technological visions of ICT, ITS and automation. Public Engagement focuses on actors from industry, research, education and policy, whereas civil society does not get taken into consideration all too often. The Work Programs

95 The Work Programs contain the Calls for the Program line, which is why these two levels are handled together in this section.

	create a knowledge-hierarchy, as technological solutions get developed by major actors from research and industry, while civil society and non-exerts get reduced to the roles of users. This lack of civil societal participation might therefore lead to technocratic solutions. While Work Program 2018-2020 reflects upon this problem in a more substantial way, there is nonetheless no clear cut with this line of thinking. Science Education and Science Literacy play a marginal role within the Work Programs, as the main concerns are having access to a skilled workforce and to educate users on the proper use of technologies, rather than giving actual insights in scientific and technological processes. However, in Work Program 2018-2020, a shift occurred, away from a focus "on 'hard' technological advances" to "addressing the 'soft' human component in this evolution" (European Commission 2017d, p. 55). While some issues persist in Work Program 2018-2020, in terms of gender, there is a call addressing "Demographic change and participation of women in transport" (European Commission 2017d, p. 61), going considerably more in depth than in previous Work Programs. As "the specific needs [of women] linked to their physical and social characteristics have not been thoroughly explored" (European Commission 2017d, p. 61), "[b]y identifying the influence of intersectional aspects such as age, social level, ethnic origins, education, family composition the transport system can be adjusted to meet th [sic] specific demands of this group and lead to increased social inclusion and equity" (European Commission 2017d, p. 61). This approach might help assessing female "specific mobility needs and the possibility to increase the participation of women in transport-related jobs" (European Commission 2017d, p. 61). This seems highly important, because in the end gender issues are not a concern of sheer numbers or awareness. Women might have specific views on technology just simply because they *are* women

	– as the societal images of the relationship between women and technology are quite different from the imagined relationship between men and technology, this might lead to quite different understandings of what technology *is or might be*. Thus a more gender-inclusive approach could lead to a more open strategy, accounting for half of society, whose views and ideas of technology do not necessarily align with contemporary perceptions. In a similar way, also Public Engagement plays a more significant role within the latest Work Program, as it is stated that there "is a need to design, organize and manage transport and mobility in a smarter way", which means that it is necessary to "include people from private households and firms in early phases of the development and design of mobility and transport concepts, vehicles and infrastructures" (European Commission 2017d, p. 8). This has led to the specific section "Accounting for the people" within this Work Program (European Commission 2017d, p. 57-67). However, at this point it is unclear whether this change can be meaningfully addressed in projects and will persist (or even deepened) in the next framework program and most of the mentioned problems do indeed remain. O's: Open Science does play a role within all Work Programs, but gets addressed quite more substantially in Work Program 2018-2020 than in the previous ones. The Open Research Data Pilot became the default during Work Program 2016-2017, although participants may opt-out. Generally speaking, the "transport sector is a very competitive sector" and "Openness seems to sometime conflict with competitiveness" – "therefore too much openness is not considered to be universally wise in this sector" (European Commission 2017c, p. 54). Open Innovation is addressed marginally and lacks a clear definition.

	Openness to the World is seen as necessary to tackle global challenges, but despite that "Smart, Green and Integrated Transport" is actually one of the program lines in H2020 with the least international participation, both in terms of third-country participations and in the EU contribution to third-country participants (Gianni, Lindner 2017, p. 30) While the cooperation with tech-leading countries is perceived as important for technological advancement, emerging countries are often times seen as problem creators, limiting their role within the program line to receivers of solutions.

Policy document level

No	
Yes	**Limited awareness** "Responsible Research and Innovation" is not mentioned within any policy documents. Keys: Ethics plays a role only within the ACARE Strategic Research & Innovation Agenda and the Innovation Roadmaps. The mentioned associations are in line with the Work Programs, for example that ethical questions must be tackled "sufficient to gain customer confidence to ensure acceptance" (ACARE 2017, p. 22). Ethics is therefore primarily important to ensure the acceptance of the users and "[a] regulatory framework may be required to ensure that data are collected, shared and used without jeopardising commercial interests" (ACARE 2017, p. 26). Within the Innovation Roadmaps, "[a] customer-centric, intermodal integrated transport system approach is proposed to ensure that benefits for the transport system as a whole in terms of efficiency, reduction of environmental impact, safety and health are maximized" (European Commission 2017b, p. 11). This underlines the conclusions from the analysis of the Work Programs, as the input of civil society is reduced to users and consumers. Since their acceptance to data sharing is necessary for the implementation of ITS and

	automation, ethical questions revolve only around data privacy and data security. Interestingly enough, in terms of airport security privacy concerns do not play a role at all and the security aspect outweighs other issues: “Behaviours can be key to identifying threats and vulnerabilities, and this can be analysed through the use of innovative means to monitor staff and passengers […] and the analysis of social media. […] A comprehensive programme of education in security culture should be developed now and be fully deployed by 2025. Ways of monitoring and analyzing people and social trends for security threats should also be developed by 2025. […] The outcome of these developments will be enhanced awareness of security for aviation personnel and society, taking account of cultural differences. Threats will be identified and mitigated early, leading to a high level of security that provides the public with “enhanced confidence in air travel” (ACARE 2017, p. 76). Gender only plays a role within the ACARE Strategic Research & Innovation Agenda, where it gets mentioned once: “For aviation to reach a larger pool of talent, gender balance must be promoted to attract female students and encourage greater participation of women in conferences, events and competitions” (ACARE 2017, p. 93). Open Science only plays a role within the ACARE Strategic Research & Innovation Agenda and the Innovation Roadmaps and is – just as ethics – vastly reduced to data sharing: “An integrated transport system relies on very high levels of cooperation and data sharing across all transport stakeholders” (ACARE 2017, p. 22). “Specific data and information services will need to be developed for an integrated transport system. Powerful safeguards must be built in to ensure the integrity of private data and ensure personal dignity. These must be sufficient to gain customer confidence to ensure acceptance” (ACARE 2017, p. 22). This is why it is necessary to “[d]evelop and test innovative and robust arrangements for public-private co-design of transport and mobility

	services, addressing […] the secure collection, management and protection of user and city data in public and commercial open data platforms and public digital infrastructures" (European Commission 2017b, p. 65). Public engagement plays a role within all documents, but the scope of civil societal input is limited to users. The ACARE Strategic Research & Innovation Agenda defines as a goal for Flightpath 2050, that "European Citizens are able to make informed mobility choices" (ACARE 2017, p. 12). Societal needs are therefore reduced to market needs: "Meeting societal and market needs is about true journey-wide customer-centric mobility for both passengers and freight" (ACARE 2017, p. 12). This leads to a situation where any input beyond a customer-view is not seen as legitimate and stakeholders get defined as being part of the (current) innovation chain: "European research and innovation strategies are jointly defined by all stakeholders, public and private, and implemented in a coordinated way with individual responsibility. The complete innovation chain from blue sky research up to demonstration and innovation is covered" (ACARE 2017, p. 16). This way, societal acceptance and societal challenges do only play a role in terms of the market: "The challenges of implementation, deployment and exploitation are of a different nature from those in technical system development, so it is important to understand societal acceptance factors. These will be key to enabling successful deployment and operation of new systems and technologies into the market" (ACARE 2017, p. 22). Following this line of thinking, public engagement is primarily seen in terms of economic benefit, as also the inclusion of authorities in early research projects should "allow breakthrough technologies and innovations to be certified as quickly as possible, increasing their competitive edge" (ACARE 2017, p. 44). And whereas the whole innovation chain plays a role for innovation processes, stakeholders of the supply chain are expected to set the research priorities: "Programs must be linked to common objectives and roadmaps shared by

	stakeholders across the entire supply chain – this will promote suitable prioritization of research" (ACARE 2017, p. 88). This leads to a situation where citizens do not get acknowledged as relevant for agenda-setting purposes, but are only taken into consideration to deliver input as users, while other agents actually make decisions perceived viable according to this information: "Companies, governments and public entities should be equally encouraged to provide collected user and urban data on the use of public space and infrastructures wherever it is available (in such a way that protects the privacy of its citizens) so that users, cities, third party apps, operators, developers and innovators can access it to inform their decisions and innovate their applications" (European Commission 2017b, p. 64). A focus on economic conditions and the interests of larger industrial actors seems to be even more problematic in science education, as "Stakeholder involvement will allow educational programs to receive up-to-date knowledge and training, and inspire students with real-world problems. It will give industry direct access to the talent pool, with the possibility to influence the development of their future employees" (ACARE 2017, p. 92). The present vision for 2050 implies a heavy focus on industrial interests, "to ensure the availability of a large enough workforce" by fostering "interest in aviation in schools at all levels from primary through secondary to higher education" (ACARE 2017, p. 93). "The availability of a workforce with excellent education is [seen as] crucial for maintaining leadership in European aviation", which makes it "necessary to go further, capitalizing on the educational portfolio in Europe and preparing students for future needs" (ACARE 2017, p. 91). In this sense, one of the specific goals for Flightpath 2050 is not only, that "[s]tudents are attracted to careers in aviation", but also that "[c]ourses offered by European Universities closely match the needs of the aviation industry, its research establishments and administrations" (ACARE 2017, p. 16). This seems highly problematic, as an orientation on

	industry's interests in education could render alternative interests within this sector as simply non-viable and illegitimate, leading to a situation where technological advancements beyond these interests can hardly be articulated, thus potentially limiting technological progress. And while the White Paper encourages and supports "the dialogue between social partners in view of an agreement on a social code for mobile road transport workers" and encourages "employee involvement, in particular through European Works Councils" (European Commission 2011, p. 21), this is also seen as important in economic terms rather than for equity, potentially limiting social dialogue to competitiveness rather than societal needs: "It will be important to align the competitiveness and the social agenda, building on social dialogue, in order to prevent social conflicts, which have proved to cause significant economic losses in a number of sectors, most importantly aviation" (European Commission 2011, p. 12). O's: The 3 O's ("Open Science", "Open Innovation", "Open to the World") do not get mentioned within the Transport White Paper, Flightpath 2050 and the ACARE Strategic Transport Research & Innovation Agenda. The term "Open Innovation" appears once within the Innovation Roadmaps (European Commission 2017b, p. 63).

Scoping level

No	
Yes	**Limited Awareness** "Responsible Research and Innovation" is not mentioned within the Scoping Papers. Keys: Overall, no key word matches could be found within Scoping Paper 2016-2017, meaning that none of the RRI-keys were addressed. Ethics

	and Science Education do not play a role within both Scoping Papers. Gender gets mentioned in the SP for WP18-20 – in the context of "factors which shape future mobility demand and acceptance of innovations" (European Commission 2016a, p. 6), leaving the impression that the focus on "demand" and "acceptance" implies an orientation on females as users and consumers. As for Public Engagement, the SP for WP18-20 points towards the stakeholder consultation process, where "[a]pproximately 40 organisations from all transport modes, including research organisations, industry associations, public bodies and users or [sic] transport as well as citizens associations, participated" (European Commission 2016a, p. 3). Furthermore, the aim of the "Accounting for the people" section for the latest Work Program is defined as: "Better understanding and anticipating the dynamics of mobility and transport demand, accounting for all citizens, industry and commerce" (European Commission 2016a, p. 6), implying an orientation towards economic aspects. In line with the changes in Work Program 2018-2020, this scoping paper also considers "aspects of accessibility and integration of new mobility solutions" (European Commission 2016a, p. 4) as essential, assuming that slow world growth has "negative impacts on accessibility, congestion, safety and the overall efficiency of transport systems" (European Commission 2016a, p. 3). O's: The 3 O's ("Open Science", "Open Innovation", "Open to the World") do net get mentioned within the Scoping Paper (SP) for Work Program 2016-2017, but all get mentioned in the SP for Work Program 2018-2020 (although there is no specific content attached to the terms).

Stakeholder Consultation

No	
Yes	**Some awareness**

	The following section covers the response of the Transport Advisory Group (TAG) for the preparation of Work Program 2016-2017, which "summarises the response of the Transport Advisory Group (TAG) to the seven questions listed in the '*Consultation of the Horizon 2020 Advisory Groups'* document" (Transport Advisory Group 2014, p. 3) and the document for "a false targeted consultation process" in May 2016 for the preparation of Work Program 2018-2020[96]. Keys: "Responsible Research and Innovation" is not mentioned in the TAG response from 2016-2017, but is explicitly referred to in the stakeholder consultation document for WP18-20. Gender and Ethics do not get addressed within both documents. Only one match could be found regarding Science Education: On an illustration in the TAG-response. This illustration implies that education and awareness campaigns are only relevant on the individual, not on the corporate or governmental level, leaving the impression that individuals/consumers are in the need to learn, whereas industry and policy debate and set the agenda what should be learned (about). Taking the role of Open Access in this document into consideration, this again leads to a point where society is mostly viewed from a user and consumer perspective: "Further research should help to analyse in how far free competition in the market, consumer choice and the related societal benefits can be enhanced through open data policies and open data standards and platforms" (Transport Advisory Group 2014, p. 23). Concerning Stakeholder Engagement, this view to focus on users persists within the document.

96 https://ec.europa.eu/programmes/horizon2020/en/shaping-work-programme-2018-2020-societal-challenge-4-smart-green-and-integrated-transport

	The Stakeholder Consultation document for WP18-20, however, takes quite a big step forward in terms of the acknowledgement of RRI and some of its keys. It is specifically asked "[w]hich areas could benefit from [the] integration of horizontal aspects such as social sciences and humanities, responsible research and innovation, gender aspects, and climate and sustainable development" (European Commission 2016b, p. 1). O's: The 3 O's ("Open Science", "Open Innovation", "Open to the World") do net get mentioned within the response of the TAG for Work Program 2016-2017, but all get mentioned and defined in the Stakeholder Consultation document for 2018-2020 (SC18-20).

Shift2Rail Work Program[97]

No	**No awareness** "Responsible Research and Innovation" is not mentioned within the document. Keys: Gender does not get addressed within this Work Program. Ethical questions do not arise within the Work Program and only play an implicit role regarding data protection (Shift2Rail 2018, p. 30) and cybersecurity (Shift2Rail 2018, p. 52), but do not get addressed in any significant way. Open Science is reduced to economic benefits and viewed as a service rather than it is connected to opening up science for a wider range of participants: "The step towards sharing data needs to be considered and progressively developed, using open standards and specifications (including TAP TSI), in order to

97 This is a work Program of the European Joint technology Initiative (JTI) Shift2Rail. Since JTIs are a significant part of the Program Line, this Work Program was additionally taken into consideration to indicate the status of RRI within these joint undertakings.

	enable service developers to provide the connected travellers with the services they need and expect" (Shift2Rail 2018, p. 9). Public Engagement is reduced to the (railway) value chain (Shift2Rail 2018, p. 6, p. 27), scientific actors and policy makers. The only time a wider range of stakeholders is taken into consideration is for demonstrations, because "performing a meaningful and relevant demonstration requests the involvement of additional stakeholders which will support the demonstration" (Shift2Rail 2018, p. 93). This is why in this case a broader participation is seeked, including "operators (urban rail, main line, others [sic] transport modes), transport authorities, passengers, cities, retailers, airlines, etc." (Shift2Rail 2018, p. 93). The expected goal is to "[e]ase and promote the market acceptance" (Shift2Rail 2018, p. 94). Science Education only plays a role regarding PhD researches, which "are expected regularly to liaise with the S2R JU and to present their research findings to the S2R events" (Shift2Rail 2018, p. 103). The aim behind this is "to challenge the traditional rail approach with innovative and breakthrough concepts", while "[a]t the same time, the PhD research who are port of the S2R activities, are expected to become European ambassadors of the possible bright and innovative future that the rail sector has in the year to come" (Shift2Rail 2018, p. 103). O's: The 3 O's ("Open Science", "Open Innovation", "Open to the World") do not get mentioned.
Yes	

4.2.2. General use of RRI

The assessment from this analysis is that all the RRI keys are at least implicitly present, but their scope is quite limited. *The term "Responsible Research and Innovation" appears only once within all documents.*

Open Science has probably the most important role within the Program line, as the Open Data Research Pilot became the default during Work Program 2016-2017, which means that grant beneficiaries "will engage in research data sharing by default" (European Commission 2015, p. 9).

There is however also the option to opt-out, which leaves the question how high this opt-out-rate is and who opted out for which reasons. *Open Innovation* is addressed marginally at best, as the term is only defined once within all documents and is mostly only used as a key word void of actual content. *Openness to the World* is seen as necessary to tackle global challenges, but despite that "Smart, Green and Integrated Transport" has one of the lowest international participation rates within all of Horizon 2020. While the cooperation with tech-leading countries is perceived as important for technological advancement, emerging countries are often times seen as problem creators, limiting their role within the program line to receivers of solutions developed by Western actors.

Ethics primarily plays a role in information and communication technologies (ICT), automation, intelligent transport systems (ITS) and safety. However, it is seen as a "challenge" whenever "public acceptance" needs to be achieved for the dissemination of specific technologies. *Gender* plays a marginal role and is mostly seen as a factor that has to be taken into consideration for the end-user-compatibility of technology. It is therefore perceived to be just another demographic factor amongst others and there is no reflection upon that technology might be inherently gendered, as it is a field historically dominated by men. *Open Access* plays less of a role in terms of scientific results, but instead focuses on getting open access to data that is necessary for the realization of the technological visions of ICT, ITS and automation. *Public Engagement* focuses on actors from industry, research, education and policy, whereas civil society does not get taken into consideration all too often.

Overall, the Program Line creates a specific knowledge-hierarchy: technological solutions get developed by major actors from research and industry, while civil society and non-experts get reduced to the roles of "users". This lack of civil societal participation therefore leads to solutions described as technological fixes that are linked more closely to economical than to societal needs.

Following this line of thinking, *Science Education and Science Literacy* play a marginal role within the documents, as the main concerns are having access to a skilled workforce and to educate users on the proper use of technologies, rather than giving actual insights in scientific and technological processes.

Work Program 2018-2020 tackles some these issues at a more substantial level and the Stakeholder Consultation document for this Work Program also mirrors this. While this leads to the conclusion that the Program Line is in the process of moving more towards Responsible Research and Innovation, it is unsure if old assumptions will prevail or new views can emerge that change current perceptions.

4.2.3. RRI beyond the keys

RRI is not traceable as an approach, a method or a process within the Program Line. Instead, the keys might be present, but their scope is quite limited, as indicated in the section above.

- A *technology-fix perspective* reduces the "human factor" to "different types of users ('drivers' / passengers, etc)" (European Commission 2017d, p. 56), as if enough data about the different aspects of human behaviour could help technology "make" the "right" decisions.

- Overall, the Program Line creates a *knowledge-hierarchy* where industry and academia are given dominance in setting agendas and roadmaps.

4.2.4. Theoretical framework of RRI applied in the program line

Within the Program Line there is little to no awareness of being responsive to ethical or societal considerations.

With the keys being limited in their content to a specific frame, this very framing determines the way these keys can be taken into consideration. Moving beyond a technological-fix approach, putting citizens' engagement before user input and placing societal (and maybe even environmental) development before economic and technological interests are not part of the conceptual frame of the Program Line. While societal impact of technologies do play a role within the Program Line, in the end technological developments get seen as value-neutral – as something that will happen, whether we like it or not. Therefore societal impact or socio-ethical issues are to dealt with as consequences of technology/innovation.

4.2.5. Overall assessment of RRI in the program line (based on desktop research):

Category	Value	Description
C	Limited awareness	• Responsibility or ethical awareness is referred to in any document • Any RRI key is mentioned; • There is reference to the need for social embeddedness of the research at hand.

4.3. Interview findings

4.3.1. Shared understanding of RRI

The concept of RRI was mostly unknown to interviewees. The keys were mostly understood in the same way as in the documents, although a few interviewees also saw these perceptions as problems. The interviews confirmed, that

- Competitiveness is seen as a problem to openness. However, some of the interviews also made it clear that the terms of open science, open access and open data are not necessarily understood and are sometimes used interchangeably.
    - "at the moment you see these big players like google maps, google or amazon – they have closed systems, they keep the data for themselves; imagine that we can have a system which is open and is not closed and it does not keep the data for itself"
- Public engagement is mostly focused on engaging civil society as users.
    - "you may have the best technology in the world but if the consumer doesn't get it there is no point of launching the product"
- Policy is framed as the actor responsible to take ethical issues and public engagement into consideration (dual use issues).
    - "what we as researchers in universities, research organizations […] can develop are technologies. The development of new products and the deployment of these new technologies or new procedures or whatever is not under the responsibility of the

researcher. There need to be discussions with the researchers and those who deploy these issues”

- Gender is widely considered to be relevant as a consumer perspective and to increase the number of women in transport, whereas gendered approaches to technology play a marginal role (e.g. taking the aspect of gender diversity into consideration throughout the innovation process including agenda setting).
    - “most of these consumer are women, so we realized quite long ago that, you know, a company where most of the managers are men […] doesn’t make any sense”
    - “women are not so interested on this mechanical engineering in their education”
    - "The car manufactures are actually getting their heads around using gender as a selling-option"
    - "you can have all the equality/ legal requirements in place but you still have influences that make it extremely difficult for women to get into the sector"
- A few interviewees pointed out a problem in science communication, also mentioning that the deliverables are felt to be imposed on projects and not practical in any way.
    - "I find the way that one has to write up the deliverables/ basically they are almost impossible for anyone else to use that hasn't been involved with the project"
- A technological-fix perspective is prevalent in the programme line.
    - “we have designed technologies in a way that makes it possible to share and to analyse data in ways that then is hidden away, that doesn’t give any feedback on what’s happening […] it doesn’t have to be that way, it could be otherwise”.
    - Public engagement “was not considered an issue […] we were mostly focused on the technical side of the proposals”
    - “in this particular area, I think that many people in these companies […] actually believe that within the near future […] we will have no crashes because automated vehicles will solve it all […] I don’t think that even you and I will ever experience that, but that is one very strong way of saying ‘yes, we understand […] however, very soon we have solved it all – for everybody’”
- This technology-fix thinking is actually present beyond the Program Line and can also be found within civil society when engaging in the sector.
    - On interviewee mentioned that Greenpeace is interested to get involved in the technology side and that they are also following a technology-fix approach, as it is an easier to lobby for specific solutions than to mobilize people.

Beyond that, a number of interviewees also challenged these views, confirming the mentioned problems, one person stating that embedding RRI more deeply into research agendas is a good way to change these issues.

4.3.2. Beyond RRI

Some interviewees see the need for a better social embeddedness of R&I and science. Others are wary to put "things unreflected into civil society", pointing out that the responsibility of research is to make things understandable and to "sell what they are doing to the public", while citizen engagement is seen as problematic.

Overall, specifically researchers of social sciences, smaller actors from SMEs and also some NCPs seemed to be more engaged with the issues that we were looking for during the interviews, whereas policy, industry and interviewees coming from a technical field did align more in their content with the Program Line as stated in the document analysis.

4.3.3. Assessment of RRI based on interviews

Category	Value	Description
A	**High Awareness** • Public engagement • Gender	• RRI as concept well understood by all stakeholders; • RRI keys and O's are used and referred to by most stakeholders; • Operationalization of RRI already present
B	**Some awareness** • RRI as a concept • Science communication	• RRI as concept understood by some stakeholders; • Some RRI keys and O's are referred to by some stakeholders; • The need for mainstreaming through operationalization is referred to by some stakeholders
C	**Limited awareness** • Open science • Open access • Open data	• Vague awareness of RRI as concept by a few stakeholders; • Any RRI key referred to by some stakeholders; • Some ideas of operationalization of RRI present
D	**No awareness**	• RRI as concept is not present; • No RRI key is mentioned; • No reference to or explicit refusal of societal embeddedness or civic engagement;

4.4. Case briefs[98]

For the analysis of the project level, the objective/abstract texts of all H2020 proposals, which are present in the Cordis Data[99] portal, were used, since no full text proposals were available. Carrying out a word-frequency analysis, by applying a selection of key-words for each of the RRI keys, RRI scores for each of the H2020 projects were calculated. This analysis shows that the

98 The analysis for this section was prepared by CWTS Team at Leiden University, Ingeborg Mejier and Tung Tung Chan for NewHoRRIzon

99 http://data.europa.eu/euodp/de/data/dataset/cordisH2020projects

Program Line “Smart, Green and Integrated Transport” has the third lowest RRI-score within all of Horizon 2020.

- While it is difficult to determine the ethics indicator qualitatively, other dimensions could be observed by:
- Public engagement: Outreach efforts to engage multiple stakeholders
- Science education: Offered educational courses, talks, workshops, seminars
- Gender equality: male and female ratio in a project team
- Open access: Materials (documents, articles, videos, lectures) accessible to every online user

The seven highest scoring projects within the Program Line indicate high scores regarding Public Engagement (all have a social media account with updates and newsletter) and Open Access (5 out of 7 have all materials online and available for download). Furthermore, 5 out these projects have educational activities. Gender equality information was unavailable in 6 project websites, but the remaining project has more male than female team members.

5. Conclusions

The term “Responsible Research and Innovation” only appears once within all documents: In the stakeholder consultation document in May 2016 for the preparation of Work Program 2018-2020. This underlines the assessment that RRI cannot be found as an overarching and coherent concept within the program line. Instead, we encountered a situation where some of the RRI-keys and the three O’s appear within the different documents, but their scope is often quite limited. The aforementioned stakeholder consultation document and the Work Program for 2018-2020 have the most depth in this regard, indicating that the importance of RRI and the three O’s within the Program Line is increasing.

The conclusion is that all of the RRI-keys and the three O’s are at least implicitly present within “Smart, Green and Integrated Transport”, but they do often times lack *depth*, *clear definitions* and *reflections upon their scope*. Therefore, this section summarizes some of the implicit assumptions and associations connected to RRI-relevant terms and concepts within these documents.

Most of the documents of the Program Line are technology-driven, often seeking for technological rather than societal solutions. Technology is expected to provide answers on how to handle the challenges societies are facing today and is perceived to be value-neutral, having a predetermined path rather than being the result of interests, goals or agendas. One example for this is automation, which is seen as the result of a technological evolution, implying that technological development will progress naturally further into this direction: “technology will evolve further towards semi-automation and eventually towards full automation in real moving traffic” (European Commission 2015, p. 76). At the same time, user and societal acceptance are seen as challenges, “which need to be tackled to enable the deployment of automated driving on European roads” (European Commission 2015, p. 76). By implying that there is a (seemingly natural and inevitable) evolution in the direction of automation the social impacts of the ‘agenda of automation’, and its societal confluence, are not discussed and debated during early phases of the innovation process.

This leads to technological visions that might not properly align with inclusive societies, as the underlying assumptions leading to those visions are not the result of democratic and open debates.

This thinking might be part of why ethics primarily plays a role in information and communication technologies (ICT), automation, intelligent transport systems (ITS) and safety. Ethics is seen as a 'challenge' whenever public acceptance needs to be achieved for the dissemination of specific technologies that were designed and innovated in a top-down process. While "robust built-in data privacy and security measures [have to be] based on appropriate public engagement" (European Commission 2013, p. 32) and "[e]thical and gender issues in compensating for human errors should be duly taken into consideration" (European Commission 2013, p. 34), it is often times left unclear how these issues should, or potentially could, be tackled. This leaves the impression that dealing with ethical issues is lacking depth. In this regard ethics is both too broad and too narrow, as this key plays are very specific and limited role in certain cases, but is at the same time too loosely addressed in other contexts. A *technology-fix perspective* reduces the "human factor" to "different types of users ('drivers' / passengers, etc)" (European Commission 2017d, p. 56), as if enough data about the different aspects of human behaviour could help technology "make" the "right" decisions. This thinking predetermines the way ethical debates take, as they are reduced to the effects of automation, ICT and ITS.

Public Engagement is mostly focused on actors from industry, research and policy, whereas non-linear forms of innovation, involving civil society, do not get taken into consideration. Overall, the Program Line creates a specific top down *knowledge-hierarchy*, where industry and academia (as 'experts') are given dominance in setting agendas and roadmaps: While the development of technological visions and solutions is perceived to be the area of major actors from research, industry and policy, civil society and non-'expert' citizens get reduced to the roles of 'users'. This leads to a situation where they can only engage by judging specific technologies in terms of usability, rather than actively being involved in co-creative research and innovation processes. Therefore, questioning or challenging the technological visions behind technological developments is not perceived as being part of 'proper' Public Engagement. A lack of civic societal participation might therefore lead to technology-fix solutions, which are linked more closely to economical, than to societal and ecological needs.

Following this line of thinking, science education and science literacy play a marginal role within the documents, as the main concerns are having access to a skilled workforce and to educate users on the proper use of technologies, rather than giving actual insights in scientific and technological processes. It is not anticipated that science education and science literacy are *preconditions for public engagement*: allowing civil societal actors to bring in their experiences, as otherwise only (self or power proclaimed) 'experts' have the knowledge to take part in research and innovation processes. In this context, it is assumed that 'policy' plays the key role to bring in societal aspects, represent societal needs and aim for the inclusion of different actors in the Program Line. This shifts the responsibility for societal inclusion away from industrial and scientific sectors (that is participants of the Program Line), assuming that scientific and economic interests do not need to take civil society into consideration, as this is (primarily) the task of policy actors and politicians.

This leads to the problem of public and user acceptance, which is required "to develop business cases to make fully automated urban road transport systems economically viable" (European Commission 2015, p. 87). In this line of thinking, acceptance is something that needs to be achieved, so that specific products and concepts can enter the market. Thus, acceptance is limited to *advancing economic viability*. It is taken for granted that solutions need to be developed first and then those solutions need to be altered (if at all) to achieve acceptance, instead of opening up research processes in the first place, to better align the outcomes with societal needs from the

very beginning – potentially also saving costs for acceptance-building. In a similar way, the main concern regarding open access seems to be to develop solutions that are ethically accepted and at the same time allow the underlying vision of ITS, automation and mobility as a service become reality. This is why this key plays less of a role in the Work Programs in terms of scientific results and instead focuses on ethical questions to get (open) access to data that is necessary for realizing the technological visions of ICT, ITS and automation.

Gender plays a marginal role in form of a tick-box-exercise (increasing the sheer numbers of women) and is mostly seen as a factor that has to be taken into consideration for the end-user-compatibility of technology. Gender is therefore perceived to be just another demographic factor amongst others and there is no reflection upon that technology might be inherently gendered, as it is a field historically dominated by men.

However, in Work Program 2018-2020, a shift occurred, away from a focus "on 'hard' technological advances" to "addressing the 'soft' human component in this evolution" (European Commission 2017d, p. 55). While some issues persist in Work Program 2018-2020, in terms of gender, there is a call addressing "Demographic change and participation of women in transport" (European Commission 2017d, p. 61), going considerably more in depth than in previous Work Programs. As "the specific needs [of women] linked to their physical and social characteristics have not been thoroughly explored" (European Commission 2017d, p. 61), "[b]y identifying the influence of intersectional aspects such as age, social level, ethnic origins, education, family composition the transport system can be adjusted to meet th [sic] specific demands of this group and lead to increased social inclusion and equity" (European Commission 2017d, p. 61). This approach might help assessing female "specific mobility needs and the possibility to increase the participation of women in transport-related jobs" (European Commission 2017d, p. 61). This seems highly important, because in the end gender issues are not a concern of sheer numbers or awareness. Women might have specific views on technology just simply because they *are* women – as the societal images of the relationship between women and technology are quite different from the imagined relationship between men and technology, this might lead to quite different understandings of what technology *is or might be*. Thus a more gender-inclusive approach could lead to a more open strategy, accounting for half of society, whose views and ideas of technology do not necessarily align with contemporary perceptions.

In a similar way, also public engagement plays a more significant role within the latest Work Program, as it is stated that there "is a need to design, organize and manage transport and mobility in a smarter way", which means that it is necessary to "include people from private households and firms in early phases of the development and design of mobility and transport concepts, vehicles and infrastructures" (European Commission 2017d, p. 8). This has led to the specific section "Accounting for the people" within this Work Program (European Commission 2017d, p. 57-67). However, at this point it is unclear whether this change can be meaningfully addressed in projects and will persist (or even deepened) in the next framework program.

Work Program 2018-2020 lays the path to engage some of these issues on a more substantial level and the Stakeholder Consultation document for this Work Program also reflects this (and actually surpasses the Work Program in this regard). While this leads to the conclusion that the Program Line is in the process of moving more towards Responsible Research and Innovation, this analysis concludes that the issues at hand need to be tackled on a more fundamental level – challenging the underlying assumptions that limit the scope of RRI within the Programme Line.

6. Timeline for Diagnosis

Month	Task(s)
4	Start of Diagnosis
4	Get to know the program line
5	Identify relevant stakeholders/experts for interviews
6-7	Interviews with experts (in total 15-.20)
7-10	Transcribe interviews, analysis
10	Finalizing Report
15	DX.1 due in M15 – ensure you send your reports to WP lead on time

7. Literature, links, resources

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NewHoRRIzon Diagnosis Report

Social Lab Nr. 11

Societal Challenge 5 “Climate Action, Environment, Resource Efficiency and Raw Materials”

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1. Executive Summary

The Programme line "*Climate Action, Environment, Resource Efficiency and Raw Materials*" was established under Horizon 2020 in the pillar of Societal Challenges – therefore called Societal Challenge 5 (SC5) – with a budget of EUR 2,965.7 million for the period 2014 to 2020. The challenge basically addressed by the programme line is "*to achieve a resource efficient and climate change resilient economy that meets the needs of a growing global population within the natural limits of a finite planet*" (Impact Assessment Report 2011, p. 38).

To comprehend how Responsible Research and Innovation (RRI) is understood, prioritized and applied in EC funding strategy to SC5 and integrated into research and innovation (R&I) processes on the project level, we have analysed relevant documents such as policy- and scoping-papers, work programmes, project proposals as well as evaluation templates. 15 interviews were conducted with present and former representatives of the Directorate-General Research and Innovation (DG RTD), the Executive Agency for Small and Medium-sized Enterprises (EASME), the Advisory Board to SC5, funding organisations and National Contact Points (NCPs), national and international networks and organisations of industry, communities or civil society as well as many researchers working on national or H2020 projects in the position of project coordinators or national partners. This report presents the results of this research.

The scoping papers and work programmes of SC5 refer to a systemic approach, explicitly in line with RRI, as guiding principles of how research and innovation should be conducted in this programme line. RRI seems to be well positioned. Indeed, 22 % of the SC5 projects so far, more than double of the average in H2020, are flagged RRI-relevant – the others either lack the awareness or the substance of RRI. Given that the programme line is very close to genuine societal challenges with relevance to attitudes, concerns and lifestyles of citizens, social embeddedness of research and innovation is essential in some research areas of SC5 to have an impact. Thus funding strategy as well as resulting research and innovation practices have the potential to demonstrate specific barriers and potentials to integrate Responsible Research and Innovation considering its key issues (public engagement, open access, science education, gender, ethics and governance), the three R&I policy goals formulated by Carlos Moedas ("three O's": open innovation, open science and open to the world) as well as the four R&I process dimensions (anticipation, reflexivity, inclusion and responsiveness).101 Identifying barriers and potentials may lead to recommendations how to foster social embeddedness of R&I in all research areas, calls, topics and projects of SC5 and beyond. Leading questions are: What can be learned from good practice? How can RRI be better rooted in R&I funding and practice?

2. Scope of this document

This report covers the programme line of societal challenge 5 "*Climate Action, Environment, Resource Efficiency and Raw Materials*".102 The report gives attention to the concept of RRI as (1.)

101 Definition of RRI: NewHoRRIzon Deliverable D6.1.

102 Early results of this research have been presented to and discussed with the participants of the Social Lab 11 „Climate Action, Environment, Resource Efficiency and Raw Materials", organized by

being present (and presented) in the EC documents related to SC5 over time in H2020 and as (2.) being understood and put into practice by project partners and within project consortia, taking into account that a project may focus on a specific aspect of the concept, include or provide tools relevant for RRI or be based on "de facto" RRI practiced in certain SC5-relevant research communities.

3. Methods

3.1. General scope of the program

The diagnosis consists mainly of three compatible elements, that is (1.) getting an overview of the programme line, (2.) locating and analysing relevant documents and (3.) identifying and interviewing key actors and stakeholders and analysing their contribution. The following research has been conducted:

- desk research: online material provided by the EU, website information and documents from general to specific, covering legal, strategic, scoping and work programme documents as well as expert group reports and project level information (such as forms, evaluation docs)
- document analysis: extensive reading combined with key word research in online documents (six keys, three O's), extended by further keyword research related to those used in the bibliometric analysis
- interviews with 15 experts: selection according to the objective to integrate diverse perspectives as far as stakeholder-groups, experiences with SC5 or national projects, positions and tasks in the projects, expertise on the challenge, gender and national background are concerned.
- bibliometric analysis: offered by Ingeborg Meijer and her team at Leiden University for project selection, integrated in the research process at different stages (e.g. desk research, identification of interview partners)

3.2. What is your programme about?

Societal Challenge 5 on "*Climate Action, Environment, Resource Efficiency and Raw Materials*" covers the following broad lines of activities:

- Climate Action – informed decisions for a climate-resilient low-carbon society
- Cultural Heritage – engaging a new cultural heritage agenda for economic growth
- Earth Observations – crucial info on climate, energy, natural hazards and other societal challenges
- Nature-based Solutions – providing viable solutions for natural ecosystems
- Systemic Eco-Innovation – generating and sharing economic and environmental benefits

The basis of these broad lines of activities is the challenge named in the Interim Assessment

the Federation of German Scientists in the framework of the NewHoRRIzon project on May 17-18, 2018, in Berlin.

Report of 2011 as "*to achieve a resource efficient and climate change resilient economy that meets the needs of a growing global population within the natural limits of a finite planet*" (p. 38). In this early paper, the kind of activities which might be funded within the societal challenges part of H2020 was defined, that is "*activities from research to market, including: R&D projects, applications of key technologies (e.g. ICT, bio, nano), pilot and demonstration projects, market uptake and replication projects, public procurement of innovative products, processes and services, appropriate support for standardisation and regulatory activities as well as innovation inducement prizes*" (p. 34f). Right from the beginning, these societal challenges had a strong focus on maximizing impact with a "*strict focus on a limited number of major challenges that "speak" to the citizen*".

When H2020 was established by Council Decision on 3rd December 2013, SC5 set out to fund research and innovation with the following specific objectives, as named on the EC-portal on "*Climate Action, Environment, Resource Efficiency and Raw Materials*", to achieve:

- *"a resource – and water – efficient and climate change resilient economy and society,*
- *the protection and sustainable management of natural resources and ecosystems, and*
- *a sustainable supply and use of raw materials, in order to meet the needs of a growing global population within the sustainable limits of the planet's natural resources and eco-systems."* (EC-portal)

SC5 objectives are well integrated in the overall strategy of H2020: "*Activities in this Challenge will help increase European competitiveness, raw materials security and improve wellbeing. At the same time, they will assure environmental integrity, resilience and sustainability with the aim of keeping average global warming below 2° C and enabling ecosystems and society to adapt to climate change and other environmental changes*" (EC-portal). Being in line with the major challenges identified in Europe 2020 strategy and the flagship initiatives, the Juncker-priorities of July 2014 influenced the outlook of the Work Programmes 16-17, with a contribution of SC5 mainly to priority 1 (Growth, Jobs and investments), priority 2 (Digital Single Market), priority 3 (Energy Union and climate change policy) and priority 9 (A Stronger Global Actor) (Interim Report, p. 881).

The changing international setting since the adoption of the framework of H2020 as well as increasing political awareness and crucial international agreements related to the societal challenges of the 21st century are reflected in the priorities of SC5, as stated in the scoping paper for WP 2018-2020: "*The priorities address the ambitious targets set recently at the global level by the COP21 Paris Agreement, the UN's Sustainable Development Goals (SDGs), the global Urban Agenda adopted in Quito and the Sendai framework for Disaster Risk Reduction, which demand a fundamental shift in technology, economics, finance and society as a whole, and help implement high-level EU policies including the 7th Environmental Action Programme to 2020, the Circular Economy, the Energy Union (including the Communication "Accelerating Clean Energy") and the Arctic*" (Scoping paper 2017, p. 2).

Supplementary policy drivers that had emerged over the past few years were chosen to guide priorities: These included for the SC5 Work Programme 2018-2020 the "three O's" of Commissioner Carlos Moedas (open science, open innovation, and having a programme that is open to the world), and other elements ranging from migration to security issues, digitisation, clear understanding that there is a challenge around resource scarcity, including energy, and the link to fighting climate change, as well as a strong will to implement the sustainable development goals (SDGs) and, finally, continuing to make the EU a stronger global actor in a world that has changed considerably since 2013 when the programme had been adopted (Imrie, 2017, p. 2).

3.3. What is the size and structure of your programme in terms of budget, applications and projects?

Budget, e.g., how much money is allocated?

The overall budget for the period 2014-2020 is EUR 2.965,7 million (EU Commission. Interim Evaluation of Horizon 2020, 2017, pp 886-899). **In 2014-2015,** EUR 725.83 million have been allocated for SC5-actions, in 2016-17 EUR 760 million were allocated. As of 1st January 2017, according to the Interim Report, EUR 1,117.3 million have been allocated to selected projects in the following lines of activities:

- Fighting and adapting to climate change: 18.5%
- Protecting the environment, sustainably managing natural resources, water, biodiversity and ecosystems: 27.8%
- Ensuring sustainable supply of raw materials: 16.4%
- Transition towards a green economy and society through eco-innovation: 24%
- Global environmental observation and information systems: 10.4%
- Cultural heritage: 2.9%

How many proposals are submitted, how many projects are funded?

As of January 2017, 1,755 proposals (excluding SME-1 and -2 instruments) were submitted of which 221 projects have been selected; 195 were ongoing and 22 under contract preparation. Looking at the success rate, the average chance of getting funded has been 12.6 %. While the success rate of European Research Area Networks (ERA-NET) Cofund proposals (all nine were successful; 100%) and of Coordination and Support Action (CSA) proposals had been rather high (45 out of 179 had been selected; 25.1%), the success rates especially for Innovation Action and Research and Innovation Action lies well below the average: Out of 679 IA-Proposals only 57 projects were selected (8.5%). The RIA success rate at least reached nearly 10 % (749 proposals handed in and 73 projects selected; 9.7%). The SME-instruments had the worst success rate, while at the same time having the highest amount of proposals handed in (SME-1: 2168/160; 7.4% and SME-2: 875/37; 4.2%). Taken these numbers, the special character of ERA-NET Cofund actions have to be considered as well as the high number of newcomers in the SME-field.

Given the rather low success-rate for IA- and RIA-proposals, up to 60% of the funded projects belong to these instruments: RIAs (33%), IA (25.8%). 20.4% of all projects belong to the CSA instrument and 16.7% to SME-2. Although the ERA-NET Cofund projects make only 4.1% of all projects, the average contribution of the EU for this instrument per project is EUR 9.69 million. The average contribution for both RIA and IA is about EUR 6.78 million respective EUR 6.72 million (Interim Report, Annex 2, p. 888).

Especially WP16-17 includes many more IAs, mainly in the areas like Nature-based solutions or the Circular Economy, so that this area was expanding.

What are the characteristics of the beneficiaries (where do they come from, mainly research, industry, which countries, etc., main stakeholders)?

The highest percentage of total participants can be found among private for-profit entities (33.9%) – many are SMEs –, followed by research organisations (25.5 %) and higher or secondary education institutions (20.3%). Public bodies hold 12.5% of total participants while "*Others*" (including NGOs) make up 7.8% of the total (Interim Report, Annex 2, pp 891-93).

The number of newcomers is significant: 29.8% of individual beneficiaries applied for grants for the first time, especially from the private sector. In FP7-Environment, industry participation was about 19.4%. This number has significantly increased in H2020, as has the percentage of "*Others*" (only 3% in FP7). Taken these numbers, one could deduct that H2020 is more open to new and diverse participants. The main beneficiaries of H2020-SC5 (TOP 30) however, can still be found in academia (research organisations and universities), with a particular group of research institutes (like the German Deutsches Zentrum für Luft- und Raumfahrt e. V. or Fraunhofer Gesellschaft) and universities (like KU Leuven or TU Delft) to be major recipients. Compared to other participants, "*the vast majority of universities and research centres involved in H2020-SC5 were already experienced with FP7*" (Interim Report, Annex 2, 894). There are no companies among the TOP 30 beneficiaries. Their main activity sectors are: professional, scientific and technical activities/engineering activities (42.8%), followed by "*Manufacturing*" (21.5%) and "*ICT*" (10%).

Geographical distribution of beneficiaries, reference: EC contributions

Most EU-funding is allocated to EU Member States (93.2%) and within the EU goes mainly to EU-15 countries (87.4% of total EC contributions). EU-13 countries receive only 5.7%. This seems rather low, however this figure is higher than the EU-13's part of the EU's Gross Domestic Expenditure in R&D (Interim Report, Annex 2, p. 897). Associated countries receive 5.1% and Third countries 1.7% of EU-funding (Interim Report, Annex 2, p. 894ff). Major beneficiaries are Spain (13.1%), Germany (12.7%), UK (12.3%), Italy (9.1%) and France (7.1%). These countries also participate to a substantial part in the projects (Spain (11.8%), Germany (10.2%), Italy (9.1%), UK (9.6%), France (7.0%)), while beneficiaries from EU-13 countries represent 9.4% of the total participants.

RRI-relevance in figures

As far as RRI is concerned, 22.5 % of SC5-projects are flagged as RRI-relevant, while the average in all programme lines of H2020 is only 11% (according to Copernicus Reference Data Access (CORDA) as of 1st January 2017, taken the data available (i.e. not missing). As a cross-cutting issue, EUR 2.7 billion (equivalent to 13.95% of the total H2020 budget) has so far been allocated to RRI-relevant projects.103 *"Excluding ad hoc calls and joint undertakings, more than two-thirds of the RRI-flagged EC contribution goes to MSCA (30.4%), SC1 – Health (14.8%), Industrial Leadership – LEIT (13.7%), and SC5 – Climate (12.4%)*" (Annex I, p. 247; D1.3, p. 22 und 23). Accordingly, SC5 is quite well placed as far as RRI-relevance is concerned.

103 EUR 19,361,213,441 EU contribution (eCorda data extraction 19/01/2017) are allocated to Horizon 2020 projects and 784 projects have an RRI flag (eCorda data extraction 19/01/2017), see: Interim Evaluation 2017, Annex 1, p. 247.

4. Current situation of RRI in the programme

4.1. RRI in brief

The Programme Line is very close to genuine societal challenges with relevance to attitudes, concerns and lifestyles of citizens. RRI provides the approach, methods and tools to conduct research and innovation in a way giving credit to these societal needs in a constructive way contributing in SC5 to the overarching H2020 principles and objectives with societal participation and thus support.

In SC5 work programmes, RRI is named explicitly since 2016/2017 and reference is given to certain RRI-aspects in some calls and topics. However, the concentration of RRI-relevance in certain calls is remarkable, while others lack the mentioning of RRI-aspects altogether. Thus, while over 22% of SC5-projects are flagged RRI-relevant (H2020 average is 11%) and the fourth highest budget for RRI within H2020 is spent for SC5-projects, it becomes obvious that RRI is rather connected to 'RRI-projects' with specific contents, participants, practices as well as understanding of excellence and innovation – than integrated in a common research and innovation strategy.

4.2. Desktop findings

4.2.1. Role of RRI on

Policy document level

- Impact Assessment Report 2011
- Council Decision on H2020, 2013
- The Role of Science, Technology and Innovation Policies to Foster the Implementation of the Sustainable Development Goals (SDGs), Report of Experts 2015
- Advisory Group Recommendations – Programming period 2018-2020, 2016
- Consultations of Stakeholders, 2016, and Synthesis of results of the 2016 stakeholder consultation, 2016

No	**-**
Yes: some awareness	**Keys:** RRI is explicitly mentioned in some documents, gender, governance, engagement is there, but rarely mentioned **O's:** openness is an issue esp. in the expert group recommendations **Implicit:** many hints to the idea of RRI and procedures, e.g. against a technological fix, in favour of a strong participatory approach + co-design, need of a change of mindset and behaviour along the lines of the SDGs and COP21
Explanation: In the Assessment Report of 2011 RRI was not yet approved as a concept to be implemented in the funding scheme. "*Science and Innovation*" were considered "*key factors that will help Europe to move towards smart, sustainable, inclusive growth, and along the way to tackle its pressing societal challenges*" (AR, p. 6). Society seemed rather to be addressed than included in this process. There were, however, few parts hinting to inclusion (p. 9) and responsiveness (p. 43), as:	

"*Of course it should be understood that a model that is at once sustainable, inclusive and smart will not depend solely on S&T but also on governance and on the involvement of the citizens who will make up our society – and shape it. A shift towards "the demand side" together with users' (and more broadly citizens') involvement is not only a prerequisite for more robust and flourishing technologies; it is also a prerequisite for more robust and flourishing societies*" (p.9).
The council decision on Horizon 2020 of December 3, 2013 established Responsible Research and Innovation as (1.) a cross-cutting issue including "*public confidence in science and innovation reinforced by activities of Horizon 2020 favouring the informed engagement of and a dialogue with citizens and civil society in research and innovation*" (p. 976) and (2.) as integral part of Science with and for Society (p.1031f).

Policy on Climate Action, Environment, Resource Efficiency and Raw Materials is mainly decided on in other DGs, such as DG Climate, DG Environment, DG Growth. R&I funding strategy has been guided by overarching EU strategy papers, by a political global setting as well as resulting international agreements (see 3.2). How this policy and guidelines/principles were integrated into research funding strategy was the task of DG RTD. The directorate integrated numerous stakeholders in this process. Following the explanation of DG RTD I.1 Strategy expert Alison Imrie to the Advisory Board, the strategic programming process towards the Work Programmes included numerous elements and interactions leading finally from strategy to the formulation of calls, timeframes and budgets in the WPs. Some named here are (Advisory Board Minutes 3027, p. 2):

- Advisory Process and Advisory Board Reports 2014 and 2016
- Specific Expert reports (esp. 2015 on fostering the Implementation of the Sustainable Development Goals; Roadmap for Climate Action; Systemic Approach to Eco-innovation to achieve a low-carbon, circular Economy; Agenda for nature-based solutions and re-naturing cities)
- Public Consultations (esp. 2016)
- Programme Committee (PC) interactions (representation of Member states and Associated Countries)
- Analysis of previous actions as well as internal deliberations (Directorates) on synergies between different societal challenges

All the above-mentioned policies, principles and new political agreements as well as stakes introduced to the process influenced what the funding strategy of the programme line SC5 was finally about.

Here, we would like to concentrate on one or two documents of the named interactions:

Expert Group Report "*The Role of Science, Technology and Innovation Policies to Foster the Implementation of the Sustainable Development Goals (SDGs)*", 2015.

In 2015, the DG RTD, Directorate I Climate Action and Resource Efficiency Unit I.1 Strategy established an independent Expert Group on "*Follow-up to Rio+20, notably the Sustainable*

Development Goals (SDGs) to provide advice on the role of science, technology and innovation for implementing the new sustainable development agenda ("2030 Agenda")." (EG Report 2015, p. 5)[104] The Report attributes science, technology and innovation the role of a key tool for moving the world onto a sustainable path. Although it does not mention RRI explicitly, the concept can be found in a specific understanding and practice deduced from the principles and paradigms of the Agenda 2030: based on the principles of universality and integration, environmental, social and economic dimensions are no longer separate pillars but intertwined; related to the new cooperative paradigm, the transition towards a sustainable path of development requires time and the mobilisation of all citizens, stakeholders, business and policy makers. These principles and paradigms, integration and participation are an integral part of RRI. Envisioning the EU a world champion in sustainable development the authors attribute certain qualities to R&T policies: "*Technology alone will not fix (..) [present and future challenges]: changes in mindsets and behaviour is also vital. And although technological progress is a key part of the solution, it can also bring new challenges and risks*" (EG Report, p. 16) The authors further refer to the objective of using analytical and scientific capacities to anticipate future risks and challenges, to the objective of making "*decisions on evidence (…) and comprehensive impact assessment tools, incorporating all dimensions of sustainable development for domestic and external aspects of its policies.*" Europe shall share its experience and knowledge with other parts of the world, developing and adapting technologies to meet their needs, "*Taking into account economic, social and cultural specificities, and engaging all stakeholders in this process.*" (EG Report, p. 16) These objectives are substantial to RRI keys, O's and practices, even if not named explicitly. Thus, following the reasoning of the Expert Group aligning R&I policy with the 2030 Agenda and the SDGs means fostering a vision of R&I funding that shares the values and practices of RRI.

Advisory Group Recommendations 2016:

The report answers to five specific questions given by the European Commission of which one relates directly to horizontal aspects, such as social sciences and humanities, responsible research and innovation, gender aspects, and climate and sustainable development. The Advisory Group makes clear that it "*promotes a strong participatory approach and co-design towards R&I for all areas, engaging a broad range of societal actors, which is in line with the guidelines for Responsible Research and Innovation (RRI).*" (AG Recommendations 2016, p. 11) Apart from explicitly mentioning RRI the idea of social impact is very present. This is due to the importance the Advisory Group gives not only to the aim of the Paris Agreement to hold the global temperature increase but also to the SDGs "*which present a set of 17 goals for a new sustainable development agenda, balancing the three dimensions of sustainable development: the economic, social and environmental*" (AG Recommendations 2016, p. 6). Science and Innovation actions under H2020 must directly support the implementation of these two agreements. Accordingly, The Advisory Group stresses the economic, environmental and social outcome of its five strategic priorities (1. Climate Action after COP21; 2. Circular Economy; 3. Innovative cities and rural areas; 4. The water-food-and-energy nexus and 5. Enabling systemic transformation). It is not surprising,

104 Members of the Expert Group: Enrico Giovannini, Ingeborg Niestroy, Mans Nilsson, Françoise Roure and Miachael Spanos.

that transformation and scale-up is envisioned via methods of co-design for R&I, tools that enable systemic transformation and addresses barriers, integrates governance, engagement strategies and tools for holistic, integrated transformations and finally mechanisms to scale up innovation and building financial incentives to scale up market transformation towards the low carbon economy. (AG Recommendations, 2016, p. 11) These ideas are integrated in the recommendations to each strategic priority.

Synthesis of the results of the 2016 stakeholder consultation for Horizon 2020 societal Challenge 5, 2016

The synthesis followed the consultation of stakeholders on potential priorities for Research and Innovation related to the 2018-2020 Work Programme of H2020 SC5.105 The stakeholders received the same five questions as the Advisory Group related to the challenges in SC5, to the output/impact foreseen, to the gaps and potential game changers, to the integration of horizontal aspects such as RRI and to the emerging priorities of SC5. They were made familiar to the programming process and to the stakeholders and analysis (e.g. the interim evaluation of H2020 due to be published in summer 2017) considered. The consultation document had several links integrated, directing the reader to the Council Decision on H2020, 2013, and to the "*Strategic Foresight: Towards the 3rd Strategic Programme of Horizon 2020*" of 2016. Though not focused on SC5 this Foresight is meant as a key part of the reflection phase where the aim is to open the agenda widely and to imagine the future, often in radically different ways, and then to reflect on the implications for programming. (Introduction by Robert-Jan Smits Director-General DG RTD to the Strategic Foresight, p.4).

The synthesis of the results makes the data transparent: over 200 answers were received, over 60% from organisations/stakeholder groups, over 30% from individuals; participation from University/Academia and Research Centres contributed up to half of the answers, while NGOs/CSOs only contributed 3.8%. Given that EC project coordinators, NCPs, Programme Committee delegates and other traditional stakeholders were main contacts of distribution, this reflects the information on low NGO/CSO-participation in H2020 projects – and/or the low awareness of having a stake in R&I funding policy. (Interim Evaluation, 2017, Annex 1, p. 247).)

Not being a representative survey of stakeholders' opinions, the consultation invited stakeholders to respond and it was the respondents' own decision to contribute or not. Accordingly, different sources of bias are possible in the feedback given, e.g. from fund recipients, lobbyists, R&I communities with more capacity than others for mobilizing response. (Consultation 2016, p. 4)

The synthesis does not mention RRI – although part of question 4 – being a major concern, with the exception of governance, none of the keys and none of the process dimensions is considered. There was one reference to assessing the impact of economic activities in different sectors (ports, land and sea transport, extraction of mineral resources and hydrocarbons) on the environment

105 Consultation of Stakeholders, February 2016. This was the third consultation during H2020; the first two consultations were conducted in preparation to Work Programme 2016-2017 (Synthesis, p. 2).

and on societies as a knowledge gap highlighted in the context of Arctic/Antarctic research. Social aspects considered included the understanding of public acceptance and the need to raise awareness, involve citizens linked to the collaboration with social sciences to understand the behaviour of different actors and to facilitate long-term thinking for a sustainable raw material supply. These aspects refer indirectly to public engagement and might be interpreted along the lines of a request for anticipatory, reflexive and inclusive elements in project design. However, the synthesis is not explicit on this.

Programming Committee interactions were not available to us. We only found summary minutes to the meetings, which were rather general.106 No information on RRI, O's or implicit relevance was given in these documents.

Scoping level

- Scoping Paper for Work Programme 2016-2017 (2015)
- Scoping Paper for Work Programme 2018-2020 (2017)

No	**-**
Yes: some awareness	**Keys:** RRI is not mentioned as an objective/a vision; gender and ethics are explicitly named **O's:** increasing awareness, openness and transparency is mentioned twice as much in 2017 than in 2015 scoping papers **Implicit:** four dimensions are referred to when strategy is translated into future calls: multi-stakeholder involvement, engagement of civil society, bottom-up approaches**;** reference to 'living laboratories' for the co-design, deployment, testing, replication and scaling-up; combining all types of innovation, including social innovation; multi-level platforms; enabling full, open and unrestricted access; fostering inclusive, innovative and reflective societies.

Explanation:
In the scoping paper 2016-17 there is a substantial change in the wording of the SC5 research agenda. RRI now seems intrinsic to R&I funding in 2016-2017: "*A systemic approach (…) requires all forms of innovation, including not only new technologies, but also business models, financing options, governance structures, social innovation, and new modes of production and consumption. A trans-disciplinary approach, with multi-stakeholder participation, is therefore an essential characteristic of this approach*" (SP-2016/17, p. 2). The systemic approach itself presents research and innovation as a participatory undertaking based on a definition of innovation explicitly not restricted to technology.

The six keys and four dimensions are more explicitly named in the part of the document when strategy is translated into future calls:

- Industry 2020 in the Circular Economy: To ensure a systemic approach, strong multi-stakeholder involvement, engagement of civil society – including with bottom-up approaches – and the active contribution of social sciences and humanities will be essential (p.6).

106 e.g. meeting of 6th October 2017.

- Smart Cities and Communities – with Nature-based Solutions: Actions funded by this Societal Challenge will launch large scale demonstration projects in cities, engaging all relevant stakeholders, as ‚living laboratories' for the co-design, deployment, testing, replication and scaling up of innovative, systemic and yet locally attuned nature-based solutions. They will thus provide evidence for economically, socially and environmentally viable alternatives to tackle simultaneously various challenges cities are facing (p. 7). These projects would combine all types of innovation, including social innovation – such as new governance and business models – induce new market opportunities and meaningful jobs, and help empower citizens to tackle urban challenges.
- Nature-based solutions for resilience: Multi-stakeholder and multi-level (local, regional, national and EU) platforms and partnerships will also be set up, collaborating – where relevant – with strategic partners from emerging/developing countries (open science).
- Earth observation: make available an operational information system, enabling sharing, discovery and full, open and unrestricted access to validated Earth observation datasets (p. 9) (open access).
- Cultural heritage: fostering inclusive, innovative and reflective societies (e.g. Europe in a changing world).

RRI is also not explicitly named in the Scoping Paper for 2018-2020. However, implicit relevance comes from the systemic approach, as expanded on already in the scoping paper for the previous two years.
Keyword research showed that in the Scoping Paper for 2018-2020, the keys "gender" and "ethics" are included; in general, there is no significant increase in the usage of RRI-keys-related terms from 2016-17 to 2018-20. In 2018-20, there is a significant increase in the usage of the 3 O's. RRI-related terms of the "four dimensions" are being mentioned, especially in the context of diversity and inclusion; however, they are less frequent in 2018-20 than in 2016-17 (no progress in time), only openness and Transparency doubles (from 3 to 7), then, for 2018-2020, often in the context of the three O's.

Work programme level and calls

Work Programmes 2014-2015, 2016-2017, 2018-2020

No	**-**
Yes: rather high awareness	**Keys:** RRI included as an objective/ a vision + closely linked to a systemic approach; ethics and gender are highlighted in the introduction, public engagement and governance are major issues in some calls/topics; the number of gender aspects mentioned in the WPs augments considerable from the second to the third work programme (5 to 17). **O's:** with the pilot on open research data, the O's receive much attention **Implicit:** openness and transparency, responsiveness and adaptive, diversity and inclusion are included in some topics, anticipation and reflexivity are indirectly included (see 4.2.3.)
Explanation: In the SC5 Work Programme 2014-2015, RRI was not yet mentioned as a guiding concept but its fundamental aspects appeared in some calls and their specific topics to address the challenge. In the call "*Waste - A Resource to Recycle, Reuse and Recover Raw Materials – Towards a near-zero*	

waste society", for example, "*a systemic approach to innovative waste prevention and management*" would benefit from "*the participation of citizens in co-developing and co-testing new solutions, particularly in the urban areas, a field with great potential for public sector innovation*" (H2020-WASTE-2014/2015, WP-14/15, p. 6). The scope of the topic "*Moving towards a circular economy through industrial symbiosis*" (Waste-1-2014) gives insights into the understanding of innovation beyond a technological fix and closely related to RRI: "*Opportunities for social innovation, encouraging more sustainable consumption behaviour and lifestyle change, and involving civil society, should be considered, with appropriate attention to the gender dimension and to the barriers to raising awareness of eco-innovative solutions and their market, household and community penetration*" (WP-14/15, p. 9). Indeed calls related to research with a special interest in the change of lifestyles or actions with a focus on coordination or information transfer mention participatory and proactive social engagement of citizens and education as well as gender balance as vital issues to approach the topic (e.g. WP-14/15, p.13, WATER-4-2014/2015, WP-14/15, p. 32, SC5-5-2014/2015, WP-14/15, p. 45, SC5-14-2014, WP-14/15, p. 60). In some calls, the relevance given to these aspects is more implicitly mentioned, e.g. if "*international collaboration with scientists with insights into the local challenges and opportunities*" is required (SC5-3-2014, WP-14/15, p. 43). This might imply a full-fledged multi-stakeholder process, as in the GREEN-WIN project answering to this call, but it might also be answered with proposals implying a much less co-productive character.

A speciality of SC5 seems to be the exploration of the concept of citizen observatories, closely related to public engagement and the integration of alternative knowledge in research processes (SC5-17-2015). Given this focus, the topic singles out within the action "*Developing comprehensive and sustained global environmental observation and information systems*" of the call "*Growing a Low Carbon, Resource Efficient Economy with a Sustainable Supply of Raw Materials*" (H2020-SC5-2014/2015). The call, in line with the overall focus on investing in the innovation for a green economy, refers to policy-makers, businesses and society at large mainly in the position of taking up research and innovation results. An active role of citizens *"to engage in the development of systems for effective transfer of environmental knowledge for the benefit of scientists, policy makers, business and society*" (WP-14/15, p. 39), mentioned in the introduction to the call, is only realized in the specific citizen observatory topic "*Demonstrating the concept of ‚citizen Observatories'*" which shall involve and foster "*new partnerships between the private sector, public bodies, NGOs and citizens*" (SC5-17-2015, WP-14-15, p. 63ff). As far as global environmental observation and information systems are concerned, the main key considered is actually open access related to the Global Earth Observation System of Systems (GEOSS) (e.g. SC5-16-2014, WP-14/15, p. 61).

There is a major change in the character of the Work Programmes starting with the one for 2016-17. The definition and spirit of the systemic approach mentioned in the scoping paper is transferred to the Work programme 2016-17. This is most important, as the grand introduction to the Working Programme shows the direction towards a recognition of innovation not only technical but also social, and it explicitly mentions co-productive processes including society: "Systemic innovation is understood as innovation that aims at responding to a societal challenge by *obtaining a system-wide transformation through affecting the system's economic, social and environmental dimensions as well as their interconnections. This implies a trans-disciplinary perspective that integrates technology, business models and economic organisation, finance, governance and regulation as well as skills and social innovation. Systemic innovation therefore calls for the adoption of a challenge-driven, solutions-oriented research and innovation strategy that crosses disciplinary boundaries and involves co-creation of knowledge and co-delivery of*

outcomes with economic, industrial and research actors, public authorities and/or civil society" (WP-16/17, p. 5).

Even more, this systemic approach is explicitly and – as on the same first page of the introduction – prominently connected to RRI: "*This systemic approach is in line with Horizon 2020's Responsible Research and Innovation (RRI) cross-cutting objective, engaging society, integrating the gender and ethical dimensions and ensuring access to research outcomes*" (WP-16/17, p. 5). As in the Scoping Paper, the six keys are numerously represented. Ethics (see also part 4.2.2) is also well positioned, following the introduction of RRI: "*The ethical dimension of the activities, including relevant socioeconomic implications, should be taken into account, such as personal data protection and privacy, protection of participants and researchers, ensuring informed consent, dual use and potential misuse of the research results, fair benefit sharing when developing countries are involved, animal welfare, etc*" (WP-16/17, p.6) In the Work Programme 2018-2020 the key "gender" was highlighted in a similar way, which will also be discussed in part 4.2.2.

The main focus/priority is on open access, given that it is placed in the introduction of the call "*Greening the Economy*", to which all actions and topics of the Work Programme belong. This implied (1.) that "*all activities funded under this work programme part should as far as possible use data resulting from or made available through different initiatives of the European Commission*" (WP-16/17, p. 8). GEOSS (Global Earth Observation System of Systems), Copernicus (the European Earth Observation Programme), ESA (the European Space Agency) and other sources of data and existing infrastructures are named. This further implied that projects under SC5 participate in the Pilot on Open Research Data "*which aims to improve and maximise access to and re-use of research data generated by projects.*" Only few topics of SC5 were excluded to this novelty in Horizon 2020 (WP-16/17, p. 8). This rather strict novelty – as irritating as it might be for some applicants especially from industry or other private institutions – loses its teeth by adding that all other calls (next to those officially exempted) may participate in the Open Research Data Pilot on a voluntary basis. Demanding open access as a must-have in European R&I funding is obviously still to be tested and to be finally decided on.

Apart from open access, ethics receives main attention in the Work Programme 2016-2018, mentioned in the introduction right after the reference to RRI (see: 4.2.2.). Two years later, gender is positioned prominently in the following work programme, while it is mentioned three times more often than two years before (from 5 to 17 times). Public engagement, next to governance, receives the main attention on the level of topics. Long-term sustainable data platforms are envisioned to be realized through large-scale research and innovation demonstration projects, not only to secure open access but also "*effective communication, public consultation, exchange of practices and sharing of experiences and a continuously building up of the 'knowledge portfolio' in the longer term (i.e. following project completion)*" (SC5-8-2017, WP-16/17, p. 30). Another topic within the action "*Nature-based solutions for territorial resilience*" focuses on a multi-stakeholder dialogue forum to promote innovation with nature to address societal challenges (SC5-10-2016) and to raise awareness "*among stakeholders, decision and policy makers, practitioners and public about the multiple benefits, cost-effectiveness and economic viability of nature-based solutions to address societal challenges*" (WP-16/17, p.34). Accordingly, in Innovation Actions, Research and Innovation Actions as well as in Coordination and Support Action elements of RRI are incorporated to address the challenge. These are also integrated in socially highly sensitive research and innovation processes as in the topic on Raw materials Innovation actions (SC5-14-2016-17): "*Participation of civil society from the start of exploration until after-mining activities in a process of co-design, co-development and co-implementation is strongly encouraged*" (WP-16/17, p. 45).

The citizen observatory topic is integrated in the call's action concerning "*Earth Observation*", now going further in calling to coordinate the initiatives by expecting them – amongst other tasks – to contribute to the integration and uptake of citizens' information in GEOSS (SC5-19-2017, WP-16/17, p. 71). Taking that EUR 1 million is envisaged to this specific coordination challenge to be addressed appropriately, other earth observation calls with much more funding available do not have any inclusive elements, however, containing a strong link to the key and overarching priority of open access.

The Work Programme 2018-20 follows the lines of the previous Programme expanding on the overarching systemic approach to innovation, integrating social innovation and the "*co-creation of knowledge and co-delivery of outcomes with economic, industrial and research actors, public authorities and/or civil society*" (WP-18/20, p.6) as its main aspects. Again, "*activities in this Work Programme should be in line with Responsible Research and Innovation, a cross-cutting issue that engages society (…)*" (WP-18/20, p. 9). Looking at the orientation of the two calls – Building a low-carbon, climate resilient future: climate action in support of the Paris Agreement, and Greening the economy in line with the Sustainable Development Goals (SDGs) – the two international focal points do not only integrate the content of these Agreements but also their spirit – how they came into being with public support and participation – into European science funding. Indeed, looking at the reference to RRI-keys, these have again augmented significantly from 2016-17 to the new Working Programme, especially governance and public participation have been given supplementary attention.

Project level

Community Research and Development Information Service (CORDIS)- and website-information on several projects of SC5 (e.g.: New Mining Concept for Extracting Metals from Deep Ore Deposits using Biotechnology (BioMOre); Green growth and win-win strategies for sustainable climate action (GREEN-WIN); Citizen Led Air pollution Reduction in Cities (CLAiR-CITY); A Citizen Observatory and Innovation Marketplace for Land Use and Land Cover Monitoring (LandSense); Environmental knowledge discovery of human sensed data (Ground Truth 2.0); An Ecosystem of Citizen Observatories for Environmental Monitoring (WeObserve); Towards a World Forum on Raw Materials (FORAM); Connecting Science with Society (EU-PolarNet); Moving towards Life Cycle Thinking by integrating Advanced Waste Management Systems (WASTE4think); An ERA-Net in biodiversity research (BiodivERsA); National Contact Points for Climate action, Raw materials, Environment and Resource Efficiency (NCPs CaRE); and others)

No	**-**
Yes: some awareness	**Keys:** very heterogeneous projects from much awareness to limited awareness; governance and public engagement seem to be of most relevance **O's**: often seen as a prerequisite for co-operation both in projects related to public engagement and governance **Implicit:** multi-stakeholder and co-creation processes receive attention and are performed on large or limited scales
Explanation: Projects on SC5 are very diverse. There are projects such as BioMOre, where RRI is not really traceable, or GREEN-WIN, where there is a high awareness of RRI with certain aspects, such as diversity and inclusion of multi-stakeholder knowledge. Other projects, LandSense or WeObserve,	

for example, became RRI-literate with vital partners being involved in Science with and for Society (SwafS) and SC5 projects such as the European Citizen Science Association, itself linked to the Leibniz research network citizen science and the citizen science international community. There are other projects where knowledge-integration e.g. from civil society organisations or movements is more traditionally rooted in a research practice than genuinely linked to RRI. These elements might be integrated in the ERA-NET Cofund project BiodivERsA3, with objectives, such as "*Develop a strategic, multi-annual vision of the network's priorities, based on ambitious mapping and foresight activities developed in collaboration with key initiatives in the field*" or "*Promote effective science-policy and science-society (including science-business) dialogue during the whole research process*" absolutely in tune with the RRI-concept (Source: CORDIS).
There seem to be projects, which have a rather high RRI-relevance according to bibliometric research conducted in the NewHoRRIzon project (see p. 4), but are not aware of the concept itself, thus implementing de-facto RRI practices. One project in the waste management field, for example, is particularly focusing on citizen participation in order to build more sustainable, eco-friendly cities and on the subsumed objectives to reduce the generation of waste thanks to prevention campaigns as well as cooperative activities and to promote behavioural changes by awareness campaigns and new educational tools (website of the project and conversation with project lead). The overarching concept of RRI seems not to be familiar and is not referred to, obviously not relevant, neither in the application process nor for project implementation.

Proposal Template level

Proposal Templates for RIA und IA

No	**-**
Yes: limited awareness	Keys: open access, gender and ethics are referred to O's: see above Implicit: use of stakeholder knowledge and impact for society might be an issue "*where relevant*" (e.g. named in the topic)

Explanation:
The Open Research Data Pilot in H2020 makes open access to the most frequently mentioned key (also part of the three O's). Ethics – although mentioned prominently in the Work Programme 2016-2017 is more or less a tick-box exercise – if ticking requires, more explanations on certain issues are requested in the final part of the Proposal Template.
The proposal template is focused on the topic level of the work programme. We would interpret this in a way that if RRI (six keys or four dimensions) is not explicitly mentioned on this level, the keys and dimensions seem not really relevant to the proposal.
The gender-aspect is integrated: "*Where relevant, describe how the gender dimension, i.e. sex and/or gender analysis is taken into account in the project's content*".
Expected impacts might, however be considered beyond the topic level and the level of the Work Programme as the applicant is asked in an open question about "*any substantial impact not mentioned in the Work programme*" (...) or "*bring other important benefits for society*" (p. 2)

The proposal template often mentions "*where relevant*". Who decides what is relevant? This refers to the information in the proposal template to integrate e.g. stakeholder knowledge or the gender-aspect, as mentioned above, "*where relevant*"; Relevance is either defined by the topic (points) or by the applicant, choosing to integrate RRI on a voluntary basis (maybe extra points, nice to have).
Public/societal engagement is mentioned as part of communication activities. This does not, of

course, hinder this key being integrated in the research or innovation processes.

The template does not include questions on estimating the impact as far as a substantial contribution to sustainability and Climate action is concerned, given the target of H2020 that 60 % of the Budget have to feed into sustainable development and 35 % into climate action.

Evaluation level

Part H of the General Annexes of the General Work Programme; standard proposal evaluation forms; Grants Manual – Section on: Proposal submission and evaluation (from 2015, Version 1.4)

No	**-**
Yes limited awareness	Keys: in the self-evaluation not mentioned O's: - Implicit: use of stakeholder knowledge and impact for society might be an issue "*where relevant*" (e.g. named in the topic)
Explanation: The self-evaluation for RIA mirrors the aspects of excellence (multi-stakeholder-inclusion) and impact (societal benefits) of the proposal template. The six keys and four dimensions are not considered at all in the evaluation documents, gender equality is an exception. The standard proposal self-evaluation does not include questions on estimating the impact as far as a substantial contribution to sustainability and Climate action is concerned, given the target of H2020 that 60 % of the Budget have to feed into sustainable development and 35 % into climate action.	

4.2.2. General use of RRI

How is RRI used in the respective programme line?

RRI is traceable as a vision in the programme line. Since the Work Programme 2016-2017, RRI is mentioned as a "*cross-cutting objective, engaging society, integrating the gender and ethical dimensions and ensuring access to research outcomes*" (WP-16/17, p. 5). It is closely linked to the systemic approach which got special attention in the Work Programme 2016-2017 certainly inspired by discussions on the SDGs. The systemic approach refers to the importance of social innovation beyond technical innovation, thus giving a strong impetus to societal impact. Accordingly, RRI is reflected indirectly in the challenge addressed.

RRI is definitely more present than as a tick-box exercise, especially if not only mentioned in the general introduction or in the introduction to a call, but when mentioned in the scope of a topic. If this is the case, applicants directly have to respond to this requirement and explain how the consortium wants to support public engagement or how the gender dimension is reflected in their research. If RRI relevant aspects (keys or processes) are not explicitly integrated in the topic descriptions, it seems to be more or less left to the applying consortium to choose a RRI-relevant process or to leave it to be a minor issue (next to tick-box exercise). Interviews with different stakeholders (e.g. project partners, NCP) indicated that different project designs (with strong or less RRI-relevance) can succeed, thus showing that this has not been a criteria of *proposal* evaluation. However, a very positive *project* evaluation of a successful RRI-relevant process (e.g. a multi-

stakeholder process) might convince other applying consortia that integrating RRI is a good thing and may help to succeed in future proposals (Interview). Another interview demonstrated that RRI-aspects (such as multi-stakeholder workshops) can be integrated and delivered even if the process (four dimensions) itself would leave some opportunities to be improved (Interview). To guarantee high quality and standards when applying RRI-relevant methods would therefore need a place in the evaluation system (proposal and project).

How are keys, O's and other RRI relevant concepts used in the documents of the programme line?

The six keys are increasingly included in the Work Programmes. Reference to governance and public engagement, for example, are constantly increasing in number over time. In some calls and topics society is moving from the position of being considered the object of research to a subject of the R&I process – and thus fostering better embeddedness of R&I in society. Other keys are getting relevance to a certain point of time:

Highlighting specific keys: examples of Ethics and Gender

Ethics were not explicitly mentioned in the Work Programme 2014-2015, but as H2020 piloted on "*Open Research Data which aims to improve and maximise access to and re-use of research data generated by projects*", open access – even if still on a voluntary basis and excluding some topics – was introduced to all aspects of H2020 and SC5 (H2020-SC5-2016-2017, WP-16/17, p. 8). Thus, privacy received increased attention. Indeed, these aspects were duly considered following the introduction of RRI on page one of the Work Programme 2016-17: "*The ethical dimension of the activity, including relevant socioeconomic implications, should be taken into account, such as personal data protection and privacy, protection of participants and researchers, ensuring informed consent, dual use and potential misuse of the research results, fair benefit sharing when developing countries are involved, animal welfare, etc.*" (WP 2016-17, p. 6) Two years later, with the new privacy regulations coming into being, this reference was reduced to RRI as a cross-cutting issue that *"(…) promotes high ethical standards, ensures access to research outcomes and encourages formal and informal science education.*" (WP 2018-2020, p. 9). The ground was prepared to introduce the three O's, "*open science, open innovation and open to the world*", by Carlos Moedas into the Work Programme.

Gender equality took this prominent position in the Work Programme 2018-20: Due to a strong monitoring group on gender issues to DG STD (Interview) and reacting to the results of the Interim Evaluation that "*The gender dimension in R&I content carries a great potential to improve R&I quality and relevance to society*" and that "*the actors involved should acquire a better knowledge of what the gender dimension entails in the various fields of R&I and the monitoring system needs to be substantially improved*" (Interim Evaluation, 2017, p. 261), it was now stressed that the activities of the Work Programme should be in line with RRI, a cross-cutting issue that "*engages society, promotes gender equality including by integrating the gender dimension of research and innovation content (…)*"(WP 2018-2020, p. 9). The gender dimension of research was mentioned more than 15 times related to specific topics, much more than in the previous SC5 work programmes of H2020.

The three O's

The Work Programmes 2014-15 and 2016-17 use these terms "*open access*" and "*openness*" without calling them three O's (as not yet offered by Carlos Moedas), e.g.: referring both to open access as far as research results and data is concerned as well as "*openness to involving additional players/groups of players during the project, for instance relevant EIP operational groups*" (WP 2014-15, p. 19). The three O's rise awareness and improve differentiation between specific dimensions of

openness. This differentiation might get further attention in future funding schemes and work programmes.

4.2.3. RRI beyond the keys

Referring to RRI as a method or process does indeed include the four dimensions of RRI, referred to openness & transparency, anticipation & reflexivity, responsiveness & adaptive, diversity & inclusion according to RRI Tools. With the introduction of the three O's, these dimensions have shifted towards the notions of anticipation, reflexivity, inclusion and responsiveness (New HoRRIzon D6.1). Openness & transparency, responsiveness & adaptive as well as diversity & inclusion are well represented in the Work Programmes and integrated in some calls. Anticipation and reflexivity are categories not explicitly considered in the programme line, they are, however immanent e.g. in the topic of "*Biodiversity scenarios*" (SC5-32-2017), because such "*scenarios of biodiversity and ecosystem services have been a key component of forward-looking decision making*" and are intended to support the commission in doing so (WP-16/17, p. 37). They are also implicitly present, for example when controversial R&I projects are advised to take society in, e.g. taken the example of "*Raw materials Innovation actions*" (SC5-14-2016-17): "*Participation of civil society from the start of exploration until after-mining activities in a process of co-design, co-development and co-implementation is strongly encouraged*" (WP-16/17, p. 45). Conflict and negative perceptions of research and innovation processes are anticipated and a process of reflection together with civil society as mentioned – thus to be reflected on when applying – in the call. The example demonstrates that not directly mentioning anticipation and reflexivity is balanced by encouraging consortia to engage in a professionally conducted multi-stakeholder process or – another option often referred to by choosing an interdisciplinary approach with social sciences included that tend to integrate the reflection of underlying motivations, assumptions and commitments as drivers for R&I in their research process.

While references to co-creative practices and multi-stakeholder processes to embed R&I and science in society were rather patchy in the WP 2014-15, co-production and stakeholder-inclusion are intrinsic to the systemic approach of the work programmes 2016-17 and 2018-20 – and including the opinions of many stakeholders and experts (not really a multi-stakeholder process) was the general approach to the formulation of the work programmes. Being aware that transformations towards a circular economy cannot leave out those stakeholders most relevant to the processes – industry and SMEs, public bodies and citizens as well as civil society organisations –, many calls and topics, such as those focussing on urban development or urban ecosystems require applicants to actively involve "*public authorities, societal stakeholders and community-based partners such as city-makers, urban (fab-)labs, urban planners, (urban) designers, cultural & creative organisations, and start-ups in close collaboration with cities to find practical and durable solutions.*" (WP 2018-20, p. 33) This approach could be flanked by the need to "*establish long-term sustainable data platforms and to secure interoperability of relevant data infrastructures for effective communication, public consultation, and exchange of experience*". It could also be enriched by an "*interdisciplinary approach including the participation of applied natural scientists, social sciences and humanities disciplines*" (e.g.) to properly address the complex challenge (in this case of CE-SC5-03-2018: Demonstrating systemic urban development for circular and regenerative cities, p. 33f.). Co-creative practices imply public engagement or other stakeholders' involvement in research processes in order to foster ownership, for example to increase public acceptance of controversial research or innovation processes and results, most relevant for example when the extraction of raw materials is concerned (see example mentioned above, e.g. WP-18/20, p. 60f.).

4.2.4. Theoretical framework of RRI applied in the programme line

The programme line seems increasingly guided by a vision of societal embeddedness mentioned right in the grand introductions of Work Programme 2016-17 and Work Programme 2018-20 introducing the overarching systemic approach which in itself presents research and innovation as a participatory undertaking based on a definition of innovation explicitly not restricted to technology:

"*Systemic innovation is understood as innovation that aims at responding to a societal challenge by obtaining a system-wide transformation through affecting the system's economic, social and environmental dimensions as well as their interconnections. This implies a trans-disciplinary perspective that integrates technology, business models and economic organisation, finance, governance and regulation as well as skills and social innovation. Systemic innovation therefore calls for the adoption of a challenge-driven, solutions-oriented research and innovation strategy that crosses disciplinary boundaries and involves co-creation of knowledge and co-delivery of outcomes with economic, industrial and research actors, public authorities and/or civil society*" (WP-16/17, p. 5).

This systemic approach is closely linked with "*Horizon 2020's Responsible Research and Innovation (RRI) cross-cutting objective, engaging society, integrating the gender and ethical dimensions and ensuring access to research outcomes*" (WP-16/17, p. 5). Thus, the vision is quite explicit right from the beginning of the Work Programmes.

Accordingly, there are examples of "*economic and social efficiency*", for example in actions of the call "*Greening the Economy* " in 2016, such as introducing "*Nature-based solutions for territorial resilience*" with the need for "*locally adapted and systemic interventions*" being "*locally attuned, resource efficient, multi-purpose, multi-functional and multi-beneficial*" (WP-16/17, p. 28) or introducing "*Cultural heritage for sustainable growth*" with the focus "*to maximise the intrinsic economic, cultural and societal value of cultural heritage in promoting well-being, cultural diversity and social cohesion*" (WP-16/17, p. 73). Reference to the SDGs such as "*Make cities and human settlements inclusive, safe, resilient and sustainable*" support this outlook of the respective topic (e.g. SC5-21-2016/2017 Cultural heritage as a driver for sustainable growth, WP-16/17, p. 77).

Other actions of the same call might underline "*user friendliness*" or "*cost efficiency*". This is the case for topic under the "*Earth Observation*" action with the exception of the coordination of citizens' observatory initiatives and the challenge answered by "*novel in-situ observation systems*" delivering Earth Observation services, including monitoring variables, for policy makers, local users and citizens. (SC5-18-2017; SC5-19-2017; SC5-20-2016).

There are requests of down streaming interactions with society and reflexivity on social embeddedness through dialogue with societal actors integrated in selected calls, announcing that "*The success potential of the proposal will be assessed according to (…) the participatory, multi-stakeholder and trans-disciplinary processes (also securing citizens' engagement and ownership of regeneration plans)*" (SC5-21-2016-2017, WP-16/17, p. 75). And they are also traceable in the following Work Programme 2018-2020, not only in the vision (see above) but also in specific topics to the calls, e.g. the scope to "*provide science- and evidence-based guidelines and models to local authorities for carrying out sustainable reconstruction within a participatory and community–based context, while adopting new governance and finance models*" of the topic "*Resilience and sustainable reconstruction of historic areas to cope with climate change and hazard events*" (LC-CLA-04-2018, WP-18/20, p. 17). Other, only shortly named examples are the task to "*foster participatory engagement in urban ecological restoration actions*" (SC5-13-2018-2019, WP-18/20, p. 59) or

"*participatory approaches in re-designing and transforming public spaces to increase health and well-being in cities through innovative public-private-people partnerships (PPPPs)*" (SC5-14-2019, WP-18/20, p. 62).

There are traces of specific, implicit and explicit collectively held, institutionally stabilized and publicly performed visions of desirable futures. Two examples are taken from different Work Programmes to illustrate this: Implicitly visions are asked for in the "*biodiversity scenarios*" topic of WP-16/17, taking scenarios of biodiversity and ecosystem services as "*a key component of forward-looking decision making as they contribute to i) better understanding and synthesizing a broad range of observations, ii) informing decision makers about future impacts of global changes such as climate change, land use change, resource overuse, invasive alien species or pollution, iii) providing decision support by developing adaptive management strategies, and iv) evaluating the implications of alternative social-economic development pathways and policy options.*" (SC5-32-2017, WP-16/17, p. 37). The BiodivERsA3 project stands out in the ERA-NET Cofund instrument as especially RRI-relevant (research of the Leiden-team, see p. 4).

Visions are explicitly asked for by the already cited topic "*Visionary and integrated solutions to improve well-being and health in cities*" (SC5-14-2019). The scope of this topic is to deliver "*visionary and integrated solutions (e.g. therapy gardens, urban living rooms, creative streets, city farms) at the intersection of social, cultural, digital and nature-based innovation to increase citizens' health and well-being in cities. These solutions should address social, cultural, economic and environmental determinants of health and wellbeing and support urban communities in reducing their exposure to climate-related risks, pollution (including noise), environmental stress and social tensions, including the negative effects of gentrification*" (WP-18/20, p. 60). This call stands out among others much less involved in visioning processes. However, if projects would include a seriously-taken multi-stakeholder-process, as resulting from "*down streaming interaction with society*" or participatory actions, this actually should always involve a visioning-sequence to give orientation where a project consortium wants to head to. Some projects in Societal Challenge 5 do already invest in these multi-stakeholder processes (e.g. GREEN-WIN) but this might be rather exceptional.

4.2.5. Overall assessment of RRI in the programme line (based on desktop research)

There is some awareness (B) of RRI in the programme line: RRI as concept is (implicitly or explicitly) present in some documents, some RRI keys and O's are used and referred to in any document and there is some process of better social embeddedness through governance or engagement.

Although RRI is present as a vision and a concept in the Scoping Papers and Work Programmes since 2016, there are some aspects that make a better rating – of high awareness – not suitable to the present state of the programme line:

- RRI is present as a vision and a concept, but not present on all levels, just on some, thus restricting its potential
- Governance structures reflect social embeddedness, and advisory boards as well as external stakeholder- or public consultation processes are mentioned as influential sources of advice and orientation; however, it is difficult to assess their influence next to other influential forums or lobby groups.
- Visioning or reflexivity processes are integrated but not mainstreamed by a consequent integration of the four process dimensions.

- There seems to be a significant need for improvement on the evaluation level as well as on standards e.g. for multi-stakeholder-processes.

Category	Value	Description
B	Some awareness	• RRI as concept is(implicitly or explicitly) present in some documents; • Some RRI keys and O's are used and referred to in any document; • There is some process of better social embeddedness through governance or engagement

4.3. Interview findings

Fifteen Interviews were conducted with present and former representatives of DG RTD, EASME, the Advisory Board to SC5, funding organisations and NCPs, national and international networks and organisations of industry, communities or civil society as well as many researchers working on national or H2020 projects in the position of project coordinators or national partners. Given the diversity of interview partners, the limited knowledge of the concept and the lack of interaction between them (which would have revealed misunderstandings and differences much more clearly) it is difficult to speak about a "*shared understanding of RRI*" as a concept.

The knowledge of RRI varied from interview partners being familiar with the components of the concept (six keys, three O's and process dimensions) to interviewees being grateful for explaining the keys and dimensions in more detail at the beginning of the interview. With these explanations at hand, many could relate to the keys and the process dimensions and provided examples demonstrating their importance – and difficulties to apply – in the context of R&I processes and mainly H2020 projects they were involved in.

While part 4.3.1. is mainly referring to the six keys (as related to the EC definition of RRI), the research process dimensions (included in present RRI-definitions such as NewHoRRIzon D6.1) will be considered in 4.3.2.

4.3.1. Shared understanding of RRI

Open access, governance and public engagement seem to be key to many researchers and stakeholders interviewed. For some they were intertwined, for others they relate to the other keys, gender and ethics.

Open access was mentioned as crucial to those active in research projects including citizen scientists or in Coordination and Support Actions committed to establishing multi-stakeholder networks on a transnational platform. Looking at "*FORAM – towards a world forum on raw materials*", governance is of the most relevance, "*overall FORAM is actually asking the question about (..) global resource governance, can it be improved? So that is by far the most relevant area. Of course, if you then dive into the project itself, on the contents, when you talk about resource management or raw materials management in developing countries, then you have of course the*

word sustainability, and sustainability has to do with ethics, gender equality, public engagement" (Interview). Public engagement was key to both – as prerequisite for any citizen science project and vital to construct a multi-perspective dialogue with balanced representation in a governance process. This implies, however, that the participation of the public, represented either by citizens, or by civil society organisations, is indeed fostered and realized when organising research and governance processes. While engaged civil society representatives consider it as fundamental that all stakeholders are included in agenda setting processes, further efforts of awareness-rising and empowerment of citizens and CSOs are needed. This seems to have the support of the European Commission, pointing proudly to the citizen science observatory projects when public engagement in research projects is mentioned (Interviews) – although this is a niche both as a research area and in terms of funding. Citizen science projects seem to have a huge potential, e.g. for the development of action plans on environmental monitoring and reporting. According to the insights of one interview partner, this area seems to become increasingly important politically: "*All these projects that were developing technologies and approaches from citizen science have been a success because now we are in the next phase. (...) Now there is a huge interest to implement these approaches for policy, to create policy initiatives, legislation, etc. (…) In terms of RRI it is a way of involving citizens and it can solve many problems in lack of trust to science, to the authorities, increasing awareness of the citizens and also it is educative (…) you can train and educate young people when (…) they can collect data about 'Natura 2000' areas, for example. (…) This is really a recent success story in terms of Responsible Research and Innovation*" (Interview). Beyond, there are also voices in EASME mentioning the need, and encourage trainings on public engagement (and inclusion) in research projects on the Information Day organized regularly by EASME (Interview).

Regarding organizing multi-stakeholder processes as part of H2020 projects, there is the awareness that gender issues and power imbalances related to this dimension need special attention (Interview). One interview partner demonstrated with experience and expertise that an informed facilitation is vital to the success of these processes.

Another researcher in position of project lead touched on the problem of two keys being contradictory to each other when applied in practice and referred to the situation of open access contradicting ethical aspects: Research done at the interviewee's institution provides sensitive data which could be exploited by industry in a way not supported by the institute according to its ethical standards. Thus, it developed a code of conduct that gives orientation on the national level. On the international level the possibilities to adhere to the code of conduct are limited, given the standards of open access to research results. Even if the institute might not agree to open access (as granted under the pilot on open research data), it might be part of research done by other partners providing their results on an open access basis. Considerations on how to deal with this problem focus mainly on developing an internationally binding code of conduct. If such a code will be agreed upon and realized in a reasonable timeframe remains an open question.

EC-staff mentioned other ethical problems, e.g. how to deal with false reporting and fraud. However, this was left – in the interview – as another open question to reflect on.

Asked about mainstreaming of RRI, an EC-insider was rather sceptical: "*Mainstreaming now is (...) constantly mentioned and the problem is more in the implementation or in practice (…) every*

time in the last ten years we have seen that this or that will be mainstreamed - that means that it does not become a priority" (Interview).

4.3.2. Beyond RRI

There was a general understanding that a better social embeddedness of R&I and science was needed. This might be owed to the selection of interview partners having already demonstrated positive attitudes towards social embeddedness in one way or another: Only one interviewee with bonds to industry criticised for example the SC5 advisory board of being too pushy with "*unrealistic*" concepts and demands (Interview). Others familiar with advisory board activities would describe them as very constructive (Interview). Most interviews tend to reflect the positions of those in favour of co-productive strategies and multi-stakeholder processes – rather than positions of those hesitant to more social embeddedness of R&I.

What is the awareness of the need for a better social embeddedness of R&I and science?

The discussions on a better social embeddedness of R&I and science much focused on EC-funded projects and built on various project experiences from different perspectives. Most of the interview partners showed a strong awareness that SC5 is very close to genuine societal challenges, thus to the needs, hopes and expectations, as well as to the habits and lifestyles of people. Research areas such as "*Innovating cities for sustainability and resilience*" in the call for "*Greening the economy in line with the Sustainable Development Goals (SDGs)*" are only possible when including societal actors actively. In some research communities applying for SC5 grants responsiveness to these needs and expectations is obviously an agreed upon and experienced practice: "*the researchers (...) those people that are doing research in urban planning or in climate impact they are near to their end-users the citizens that are involved or affected by research interventions*" (Interview).

COP21 and the SDGs as an Opportunity:

It is assumed by some interview partners that the international political agreements, mainly the Paris Agreement and the Sustainable Development Goals (SDG) will inspire future SC5 research funding strategy as the EU has to respond to the spirit of these international agreements. Representatives of the EC see "*enormous opportunities for FP9 and for the last years of Horizon 2020 (...) because there are some international agreements, the SDGs, the COP 21 agenda, (...) where the European Commission played a very important role to negotiate them, they are really at the core of the European policy (...) the commission could really focus the priorities of R&I towards these international agreements*" (Interview). Especially the Work programme of 2018-2020, explicitly referring to these agreements calling for a systemic transformation and social impact – as indirect indicators for social embeddedness and the importance of RRI – seems to inspire this assumption.

Concerns about EC positions:

Given the widely welcomed orientation of SC5 along the SDGs and the Paris Agreement it was of irritation to some of the interview partners that there was no clear Commitment of the EC towards its own proclaimed objectives: This seemed of special concern as the strong commitment to the SDGs and the Paris Agreement which was incorporated in H2020 science funding since 2016 goes

in line with the overall objective promulgated by the EC that "*at least 35% of Horizon 2020's total budget is expected to address climate action, while at least 60% is expected to involve sustainable development*" (Participant Portal H2020 Online Manual). Looking at the proposal and evaluation level, however, there is no need to expand on how a project will actually contribute to this objective and how this contribution is evaluated. Interview partners identified a lack of political will to monitor efforts and to change work programmes because there were these objectives to reach. One interview partner argued that only after an audit, which was very critical, the directorate started to engage in this aspect. It is assumed that the DG RTD still does not know what the projects are delivering in terms of innovation, about the uptake in the market, the resource efficiency of these innovations, the reduction or not of emissions, which is fundamental information related to the given objectives.

There was also some concern about the emphasis on innovation since the last years of FP7 as a sole point of orientation. "*Innovation was the dogma, the line to take for everyone, and for many services within DG RTD Responsible Research and Innovation is very, very secondary.*" This perception included the concern that the "*innovation principle*" might repress the precautionary principle, which is in the Lisbon Treaty article 191 and is one of the pillars of the environmental policy in Europe.

Scepticism about RRI being rooted in the application and evaluation process:

However, looking for example at the calls (or work programmes) from an NCP-perspective, there is some scepticism about RRI being applied on the project level. NCPs independently from each other stated that RRI is no relevant issue for them (and their advice to applicants): "*I have to admit (…) that I am not pushing that much on having RRI proposals created because the matter is not taken up that seriously on SC5. You can have maybe some plus points if you do that nicely, if you integrate gender aspects, if you saw that you have an ethics by design project in place, but experience shows that you can easily have your proposal funded without considering any aspect of RRI*". If RRI-relevant components are demanded in the calls, such as co-creation or co-development, "*people try to interpret all these things with a minimum amount of effort*".

Therefore, a closer look at the positions taken towards the integration of RRI on the call, funding instruments and evaluation level of proposals and projects was a main part of the interviews.

What do interviewees think about the further need of social embeddedness? How should it be achieved?

Interview partners referred to good practice of social embeddedness of R&I in SC5 projects, for example describing successful co-creative processes providing space for stakeholder involvement (e.g. GREEN-WIN), integrating alternative knowledge through citizen observatories (e.g. Ground Truth 2.0/LandSense) or involving SMEs to produce marketable solutions for identified problems (e.g. GREEN-WIN and Ground Truth 2.0/LandSense). Being close to these or similar projects, interview partners were able to provide practical insights on difficulties and barriers to social embeddedness of R&I and science:

- Level of calls and topics: As mentioned above, some projects (e.g. in the field of citizen observatories) have become the showcase of EC representatives demonstrating successful civil society/citizen science inclusion (Interview). There are, however, huge research projects funded by the ERA-NET Cofund instrument (e.g. ERA-PLANET – the European Network for observing our changing planet, funded with EUR 11 million by H2020 out of a total budget of over EUR 50 million) which include major research institutes around Europe but lack civil society participation, even obvious partners such as citizens science networks or organizations altogether. The WeObserve-project is intended to "forge links with GEOSS and Copernicus to demonstrate how COs [Citizen Observatories] can complement the EU's Earth Observation monitoring framework" (cordis on WeObserve), funded from 2017 onwards for three years with EUR 1 million. **Integrating new approaches and perspectives in established research and partner networks would spread the word for RRI.**

- Level of funding instruments: It is acknowledged that especially Cooperation and Support Actions (CSA) support international networks including a wide range of stakeholders and providing spaces for experimentation and testing. Other funding instruments, however, such as the ERA-Net Cofund and the SME-Instrument (both about 7% of SC5 funding) are viewed much more critical for RRI generally having a very low priority (Interviews). In ERA-Net Cofund calls, a reference to RRI seems patchy and with little chance for implementation – as there is only partial funding by the EU – if neither pushed nor controlled by other funding partners. One interview partner with experience in DG RTD referred to BiodivERsA as an ERA-Net Cofund best practice example as it seems that both, funding institutions and funded project partners, care about RRI and multi-stakeholder inclusion. **Awareness rising by offering training units or standards set by the EU – such as the inclusion of RRI in the evaluation process would improve the situation, as argued from the perspective of project participants and NCPs.**

- Level of evaluation: It seems necessary to differentiate between proposal evaluation and project impact evaluation. A lack of RRI on the proposal evaluation level degrades RRI from a need-to-have to a nice-to-have. Not being rooted in the proposal evaluation process makes it difficult for NCPs to advise on its inclusion in the proposals, as convincing applicants about integrating RRI might not imply a substantially greater chance to succeed (Interview). Training of evaluators was questioned but the EASME team responsible for Evaluation processes stressed the fact that evaluators were chosen according to their expertise in the fields of the specific calls, including RRI-relevant aspects, if in line with the call's requirements (Interview). The description of a project evaluation where the integrated multi-stakeholder process was positively mentioned by the evaluators not only strengthened the approach internally but also convinced other project consortia to engage in a professionally lead and well-integrated multi-stakeholder process in subsequent proposals (Interview). **Standardized inclusion in the evaluation process would transform RRI from a nice-to-have into a need-to-have and would then require information and training for applicants and project consortia.** Indeed, evaluation seems the key to bring the visions and approaches from the Work Programmes into the project: "*Evaluations are the key moment*

in R&I – this is when the Commission decides where to put the money, so the evaluations should be perfect". This is where RRI should then be rooted.

Looking at the project level, the solution offered to problems of embeddedness seem more often than not to relate to the commitment of the funding body to direct research practice by the funding principles and instruments applied:

- **Integrating civil society (organisations) successfully:** Some interview partner called for a change of project setup in terms of time and money. In the Interim Evaluation of October 2017, it was criticized that not enough civil society organisations were involved in project consortia and that CSOs would generally get a small share of the funds allocated, too small to provide substantial work and have an impact in the project results (Interim Evaluation, 2017, Annex 1, p. 247). **Accordingly, having a substantial share available for civil society partners is essential for civil society inclusion.**

Having a substantial share of the funds available was not only a question concerning project participation of civil society organisations or networks in consortia, but also for RRI-relevant processes in the setup of projects: "*If you really want to come to consensus solutions, really to have people feel ownership (…), then you really have to involve them and not only give them the opportunity to ask questions, and that needs time*". A representative of a public body network explained the specific needs for time and money dedicated to such processes with the different perspectives and objectives of research practice and democratic processes coming together when e.g. researchers and local government representatives meet on innovating cities for sustainability and resilience: To find a common language and a common understanding how to proceed and to which end, at least half a year was needed (Interviews). Beyond that, time was needed to follow the multi-stakeholder process at all stages of the project from scoping, visioning, co-creating until reiteration and conclusion.

- **Providing time and money for RRI:** Two other aspects of project-setup, as far as timeframe and money allocated are concerned, were of major importance to the interview partners:

(1.) It was criticized in the application process that some future project partners were needed to get the funding, e.g. from industry or academia partly because of their standing at the European Commission. They would participate being interested in the funding much more than in the idea and research strategy of the project to the end that when the funds were granted these partners would not cooperate on certain parts of the project, such as multi-stakeholder processes. This experience was shared by several researchers. A solution offered by a project lead addressed the application-procedure: If there would be a two-step application process with a first step reserved for a core project team getting a preliminary approval for their research idea and strategy, they would choose their consortium partners appropriate to conduct the research in the second step of the application. **A two-step application process along these lines would secure that all consortium partners commit and stick to the approved research idea and strategy.**

(2.) Another problem identified by interview partners focused on societal impact. Interview partners were sensitive to the need of improving the implementation of research results. From the

perspective of a local government representative being involved in research projects, the period between having substantial results produced and the end of the project is very short in terms of bringing the results to the cities. The interview partner thus suggested a second round of proposals for an innovation phase of perhaps two years for the implementation of project results then ready for application. Another interview partner from a research institution differentiated between scientifically relevant research (of interest for many researchers) and the translation of this research to make it socially relevant and useable for innovation. He criticised that the lack of time, money and interest of researchers left many research results unused for societal impact. Also, from this perspective, **the solution was seen in offering the possibility of implementation-oriented follow-up calls to which projects could apply in order to expand and intensify the period of result implementation.**

- **Learning a new research practice including stakeholders:** Especially local government, citizen science and civil society organisations were sensitive to their role in research processes being rather the object of research than subject in the process. There is a strong interest e.g. from a local government's representative perspective to be "*an active partner in the research and not only an object that is researched – which is still quite often the case that researchers are interested to learn, to extract data, (..) but in principle the city is not in that sense a subject, it is not involved, [the research] is not necessarily based on demands from the city, or needs from city and local government.*" Thus a change of perspective and project design including stakeholders is a major issue. Limited funding to foster the contribution of civil society or local government partners in consortia supports this view as does a sometimes-limited influence on the results of multi-stakeholder-processes – this was self-critically stated by one project lead indicating that they conducted a stakeholder processes but acknowledged that they had little knowledge actually how to do it. Finally, alternative views and positions did not adequately enter the resulting documents, such as policy recommendations. **This researcher confirmed that training would be of great support, another interview partner from university asked for guidelines what a multi-stakeholder process is and how actually to conduct it.**

Limited acceptance of co-productive approaches, limited experience of how to integrate co-productive elements and limited responsiveness to experienced alternative knowledge and positions demonstrate the need of a readjustment of research culture to have full benefit from RRI fostering societal embeddedness of R&I and science. The European funding scheme can contribute to this task by setting standards in innovative research procedures, by integrating RRI in the evaluation system, training applicants and project partners, making best practice examples public to researchers and stakeholders and, if necessary, by sanctions of misbehaviour.

The positions collected and summarized here reflect a high awareness among the interview partners concerning the need of social embeddedness. Their reflection and reasoning leading towards differentiated recommendations to improve this embeddedness demonstrate the importance they give to certain aspects of RRI, especially concerning the research process dimensions – even without much knowledge of the concept itself. Thus, the interviews confirm once again the overarching character of RRI, including a diverse set of practices and well-established

research concepts rooted in the research culture of some communities active and present in SC5 (TAB Hintergrundpapier Nr.22, 2016, p. 14).

4.3.3. Assessment of RRI based on interviews

There has been a high awareness among interview partners about the need of better embedding R&I in society.

Stakeholders interviewed showed some awareness (B) of RRI in the specific Programme line. They showed main interest in the keys and O's of major relevance to their project tasks and we had the impression that they had or gained a clear understanding of the concept but were critical about it for different reasons.

The following aspects might be of interest concerning the awareness among interview partners:

- The present choice of keys was questioned by several stakeholders. They offered alternatives, such as security or sustainability.
- There was a tendency of interest towards process dimensions as being more relevant for those involved and in charge of research projects. Commitment to the topic of the interview was much more intense when RRI beyond the keys and O's was discussed
- Stakeholders could easily relate to keys and dimensions when explained and use them as reference to their work. Nevertheless, using the wording and relating to the content, there remained significant knowledge gaps only discovered by chance – such as RRI being the acknowledge concept of the EC integrated as a cross-cutting issue in H2020.

Category	Value	Description
A	**High Awareness** • Better embeddedness of R&I in society	• RRI as concept well understood by all stakeholders; • RRI keys and O's are used and referred to by most stakeholders; • Operationalization of RRI already present
B	**Some awareness** • RRI as a concept	• RRI as concept understood by some stakeholders; • Some RRI keys and O's are referred to by some stakeholders; • The need for mainstreaming through operationalization is referred to by some stakeholders
C	**Limited awareness**	• Vague awareness of RRI as concept by a few stakeholders; • Any RRI key referred to by some stakeholders; • Some ideas of operationalization of RRI present
D	**No awareness**	• RRI as concept is not present; • No RRI key is mentioned;

		• No reference to or explicit refusal of societal embeddedness or civic engagement;

4.4. Case briefs

Selecting projects – the issue of transparency:

Having deliverables available on the website is a matter of transparency and we were amazed that we did not find many SC5 projects (of which we tried to find information) providing these insights. Some have their policy briefs online (e.g. climateurope). It is, however, more likely to find conference contributions, reports or newsletter. This is already a great amount of information, even if selective and often prepared especially for the public. Other websites have the appearance of image brochures, mainly when funds are linked to industry (e.g. BioMOre). Most striking is the lack of transparency when SMEs or start-ups are funded by the EU. It was not possible to get any information about who exactly was getting the grant or was involved in the project with a contact option beyond a form – but with the demand of detailed information about me using the contact form. In some cases, platforms like LinkedIn were the only source to get any information beyond a firm name. Having tried to get in touch half a year later this seems also to be a question of getting increasingly organized: two examples which we tried to contact for interviews or social lab participation (Ranmarine/wasteshark and paptic) had at least a phone number or a video with the name of the founder online.

Choosing project examples:

There is GREEN-WIN and MICA with excellent project documentation online. Bibliometric research in the NewHoRRIzon project attributed a rather high RRI-relevance to GREEN-WIN (8.6), while MICA shows less awareness of RRI (1.6). As the concept of Citizen Observatories has been mentioned several times, LandSense is taken as an example. LandSense got high RRI-relevance (8.3) acknowledged. There is information available online, but not the deliverables.

Project: GREEN-WIN: Green growth and win-win strategies for sustainable climate action (ID: 642018)

Website: www.green-win-project.eu

Deliverables online: yes

Duration: 2015-09-01 to 2018-08-31

Funding: **Total cost:** EUR 3 925 012,50**; EU contribution:** EUR 3 624 762,50

RIA/CSA: Research and Innovation Action

Number of Institutions: 16 (Lead: Global Climate Forum e. V.; Germany)

According to the project website, "*The GREEN-WIN project aims to develop and disseminate win-win strategies for sustainability and climate action by improving our understanding of their linkages, trade-offs and implementation barriers.*" The main objective is to produce "*evidence-based policy packages to help mobilize and redirect financial resources and institutional frameworks towards green growth pathways, with a particular focus on coastal zone flood risk management, urban transformation and energy poverty eradication*" (see www.green-win-project.eu).

The consortium to reach this objective is led by the Global Climate Forum, a global association based in Berlin, Germany, conducting "*high-level research on climate change and related global challenges. Its members comprise institutes, (insurance) companies, NGOs and individual researchers*" (globalclimateforum.org). This association bringing together different stakeholders has also the Institute for Advanced Sustainability Studies (IASS) as a member, now partnering in the EU-project and providing both its special knowledge on economically, ecologically and socially sustainable financial system and integrated risk governance. Next to other renowned research institutes the consortium integrates two associations ("*Ground_Up Association*" and "*Association 2 Degrees Investing Initiative*") of specified expertise and their stake in the challenge addressed. Further the consortium integrates a researcher with experience and expertise in participatory stakeholder processes.

This stakeholder process had a central position to the project bringing researchers and practitioners, mainly SMEs together in order to develop transformative narratives, examine finance governance arrangements, substantiate the economics of green growth to overcome barriers to de-carbonisation and contribute to overcoming economic and institutional barriers through identifying win-win strategies, sustainable business models and enabling environments.

Information on the project and its work packages as well as the results and deliverables is available online. The challenge and the objective show a strong awareness of the benefits of RRI being included in the project design. Work package 1 concentrating on stakeholder engagement demonstrates the importance attributed to participatory research processes, while deliverables to (supplementary) work package 9 reveal awareness about ethics guidelines and requirements and data management. The six keys are related to and present, even if not in high number, in the stakeholder management plan as well as in the final policy brief, expanding on Best Practices to create green business models, investment opportunities and partnerships on energy poverty eradication and resilient livelihoods. Open processes are relevant, as well as participatory formats. Governance has an own part of the policy brief dedicated to. Especially the policy brief "*Transformative narratives for climate action: win-win strategies linking climate and sustainable development goals*" as a result of work package 1 is RRI-relevant, expanding on co-designed strategies leading to co-benefits in costal adaptation projects, for example. The intense stakeholder process accompanying the whole project has been positively mentioned in the project evaluation process.

Project: MICA: Mineral Intelligence Capacity Analysis

Website: www.mica-project.eu

Deliverables online: yes

Duration: 2015-12-01 to 2018-01-31

Funding: Total cost: EUR 2 005 205; EU contribution: EUR 1 998 955

RIA/CSA: Coordination and support action

Number of Institutions: 18 (Lead: Geological Survey of Denmark and Greenland, Denmark)

According to the project website, there exist to date no raw materials knowledge infrastructure at EU level. The "*MICA project brings together experts from a wide range of disciplines in order to ensure that Raw Materials Information is collected, collated, stored and made accessible in the most useful way in order to correspond to stakeholder needs.*" (mica-project.eu) The goal is to

provide stakeholders (e.g. policy and decision makers, industry, investors, economic analysts, researchers and others) with answers to their raw materials-related questions and proposes options available for addressing associated problems. "*To accomplish this goal, MICA will assess sources of relevant data and information and conduct analyses of appropriate methods and tools in order to provide guidelines and recommendations.*"

The consortium is led by a Dutch research organisation; it is composed by well-known research institutes and supplemented by the Federation Européenne des Géologues as well as the Joint Research Centre. Prof. Dr. Guenter Tiess, managing director of MinPol, Agency for international Mineral Policy (SME), is included in the consortium. Although the consortium is rather strong on the R&I side, it does not reflect the integration of other stakes relevant to the challenge included in the project. Third parties linked to the project are mainly national geological survey institutes; the members of the advisory board linked to public services or industry. A civil society stakeholder is not represented.

Deliverables looked at are reports on the project as a whole or on stakeholder mapping and stakeholder needs and requirements. As far as the six keys are concerned, openness and transparency are vital. Adaptivity comes in as far as the feedback from stakeholders is concerned. Indeed, a deliverable gives insights in an extended research on stakeholders, including a wide range of civil society actors. A survey, a multi-stakeholder workshop and 20 interviews have been conducted. In a critical reflection in the resulting deliverable it is mentioned, however, that "*the mobilization of dependent stakeholders required substantial efforts. While the bio-based industry showed up in the form of one workshop participant and one survey respondent only, consultancies & planning offices' needs and requirements are collected through interviews and the stakeholder workshop. An extensive interview series captured the positions of an environmental agency, city organisations, CSOs and NGOs (transparency & democracy NGO, environmental NGO, trade union, consumer organisation) and prosumer communities. All were invited to the stakeholder workshop but did not show up. Likewise, responsible STI initiatives, repair & maintenance industry, waste treatment & disposal industry and parliaments did not respond to our invitations*" (MICA, D2.2 Map of stakeholder RMI needs and requirements, p. 39). This indicates that a multi-stakeholder-process beyond a workshop and including civil society representation might have fostered social embeddedness of R&I in this project.

Project: LandSense: A Citizen Observatory and Innovation Marketplace for Land Use and Land Cover Monitoring

Website: www.landsense.eu

Deliverables online: no

Duration: 2016-09-01 to 2020-08-31

Total cost: EUR 5 751 232,66**; EU contribution:** EUR 5 088 291,88

RIA/CSA: Innovation action

Number of Institutions: 18 (Lead: Internationales Institut für Angewandte Systemanalyse, Austria)

According to the project website, "*the LandSense Citizen Observatory aims to aggregate innovative EO technologies, mobile devices, community-based environmental monitoring, data collection, interpretation and information delivery systems to empower communities to monitor and report on their environment*" (LandSense.eu). A key component of the project is the LandSense

Engagement Platform. Various communities will be able to actively participate within the LandSense engagement platform through a variety of interactive tools and functions to facilitate information transfer, assessment, valuation, uptake and exploitation of environmental data and results. (see: website) The platform is tested and used related to three themes, urban landscape dynamics, agricultural land use and forest & habitat monitoring.

The consortium consists of stakeholder networks and institutions with a wide range of expertise such as nature conservation, environmental protection, information technology, remote sensing as well as exploiting and managing geographic information. The European Crowdfunding Network is engaged in the work packages for empowerment and awareness raising, thus supporting crowdfunding campaigns to raise funds for purchasing very high-resolution satellite imagery (LandSense.eu). Indeed, most of the project partners are taking an active part in the work packages on empowerment (more or less the research institutions and public expert authorities), awareness (linked to expertise on dissemination, communication and exploitation of LandSense services) and involvement (mainly attributed to the stakeholder networks in the project, such as the European Citizen Science Association, BirdLife International, or global 2000, the largest worldwide network of environmental grassroots organizations) according to the objective of LandSense. Obviously, the consortium and the work packages reflect the participatory, multi-stakeholder-approach of the project altogether. On the basis of this expertise and experiences, the key characteristics of the LandSense Citizen Observatory are addressed:

- Bidirectional information flows between different communities (i.e. citizens, scientists, policymakers, industries, SMEs, NGOs, etc.);
- Involve new citizen functions in accumulating and using information;
- Support multi-scalar government from the EU level downwards;
- Complement EO (i.e. remotely sensed) data and state-organized data collection
- Give communities access to easily-understandable information needed for decision-making.

5. Conclusions

Within the SC5 Programme line, Responsible Research and Innovation is present as a vision linked to the overall systemic approach formulated in the research guiding documents – mainly since the work programme 2016-2017. RRI is partly considered in the main funding instruments, such as Innovation Actions (IA) and Research and Innovation Actions (RIA), it is patchy in the ERA-net Cofund Action and not mentioned in the SME-Instrument. Some topics of the calls expand explicitly on certain keys, refer to RRI-relevant research practices (four dimensions) or relate more indirectly to RRI when societal impact is expanded on. Openness, governance and public engagement are mentioned in some specific topics and research areas. Governance for example is a main focus of the topic "*Raw materials international co-operation*" (SC5-16-2016-2017, CSA), while public engagement by involving "*novel partnerships between the private sector, public bodies, NGOs and citizens*" is a major issue for *"Demonstrating the concept of 'citizen observatories'"* (SC5-17-2015, IA, WP-14/15, p. 63).

All in all, SC5 seems to be one of the Programme lines within Horizon 2020 willing to engage in RRI experiments, as for example demonstrated by the topic on "*Visionary and integrated solutions to improve well-being and health in cities*" (SC5-14-2019, IA, WP-18/20). Such calls seem to be answered by research communities aware of and experienced in participatory research, open and responsive to the RRI keys and dimensions. For these communities, the calls give the opportunity to have their approach and research interests funded thus contributing to the embeddedness of R&I in society. Other communities seem to respond to the positive resonance of successful RRI-relevant projects by the European Commission (via project evaluators) and open up their project design to

new priorities and processes. However, problems arise, if visioning or multi-stakeholder processes are not accepted by some project partners or even boycotted within the consortium. If specific keys or processes were demanded explicitly in the call, some try to fulfil these obligations with minimal effort of time and money. This assessment is supported by the bibliometric analysis conducted in the NewHoRRIzon project (see p. 4) arguing that many projects realized within the programme line have a rather insufficient RRI rating and showed – at least in their project description – a limited awareness of the relevance of RRI for the overall success of the project.

This report offers three suggestions how to better root RRI in R&I funding and practice with the overall objective to improve the social embeddedness of research and innovation. These suggestions are based on interviews with stakeholders as well as desktop research. The insights and ideas provided by stakeholders and presented as suggestions here are consistent with the desktop findings on RRI in the SC5 programme line.

1) The commission should be clear about its commitment to foster the implementation of the vision of RRI named in the work programmes. This should find expression on different levels:

- On the level of calls and topics, it should be mandatory to integrate RRI-relevant research dimensions such as anticipation, reflexivity, inclusion and responsiveness, e.g. via a multi-stakeholder process. Guidelines to what is required for the implementation of the RRI keys and dimensions are needed as well as a definition and some orientation for participatory strategies such as multi-stakeholder processes to prevent the temptation of lukewarm commitment and minimal effort for social embeddedness.

- On the level of instruments, it should be clear that funds from the European Union are only available if these standards are taken seriously, either by other funding institutions (e.g. in the ERA-net Cofund instrument) or by consortia and SMEs (as far as the SME-instrument is concerned) receiving money directly from this source.

- On the level of evaluation: The EC as a funding institution could strengthen its influence to enforce the RRI-vision and the systemic approach named in the work programmes either by sanctions or benefits for applicants to EU-funding and already funded consortia. In the R&I funding system these mechanisms mainly work over the proposal evaluation or the project evaluation process. Having RRI rooted in the evaluation process would definitely foster the commitment to better integrate RRI keys and dimensions in project outlines and implementation.

2) Learnings from project experiences of practicing RRI should be integrated in funding principles and standards:

- Civil society participation in research & innovation processes is a main aspect of RRI keys and dimensions. To integrate civil society partners successfully in project consortia, it is necessary that a substantial share of funds is provided for these partners to make real participation possible. Beyond the funding, time is needed to organize and realize co-creative processes.

- Commitment of all consortium partners is vital to implement RRI-relevant practices in a research project. A two-step application process could be advisable to ease cooperation within a consortium, first approving the idea and strategy developed by a core-team, then allowing them to find partners suitable to realize it.

- Implementation of research results is a main part of EU-funded R&I-projects. To maximize societal impact, it is suggested that project consortia interested in fostering the implementation of their results should have the possibility to apply for follow-up calls.

3) Training on RRI keys and procedures should be available to applicants for and recipients of EU research funding. Given that RRI, its keys and procedures are not yet well rooted in research practices on a wider scale and taken that this shall be improved, trainings on RRI for researchers and innovators should be provided by the European Commission. These trainings should consider the experiences and needs of all stakeholders, they should include NCPs and may involve other advising or funding institutions. Trainings should be mandatory for applicants and recipients of EU research funding.

These suggestions are meant to help closing the gap between the vision and objective of RRI, related to the systemic approach of the Work Programmes since 2016 and its implementation in EU-funded research projects. Accordingly, consistency within EC action, between the Commission as a policy and a research funding institution would be enhanced. This aspect is closely linked to the priorities of present and future research funding: Many stakeholders interviewed see a great opportunity in the Paris Agreement and the SDSs being at the core of EU policy and research strategy. However, some interview partners were concerned about the perceived lack of commitment towards the overall objective that "*at least 35% of Horizon 2020's total budget is expected to address climate action, while at least 60% is expected to involve sustainable development*" (Participant Portal H2020 Online Manual). Interview partners identified a lack of political will to monitor efforts and to change work programmes because there were these objectives to reach. Only with an audit, which was very critical, the directorate started to engage in monitoring and reporting. It is assumed that the DG RTD still does not know what the projects are delivering in terms of innovation, the uptake in the market, the resource efficiency of these innovations and the reduction or not of emissions, which is fundamental information related to the given objectives. How important then is climate action and sustainability, COP21 and the SDGs really for the EC research funding strategy?

This example demonstrates that a political will and a major attention are needed by the EC to link visions and objectives to implementation, to find mechanisms of operationalization, monitoring and control. It is not just about defining the appropriate criteria of quality assessment, but about the use of public finances for research and innovation in general.

6. Relevant stakeholders

6.1. Who are relevant applicants/actors/stakeholders?

All of the approx. 60 people identified and contacted either for an interview or for social lab participation are considered as relevant stakeholders.

7. Timeline for Diagnosis

Month	Task(s)
4	Start of Diagnosis
4	Get to know the programme line
5	Identify relevant stakeholders/experts for interviews

6-7	Interviews with experts (in total 15)
7-10	Transcribe interviews, analysis
10	Finalizing report
15	DX.1 due in M15 – ensure you send your reports to WP lead on time

8. Literature, links, resources

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NewHoRRIzon Diagnosis Report

Social Lab Nr. 12

"Europe in a changing world - Inclusive, innovative and reflective societies"

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SciencesPo

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1. Executive Summary

The following report provides an overview of the objectives, methodologies and developments of Societal Challenge 6 (Europe in a changing world - Inclusive, innovative and reflective societies), with a particular focus on the role of Responsible Research and Innovation. The analysis considers the different aspects involved, like the allocation of funding, the development of the different calls, and the relation between scooping papers, expert reports and consequent strategies in trying to answer the main and contingent challenges.

The report starts by providing an overview of the contents of SC6 in the 3 Work Programmes, showing the complementarity of the different calls. This part also highlights the material allocation to answer this Societal Challenge so to assess the actual proportion between objectives and means to achieve them.

In the following sections, SC6 is analysed through the focal lens of Responsible Research and Innovation. This analysis has been operated on different levels given the porosity and polysemy of RRI. It was first detected the explicit presence of RRI in official documents. Then the recurrence of keys related features was explored. Finally, it has been evaluated if ethical aspects orbiting around the galaxy of RRI are present in present and future strategies.

In a subsequent part we have reported the results of the interviews made in the last months, trying to provide very different perspectives on the main issue.

At the end of the document we have flagged two projects that could exemplify the general tendency with regard to RRI and beyond. We have briefly motivated the reason to choose them and we have shown some ambiguities that, in a way, are present throughout the programme line because of the social nature of the challenge.

2. Scope of this document

The scope of this document is to provide an overview of the role played by RRI or RRI-sound aspects in the Programme Line SOCIETY (Europe in a changing world - Inclusive, innovative and reflective societies). The document is composed of different parts so integrate objective data with interviews results and more theoretical analyses. The main objective of the document is to then offer a basis for the future development of RRI features in this specific societal challenge.

3. Methods

In order to operate a diagnosis of the current situation of SC6, together with its developments, we have started from a desk research, operated on the base of official documents promulgated by the European Commission. We have then matched these documents with opinions of actors working within the SC6 and with reports addressing the development of Social Sciences and Humanities (SSH).

More specifically, we have started by analysing the current situation and the development of SC6 from the EC perspective, through the Work Programmes and experts reports about SC6, and more in general about H2020. We have then studied sources 'surrounding' the official documents, like reports made by specialised associations (EASSH) and opinions given by practitioners. These were NCPs as well as researchers and experts on RRI and SC6 and/or SSH. These informal discussions were supported by interviews with specific stakeholders. However, with regard to RRI, SC6 is perhaps a more complex programme line than others given its need to integrate ethical and, most of all, societal aspects by design. Therefore, we have also operated an additional hermeneutic analysis so

to reveal implicit aspects of RRI, or the presence of ethical features beyond RRI framework (keys, Os). Finally, keeping in mind also these alternative criteria, we have analysed some projects funded under the previous WP (which were flagged as RRI relevant by Ingeborg). As we were strongly advised by practitioners to pay attention to actual strategies, our overall approach has been critical, trying to detect inconsistencies between announced strategies and their implementation.

3.1. General scope of the program

The program has a general scope is to help increasing integration amongst European communities through the awareness of the differences, changes at the global level and future possibilities. The SC has addressed, and continues to do so, these aspects through three main temporal lapses. Firstly, by looking at the past and European's heritage(s). Secondly, by responding to present, urgent matters like migration and social integration. Thirdly, by addressing the changes at the global level requiring innovative solutions for the future.

"Reducing inequalities and social exclusion in Europe are crucial challenges for the future of Europe. At the same time, there is great potential for Europe through opportunities provided, for example, by new forms of innovation and by the engagement of citizens. Supporting inclusive, innovative and reflective societies is a prerequisite for a sustainable European integration.

EU research and innovation will address social exclusion, discriminations and various forms of inequalities. It will explore new forms of innovation and strengthen the evidence base for the Innovation Union, the European Research Area and other relevant EU policies. It will promote coherent and effective cooperation with third countries. Finally, it will address the issues of memories, identities, tolerance and cultural heritage" (https://ec.europa.eu/programmes/horizon2020/en/h2020-section/europe-changing-world-inclusive-innovative-and-reflective-societies).

In short, this Societal Challenge of the Horizon 2020 programme aims at fostering a greater understanding of Europe, by providing solutions and support inclusive, innovative and reflective European societies with an innovative public sector in a context of unprecedented transformations and growing global interdependencies.

The WP 14-15 focused on:

New ideas, strategies and governance structures for overcoming the crisis in Europe (resilient economic and monetary Union, EU growth agenda, EU social policies, the future of European integration, emerging technologies in the public sector).

The young generation in an innovative, inclusive and sustainable Europe (job insecurity, youth mobility, adult education, social and political engagement of young people, modernisation of public administrations).

Reflective societies: transmission of European cultural heritage, uses of the past, 3D modelling for accessing EU cultural assets.

Europe as a global actor: focusing research and innovation cooperation with third countries, new geopolitical order in the Mediterranean, EU eastern partnership and other third countries.

New forms of innovation in the public sector, open government, business model innovation, social innovation community, ICT for learning and inclusion

(http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-societies_en.pdf)

The WP 16-17 tackled four major challenges currently faced by the European Union:

Economic recovery and inclusive and sustainable long-term growth with focus on co-creation for growth and inclusion: engaging citizens, users, academia, social partners, public authorities, businesses including SMEs, creative sector and social entrepreneurs.

Reversing inequalities in Europe. For more inclusive societies to take shape in the medium term, coherent visions will need to be devised on how to foster a social and economic framework that promotes fairness and sustainability in Europe.

The global environment in which the EU operates is constantly evolving. Recent developments show just how dynamically the strategic and geopolitical contexts are changing.

A better understanding of Europe's cultural and social diversity and of its past will inform the reflection about present problems and help to find solutions for shaping Europe's future (http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-societies_en.pdf).

The aim of the work programme 2018-2020 for SC6 is to address the concerns of the European citizens regarding migration, the fourth industrial revolution and the challenges of governance by providing objective scientific elements of assessment regarding these phenomena and formulating elaborate policy options or applicable solutions in order to help better tackle these complex issues and inform citizens objectively (http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-societies_en.pdf).

To accommodate evolving priorities, the work programme has been designed in a flexible way, in order to responding to pressing societal challenges and needs, and further generating possible cross-cutting social impact. This is well illustrated firstly in Call 1, where a new research agenda on migration will support the need for global governance systems with a solid research generated evidence base. Secondly, while the first three years of the SC6 work programme emphasized the aftermath of the economic and social crisis, this work programme focuses on the future of work. It emphasizes the technological transformations and the knowledge and digital driven economy that will shape human productivity, and that will require new learning and training models as well as extensive reorientations of the economic system (collaborative economy, smart specialization, disruptive innovations, etc.). Finally, the current work programme includes topics on radical ideologies and societal polarization, which take into account changing European and international geopolitical realities. These examples, among others, demonstrate how the lessons learned from the interim evaluation of H2020107 on the requirements of flexibility were rapidly taken into account.

3.2. What is your program about?

[Please give a general overview about the objectives of the programme, is it, e.g,. a funding program, an institution, whom does it address, with what purpose …?]

107 https://ec.europa.eu/research/evaluations/index_en.cfm?pg=h2020evaluation

3.3. What is the size and structure of your program in terms of budget, applications and projects?

Societal Challenge 6 is a quite small R&I programme line in H2020, the second least financed (1.3B). Although the number of proposals and researchers belonging to this sector cannot be conceived as irrelevant, the tools may not be considered as expensive as the ones necessary for other fields of investigation. Therefore, €516M have been allocated until 2017 in order to finance 293 projects (including the 2-stage proposals 2017). The data do not include those projects with deadline 2018 (15-20 projects). The budgetary forecasts for the next three-year period show that money will presumably be allocated in the following way:

2018 (€171,95M)

2019 (€183,41M)

2020 (€195,71M)

Budget breakdown for 2018-2020:

Societal Challenge 6	**2018**	**2019**	**2020**
Call 1 Migration	36	35	40
Call 2 Transformation	48.5	55.4	63
Call 3 Governance	40.5	53.5	55

It has to be noticed that the amount of funding has been increasing in a constant way over the years, whether the number of calls has been decreasing:

2014/15 - 5 calls

2016/17 - 4 calls

2018-2020 - 3 calls

According to the Horizon 2020 Interim Evaluation Report, a total of 3653 eligible proposals were submitted with a success rate of 5.4%, representing one of the lowest of H2020 (12,7% average).

4. Current situation of RRI in the program

4.1. RRI in brief

We do not have a specific reason for which we would see RRI as a crucial improvement of this Societal Challenge, unless we would assume that all the keys provided by the EC should be implemented at the projects level. Ethical issues and societal dynamics are central for this programme line although they might not always be matching the six keys. Therefore, the only improvement I would see is the mandatory implementation of all the keys, as these assume a different understanding if taken in a complementary manner.

4.2. Desktop findings:

Policy document level

No	**N.A.**
Yes	Keys: N.A. O's: N.A. Implicit: N.A.
Explanation	We could not find matching documents.

Scoping level

No	
Yes	Keys: Some Awareness O's: High Awareness Implicit: Yes
Explanation	Governance is central; gender is present but not central; ethics is mostly imperceptible; engagement is present but not sufficiently defined. The three Os (and openness in general) are very much present throughout the document, introducing also the notion of 'Open Governance'.

Work program level

No	
Yes	Keys: Some Awareness O's: Some Awareness Implicit: High Awareness
Explanation	Only Governance is explicitly present and appears extensively addressed. The three Os are present in the current WP, in one call and as external actions. However, they have a minor relevance when compared to the overall strategy.

Call level

No	
Yes	Keys: Some Awareness O's: Some Awareness Implicit: Yes
Explanation	Governance is one of the calls so high awareness about it. However, some other keys are not explicitly addressed. The three Os have a similar understanding. Openness is very much present under the Governance call and it has dedicated

	section but it is absent from the other two main calls.

Project level

No	
Yes	Keys: Some Awareness O's: Limited Awareness Implicit: Yes
Explanation	

Proposal Template level

No	
Yes	Keys: No O's: Limited Awareness (Open Access) Implicit: No
Explanation	

Evaluation level

No	**N.A.**
Yes	Keys: O's: Implicit:
Explanation	

4.2.2. General use of RRI

In the current SC6 strategy is missing the explicit presence of all RRI keys. If gender is an aspect that is strongly encouraged and governance is one of the funded topics, other 'keys' are scarcely addressed; the word ethics, for instance, is completely absent, apart from two side references. In the WP16-17 the notion of RRI was explicitly mentioned, influencing the proposals in a concrete way. Several ongoing projects present two or more keys in their deliverables. It cannot be assessed as a tick-box exercise because of the extent of their approaches. However, not all projects have conducted the investigations with the same depth about RRI.

The three Os, to consider the newest understanding of RRI at the EC level, are highlighted only in the section "other actions", and little money (approximately 2M over three years) has been allocated to the investigations of their features and their implementation.

It is difficult to provide a final judgement because, there are different possible interpretations. If specific terms are sometimes missing, the overall flavour seems to be nevertheless focused and driven by societal aspects, replacing RRI keys.

However, some experts, have noticed that many funded projects (approx. 29%) did not have any social or human scientist in the Consortium, shedding a grim light on the evaluations and the actual consistency between principles and their implementation. In other words, if there is a presumed necessity to include at least one social scientist to address social issues and this does not

seems to be a necessary condition for a successful evaluation, the risk is that it could happen the same with RRI.

4.2.3. RRI beyond the keys

The current WP is severely framed by the Expert Advisory Group's recommendations (http://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/SC6_EAG_report_2018-2020.pdf). The WP description is tackling all the issues raised by the report and therefore the relation between this WP and previous ones might be not only inherent to scientific results but also and mainly to extrinsic suggestions. It can be noticed a sort of ambiguity in the philosophical principles guiding the WP description, which makes it difficult to assess with sufficient reasons the actual motivations. Both, the Experts' recommendations and the EC's answers, are deeply integrating ethical aspects in the development of R&I within this particular framework. The urge for democratization, engagement and the need to analyse the level of trust about policy-makers are clear signals of the direction that should be taken. The overall methodological turn is one that believes in the great value of enabling citizens to express their needs, desires and values in the decision-making process. We can then witness a double-layer through which this main objective can be achieved. The first one is to provide an immediate possibility to foster a bottom-up approach by integrating stakeholders' participation. A second one expresses a strong trust in the role of technological innovation for building capabilities in actors not directly involved in the R&I process. The explicit reference to a greater level of transparency is but one example. Furthermore, we can detect the strong presence of the academic framework of RRI (Owen *et al*.2013). Anticipation, for instance, is the main objective of the WP ("this work programme focuses on the future of work"); the words inclusion, reflexivity are important parts of the societal challenge and responsiveness is mentioned throughout the document.

However, it is not easy to make a final assessment because of two main reasons that make us raise some doubts about the actual development that this line will follow. The first one is the material contribution allocated to this sector, which is considered by practitioners far from being acceptable if objectives are to be achieved. The second aspect, closely connected to the first one is probably a minor one, but it opens the way to different possible interpretations and therefore manipulations of the overall ethical objectives. In the WP description is missing the explicit presence of all RRI keys. If gender is an aspect still strongly encouraged and governance is one of the funded topics, other 'keys' are scarcely addressed; the word ethics, for instance, is completely absent, apart from two side references. The three Os, to consider the newest understanding of RRI at the EC level, are highlighted only in the section "other actions" and little money (approximately 2M over three years) has been allocated to the investigations about their features and their implementation. Again, it is difficult to provide a final judgement because, there are different possible interpretations. If specific terms are sometimes missing the overall flavour seems to be very society driven. However, the EASSH noticed that many funded projects did not have any social or human scientist in the Consortium, shedding a grim light on the evaluations and the actual consistency between principles and their implementation. Moreover, from the H2020 midterm evaluation report it emerged that the number of women coordinating project in this programme line is one of the lowest. At the same time the number of projects including gendered topics is around 38%. It then appears as if the topic is very well studied but not as equally applied.

4.2.4. Theoretical framework of RRI applied in the program line

The programme line is strongly driven by a bottom-up societal approach. The Scoping Paper is probably the perfect document witnessing this tendency. As reported in the document, for instance: "The EU approach to economic development and growth lays considerable stress on the

open and inclusive aspect of development, be it related to consumers, small and/or social entrepreneurs and creative firms/start-ups and scale ups, or civil society organisations and citizens at large, thus effectively allowing all stakeholders to play an active, participatory and productive role in the new economy, common good and welfare. This is a question of legitimacy and political acceptability, of the desire to integrate and tap into a wide variety of existing talents in society that would otherwise not be mobilized. This process carries with it a wide variety of bottom up notions of innovation, such as social innovation, frugal innovation, open innovation, public sector innovation and open science, social economy and social entrepreneurship".

The theoretical framework behind is one that appears to integrate technical aspects with ethical ones, where the latter reinforces the former and vice versa. With regard to the migration challenge for instance the report clearly states: "Social innovation and digital solutions can facilitate immigrants' participation in decision-making processes and promote public participatory governance. It is also praiseworthy the recognition of the fact that cultural differences can foster innovation: "Education and culture are major public policies for social, cultural and political cohesion while cultural diversity has a strategic importance for creativity and innovation". It is worth noticing that the document is also aware of the changing understandings of justice and fairness and promotes an investigation about new needs and values.

There is, without doubts, a strong interest in economic growth, but this is conceived as concomitant with social welfare and justice. Openness is present throughout the document, endorsing the relation between transparency and trust, and the subsequent improvement of European institutions image and role.

4.2.5. Overall assessment of RRI in the program line (based on desktop research):

Category	Value	Description
A	High awareness	• RRI as concept is (implicitly or explicitly) present in most documents on all levels; • RRI keys and O's are used and referred to in several documents; • Governance structures reflect societal embeddedness; • Upstream/Downstream engagement is present on multiple levels
B	Some awareness	• RRI as concept is(implicitly or explicitly) present in some documents; • Some RRI keys and O's are used and referred to in any document; • There is some process of better social embeddedness through governance or engagement
C	Limited awareness	• Responsibility or ethical awareness is referred to in any document • Any RRI key is mentioned;

		• There is reference to the need for social embeddedness of the research at hand.
D	No awareness	• RRI as concept is not present in any document; • No RRI key is mentioned implicitly or explicitly; • There is no reference to societal embeddedness or civic engagement;

The general awareness of RRI-sound features is acceptable. The presence of RRI is (and was) somehow present in the documents (e.g. governance, three Os). Besides, we have detected several indications about engagement, bottom-up approaches and more general ethical issues. It is clear that this programme line is deeply concerned with societal aspects and tries to find answers in society itself. It is also due to the nature of the challenge and the kind of 'sciences' involved, which are closer to a societal perspective. However, it is to be stressed once again that RRI as such has been removed from the current WP and the introduction of the three Os does not appear to be sufficient because of the role they have in the overall strategy. Therefore, we believe B to be the appropriate 'mark' with regard to RRI in Societal Challenge 6 documents.

4.3. Interview findings

4.3.1. Shared understanding of RRI

The awareness of RRI as such is generally very limited, if not absent. Mainly actors dealing with the SC at the policy level have shown competences about the notion of RRI, its opportunities as well with its problems. Actors involved in research and innovation in this particular programme line are usually concerned by the social and ethical aspects underpinning the necessary methodology and the objectives. There is a general agreement in this programme line that technology should help society and therefore it should be driven or monitored by ethical features. However, some of them circumscribe these concerns to specific aspects (e.g., privacy) whether others have a more general focus on measures to increase engagement and inclusion, without targeting any direct aspect. Researchers dealing with the notion of RRI but not directly involved in projects funded in this programme line have shown scepticism with regard to the applicability of RRI and the role of the six keys. Actors involved at the policy level have manifested doubts about the development of RRI within official documents and its consequent future for R&I at the EC level.

In general, there is a common understanding of the importance of participation of different stakeholders. Therefore, engagement is conceived as a valid and crucial aspect. Gender is also widely considered a main concern for reducing inequalities. After explaining the intended role of the keys, all stakeholders agreed on the importance of them although many of them proved to be sceptical about their implementation. Some of them have also raised some doubts about the absence of other factors, very important to them, like sustainability. Considering these points, there is not an understanding of the key's order or weight apart from engagement, which is seen as the main assumption.

At present, we cannot detect a deep reflection on RRI apart from those who were already familiar with the notion because they have been working on it. Therefore, it is very difficult to obtain a clear answer about the necessity to include RRI in the next framework programme. However, all

interviewees are in favour of improving ethical and societal aspects in research and innovation. It has to be mentioned, for the sake of objectivity, that all participants to this investigation have already some interest or expertise in SSH, biasing the overall outcome in favour of RRI-sound frameworks.

4.3.2. Beyond RRI

All of the interviewees recognize the necessity to foster social embeddedness in R&I. As stated before, the general level of awareness and the way to implement such objective vary according to the expertise of the different actors. Therefore, some interviewees propose a general increase in stakeholders' involvement, others to improve gender aspects. Others have also criticised the quantity of funding allocated to this programme line because it becomes difficult to improve participatory forms, being expensive processes. Most of them agree that social embeddedness should be promoted at the funding level, calling for an improvement at the EC level.

4.3.3. Assessment of RRI based on interviews

Category	Value	Description
A	High Awareness • Better embeddedness pf society in R&I • Public engagement • Gender • Stakeholder engagement	• RRI as concept well understood by all stakeholders; • RRI keys and O's are used and referred to by most stakeholders; • Operationalization of RRI already present
B	Some awareness • Ethics	• RRI as concept understood by some stakeholders; • Some RRI keys and O's are referred to by some stakeholders; • The need for mainstreaming through operationalization is referred to by some stakeholders
C	Limited awareness • RRI as a concept	• Vague awareness of RRI as concept by a few stakeholders; • Any RRI key referred to by some stakeholders; • Some ideas of operationalization of RRI present
D	No awareness	• RRI as concept is not present; • No RRI key is mentioned; • No reference to or explicit refusal of societal embeddedness or civic engagement;

As stated in the previous sections, interviewees all agree on the necessity to integrate and promote RRI-sound aspects in the R&I process. However, apart from those already dealing with the notion of RRI, there is little awareness of it as such. From a general perspective, and after explaining the presumed objectives and features of RRI, all stakeholders agreed on its importance. The effort to operationalise it in a considerable way is though limited, also because of structural obstacles at the funding/policy level. Most of the times, practitioners and end-users have to work within the boundaries set by institutional frameworks. Therefore, we believe that B would be the right level of awareness.

4.4. Case briefs

WeGovNow

"The project involves a set of innovative technologies which we integrate within a unified citizen engagement platform (i.e. WeGovNow! platform), as a solution to overcome limitations of existing digital tools in the context of citizen reporting, e-participation, and citizen-government communication. In doing so, WeGovNow! enables a new type of interactivity, enhancing and expanding the viability of and capacity for citizen co-production in the public sector, not only in a traditional citizen-to-government dynamic, but also in an arrangement where the government informs, assists, and enables private actions, or where citizens assist one another, with IT replacing the dependency on administrations as a vehicle for collective action".

Although this project has been flagged as best example of RRI in SC6, it is difficult to assess its correspondence to an RRI approach as defined by the EC. Although the overall objective appears in line with RRI features, some parts (keys) are not explicitly addressed in the project development, and keys like ethics seem to have been addressed through a very specific regulatory analysis. It is most probably a very interesting approach to the relation between political administration and citizens but it is difficult to provide a definitive RRI assessment

Smarticipate

"Smarticipate will give citizens access to data about their city in an easy to understand way, enabling them to better support the decision-making process. Local governments will be able to tap into the ingenuity of their residents, gaining valuable ideas. This two-way feedback makes cities more democratic and dynamic. Residents will also play an active role in verifying and contributing to data.

Information available to urban planners – such as applicable legal frameworks and relevant policies – will be presented to citizens, providing them with a better insight into the planning process and local government decision making. Through Smarticipate, the choices made by local governments become more transparent, democratic and inclusive. If successful in these three cities, the project platform will be made available across Europe".

This project embeds a strong participatory approach. It is strongly focused on engagement at different levels. For instance, they state in one paper: "The project […] will foster citizen involvement on four levels: to join forces of committed key stakeholders, to gather local knowledge, to enable exploratory planning exercises and to create new public services. This will be realized by innovative tools, designed within Smarticipate, that provide immediate context-tailored feedback to each contribution made by citizens via online participation services" (Vogt & Fröhlich 2016). It is a community-based approach, aiming at responding to contingent needs and perspectives overcoming the limits of experts' participatory forms. It integrates technologies with social value and needs. It is perhaps not adopting an explicit RRI vocabulary and rather the one of openness and social innovation but the overall methodology is ethically very strong.

5. Conclusions

The main challenges for the up taking of RRI in Societal Challenge 6 are, according to our analysis, endemic and all connected in a sort of vicious circle. The starting point concerns the very nature, methodology and objectives of R&I domains embedded in this Societal Challenge. Society is the core objective of this programme line, and therefore it appears logical that societal aspects, like the one promoted by an RRI-sound approach, are already present in a considerable way.

Accordingly, it might appear sometimes redundant or not adding much, the adoption of a framework like the one of RRI. Furthermore, the contested understanding of RRI, its rapid development (from the keys to the Os) and the doubts about the legitimacy of its extent, make its uptake quite difficult. The absence of environmental aspects, for instance, can severely undermine the judgement of a framework wanting to represent an exhaustive ethical objective. Such theoretical aspects can affect also the definition of Work Programmes at the policy level. If the possibility of integrating RRI aspects does not represent an urgent need for stakeholders, it is reasonable to believe that policy-makers may not consider it to be a priority. This process then can also be seen the other way around. If researchers applying for funding, as well as other stakeholders involved in the process, are not asked to consider RRI aspects, it is highly probable that they will not address them. This can be detected if, for instance, we compare the two Work Programmes. Although the outcomes of WP18-20 are not available yet, we may argue that the presence of RRI in some projects funded under the previous WP is most probably due to its explicit reference in the WP description and the calls. In conclusion, it is hard to foresee how things could change with the adoption of RRI and therefore how to justify its support. Nevertheless, in our social lab the suggestion was to address directly actors at the EC level in order to “campaign” for RRI and explain its positive aspects. It will be only after such confrontation that we will be able to understand why and how RRI could represent a substantial ethical improvement for SC6.

6. Relevant stakeholders

6.1. Who are relevant applicants/actors/stakeholders?

Name	Stakeholder Group	Organisation	Country	Awareness for RRI	Gender	Relevance to program line	Interview	Social lab team member	Social lab wider circle
	Academia	UniPadova	Italy	High	Male	Expert in RRI	Yes	Yes	N.A.
	CSO	EASS	Belgium	High	Female	Expert in the Programme Line	Yes	No	Yes
	Industry		Netherlands	Low	Male	Expert in Innovation	Yes	No	No
	Academia	Maastricht Uni	Netherlands	High	Male	Expert in RRI	Yes	Yes	N.A.
	Academia	Coventry Uni	UK	High	Male	Expert in the Programme Line	Yes	Yes	N.A.
	NCP		Germany	High	Female	Expert in the Programme Line	Yes	Yes	N.A.
	Academic	SciencesPo	France	High	Male	Expert in Societal Engagement	Yes	Yes	N.A.

	High	Low	None	Un-known
Level of knowledge about European research funding				
Knowledge about H2020/FP7				

Knowledge about the specific program line				
Project/Research experience **Involvement in EU funded research as project partner** **Involvement in EU funded research as project manager**	Participant	Other		
Impacted by EU funded research (assumed)				
Assumed Impact on EU funded research				
Assumed Knowledge/awareness about RRI				
Experience with RRI				
Experience with social labs				

7. Literature, links, resources

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NewHoRRIzon Diagnosis Report

Social Lab Nr. 13

"Secure societies - Protecting freedom and security of Europe and its citizens"

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1. Executive Summary

Activities under Secure Societies program aim to protect citizens, society and economy as well as infrastructures and services, political stability and wellbeing. Many of todays' security threats are hard to predict and recognise and instead of direct threat of foreign power, Europe is facing security threats that are more difficult to identify e.g. cyberattacks, natural disasters and radicalisation. Because of the cross-border and cross-sectoral nature of security threats, increasing amount of cooperation between different stakeholders is needed. The Responsible Research and Innovation (RRI) approach supports this by engaging all the important stakeholders in order to gain the best possible results that answer to real needs of end-users and bring true value for the society.

Security itself is seen as a societal value in the Secure Societies program line and the presence of RRI has increased through the three Horizon 2020 security work programmes. Ethical aspects are mostly understood through fundamental rights and justification of actions is relying strongly on legislation. At the same time questions of data security, privacy, national security and surveillance are raising ethical considerations.

Integration of responsible research and innovation and social sciences and humanities is happening in the program line, but it is still highly uneven across the program. Security research in Horizon 2020 is many times dealing with the consequences of social change with technologies instead of discussing how to decrease or even abolish existing security threats by solving social challenges or conditions, which create security threats. This indicates how the security research and innovation is still mostly led from the technical point of view and more discussions are needed in order to combine the knowledge form different fields of expertise. Policy documents are especially worried about social acceptance of new technologies and for this purpose engagement practices and assessment of social impacts, especially from the perspective of fundamental rights, is needed. Security research and innovation brings together stakeholders from industry, academia and public sector, however, leaving the potential of wider group of stakeholders, especially citizens and civil society actors, still without further notice.

2. Scope of this document

Responsible research and Innovation (RRI) is recognised as a crosscutting policy goal of the Europe 2020 strategy to make the research and innovation processes and outcomes better align with the values, needs and expectations of European society. This document describes and discusses the state of RRI in the Horizon 2020 Secure Societies program line, and more widely, in the European research and innovation in the field of security. VTT Technical Research Centre of Finland bases the report on various research practices carried out during the spring 2018 as a part of the European Union funded NewHoRRIzon project. The role of RRI in the security related research and innovation is considered in policy document level, work programme level, call level and project level in order to provide a comprehensive understanding of the state of RRI in the European security research and innovation, and to give guidance for the future development of RRI in this field.

This report is not an official Deliverable and it is written for the internal use of the Consortium.

3. Methods

Document analysis were conducted to study the role of RRI in different levels of the Secure Societies program line. References of RRI dimensions, six RRI keys and three Os, were searched from selected documents and an overall view of the situation of RRI in different levels was formulated.

For the policy level scanning European Union's security related strategy level documents, reports and action plans were searched and looked through. These materials included e.g. European Security Strategy (European Council, 2003), European Union's Internal Security Strategy (European Commission, 2010), European Union's Cybersecurity Strategy (European Commission, 2013) and Security Industrial Policy (European Commission, 2012). Work programme level scanning concentrated to the Horizon 2020 Secure Societies work programmes 2014-2015, 2016-2017 and 2018-2020. These work program texts were also used to evaluate the RRI in call level. Finally, the project level scanning was made by going through 47 projects' (funded under Horizon 2020 Secure societies work programme) project summaries available in CORDIS and work package information available online. Selected projects included projects listed in the reports EU Research for a Secure Society (European Commission, 2015a) and From Research to Security Union (European Commission, 2017a). In addition, the project summaries and project web pages were scanned on the part of the projects that were recognised as top RRI projects[108] in the field of security.

During the spring 2018, fourteen interviews were conducted with people involved in research, innovation and security. This included security related European Agency representatives, project consortium members, company representatives and security research experts from academia. Interviews focused on the views and experiences of ethical and societal aspects of security research and innovation in the work of the interviewees. The semi-structured interviews followed the interview guide provided by the NewHoRRIzon project consortium and the interview data were analysed using qualitative content analysis.

3.1. General scope of the program

Extensive aggression against any of the European Union Member States seems improbable but Europe is facing many other security threats that are more difficult to recognize and predict. Such threats are consequences of major global changes e.g. globalisation, digitalisation and climate change and appear in forms of increased international crime, radicalisation, terrorism, cyber-security attacks and natural disasters. Innovation and co-operation are needed in order to respond to these threats effectively and this has been recognized in the European Union.

Policy goals of the Europe 2020 Security Strategy include the Internal Security Strategy, the Security Industrial Policy and the Cyber Security Strategy. The Europe 2020 Security Strategy forms a base for the Horizon 2020 "Secure Societies - Protecting freedom and security of Europe and its citizens" program. European Security Strategies are based on common European values including rule of law, human rights, democracy and peace.

"The EU's role in our internal security consists of common policies, legislation and practical cooperation in the areas of police and judicial cooperation, border management, and crisis management" (European Commission, 2010 p.2).

Because of the cross-border nature of today's security threats cooperation between member states and partners outside the European Union is needed. The Secure Societies programme supports the implementation of policy goals of the Europe 2020 strategy through research and innovation actions. The program encourages cooperation between security actors and stakeholders inside the EU and beyond boosting new solutions and innovation.

108 Top RRI projects were selected based on the NewHoRRIzon RRI key terms survey and the report European Commission (2015a) from which the projects under the headline "Ethics and Justice" were selected.

The main goals of the Secure Societies programme are:

- *To enhance the resilience of our society against natural and man-made disasters, ranging from the development of new crisis management tools to communication interoperability, and to develop novel solutions for the protection of critical infrastructure;*
- *To fight crime and terrorism ranging from new forensic tools to protection against explosives;*
- *To improve border security, ranging from improved maritime border protection to supply chain security and to support the Union's external security policies including through conflict prevention and peace building and*
- *To provide enhanced cyber-security, ranging from secure information sharing to new assurance models.* (European Commission, 2017b)

The Cyber Security Strategy outlines that the need for transparency, accountability and security need to be secured, not only in the physical, but also in the digital world. This includes protecting fundamental rights, democracy and rule of law in cyberspace. The economic growth is heavily dependent on information and communication technologies and many business models, services and infrastructure rely on open and safe ICT systems and access to Internet. Governments have an important role in securing safe and open access to Internet but at the same time private companies operate significant parts of cyberspace and this needs to be understood when fighting against malicious activities and misuse in cyber space. In Cyber Security Strategy, the shared responsibility of public authorities, private companies and citizens is seen as a key for successful cybersecurity. (European Commission, 2013.)

"Industry forecasts and independent studies predict that the current market share of EU companies in the security sector could drop by one fifth from around 25% of the world market in 2010 to 20% in 2020, if no action is launched to enhance the competitiveness of the EU security industry " (European Commission, 2012). In order to answer this development the Security Industrial policy is targeted to raise competitiveness, enhance growth and increase employment in European security industry e.g. by establishing a better functioning Internal European Market for security technologies. Objectives set by European Commission to the innovative and competitive security industry include overcoming market fragmentation, reducing the gap from research to market, and better integration of societal dimension (European Commission, 2012). Especially societal acceptance of new security technologies and the effects that security technologies may have directly or indirectly on fundamental rights are recognised as challenges in security industry (European Commission, 2012).

3.2. What is your program about?

Secure Societies "Protecting Freedom and Security of Europe and its Citizens" is one of the seven Societal Challenges that are recognised under the Horizon 2020 programme. The Secure Societies challenge is about protecting citizens, society and economy as well as Europe's assets, infrastructures and services, its prosperity, political stability and well-being. In order to manage and prevent the risks that Europe is facing, it is important to develop innovative solutions (e.g. new technologies), raise knowledge, enable the cooperation between security solution providers and users and improve the competitiveness of the European security industry (The Council of the European Union, 2013a).

The eight original objectives of the Secure Societies programme that will be pursued are:

- *Fighting crime, illegal trafficking and terrorism, including understanding and tackling terrorist ideas and beliefs*
- *Protecting and improving the resilience of critical infrastructures, supply chains and transport modes*
- *Strengthening security through border management*
- *Improving cyber security*
- *Increasing Europe's resilience to crises and disasters*
- *Ensuring privacy and freedom, including in the Internet, and enhancing the societal legal and ethical understanding of all areas of security, risk and management*
- *Enhancing standardisation and interoperability of systems, including for emergency purposes*
- *Supporting the Union's external security policies, including through conflict prevention and peace-building* (The Council of the European Union, 2013a pp. 91-94)

Secure Societies challenge should bring together all important security stakeholders including industry, starting from SMEs to universities, research organisations, public authorities, non-governmental organisations and public and private organisations in the field of security. The end-user driven approach is urged meaning that wide range of stakeholders should be engaged to the development including actors such as law enforcement agencies, first respondents, market operators, service providers, manufacturers, civil society organisations and citizens (European Commission, 2017b).

3.3. Size and structure of the program

The estimated final budget of Horizon 2020 Secure Societies programme is 1 695 million euro and the realised amount based on the Participant portal (16.1.2018) is 670,2 million euro which is 1,91 percent of the Horizon 2020 total realised budget.

Number of eligible proposal in Secure Societies programme is 2617 (Participant portal 16.1.2018) and the number of financed projects in the programme is 235 projects (Participant portal 16.1.2018). Beneficiaries by sectors are divided into private sector (39,7%), higher education (24,3%), research (23,5%), public (9,5%) and other (3,1%) (Participant portal, 7.12. 2017). The most successful beneficiaries by country are Italy (11,5%), United Kingdom (11,4%), Spain (10,8%), Germany (9,2%) and France (7,2%) (Participant portal, 7.12. 2017).

4. Current situation of RRI in the program

4.1. RRI in brief

When security issues are becoming more and more complex the RRI approach helps to better align the processes and outcomes of security research and innovations with the actual needs of society. Ethical reflection is especially important to have as a part of situations where different courses of action need to be balanced with the values that the society holds. This means for example balancing basic rights and freedoms and privacy requirements of an individual and security needs of

the society. Security research and innovation includes many profound ethical questions in terms of individual and societal security, privacy, surveillance and dual-use of new technologies, just to name few. RRI can be seen as an important framework providing guidance to develop future security solutions that are wanted, accepted and increasing the security and wellbeing of individuals and society.

4.2. Desktop findings

4.2.1. Role of RRI on

Policy document level

YES "some awareness"	Keys: Ethics (Fundamental rights) O's: Open science (sharing research results) Implicit: Stakeholder engagement
Explanation	Ethics is the most visible RRI key in policy document level of security. Ethics is recognised mostly through fundamental rights. Privacy and data protection are seen as major ethical issues concerning new security solutions and innovation. In the Ninth progress report towards an effective and genuine Security Union (European Commission, 2017c) it is outlined that "*the comprehensive assessment confirms that the compliance with fundamental rights is a key characteristic of EU security policy, in line with the legal obligation under the Treaties. In addition to effective judicial control by the Court of Justice of the European Union, the Commission has developed several mechanisms to mainstream fundamental rights in the formulation of legislative and policy proposals"* (European Commission 2017c). The Cybersecurity Strategy of the European Union (European Commission, 2013) underlines the importance of fundamental rights in policy level. The document brings out how "*cybersecurity can only be sound and effective if it is based on fundamental rights and freedoms as enshrined in the Charter of Fundamental Rights of the European Union and EU core values"* (European Commission, 2013). The important stakeholder groups that need to be engaged vary depending on the security

	theme. Practitioners and public authorities are seen as important stakeholders in all security themes when citizens are recognised as key stakeholders in the themes of radicalisation and cybercrime. The Cybersecurity Strategy (European Commission, 2013) brings out how "*all relevant actors, whether public authorities, private sector or individual citizens, need to recognise this shared responsibility, take action to protect themselves and if necessary ensure a coordinated response to strengthen cybersecurity*" (European Commission, 2013). In the security themes, such as international crime networks and border security, citizens are not mentioned as stakeholders that should be engaged but more as a group that is in the receiving end of the security actions. The need for improved sharing of intelligence among Member States and with partners is recognised in policy document level (European Council, 2003). Dissemination of security research results is encouraged and this is how open science is present in policy level documents. Security Industrial Policy states that its' "*overarching aim is to enhance growth and increase employment in the EU's security industry"* (European Commission, 2012). This statement leaves little room for the social and ethical consideration inside the political decision-making concerning security industry. However, it is noted that the Charter of Fundamental Rights, especially the right to privacy and personal data protection, needs to be followed when developing EU's internal security market (European Commission, 2012).

Work program level

YES "some awareness"	Keys: Ethics (Fundamental rights), Public engagement, Gender equality O's: Open access, Open science, Open to the world

	Implicit: Security as societal value
Explanation	The level of RRI is increasing through the three Horizon 2020 security work programmes. This can be seen already in the work programmes' introduction parts. The RRI has its own section in the introductions of work programmes 2016-2017 (European Commission, 2017d) and 2018-2020 (European Commission, 2017e) but not in the work programme 2014-2015 (European Commission, 2015b). This shows how the importance of RRI is increasing. The RRI part of the introductions of the Work Programmes 2016-2017 and 2018-2020 sums up the main goals of RRI. "*The calls under 'secure societies – Protecting freedom and security of Europe and its citizens' are in line with the Horizon 2020 Responsible Research and Innovation (RRI) cross-cutting issue, engaging society on sensitive security issues, integrating the gender and ethical dimensions, ensuring the access to security research outcomes whenever possible and encouraging formal and informal science education relating to security. Activities will be multi-actor and underpinned by public engagement*" (European Commission, 2017d; European Commission, 2017e). Fundamental rights are brought out as major ethical issues in all three Work Programmes. According to the Work Programme 2016-2017 "*security as societal value is a guiding principle throughout this Work Programme. All individual actions must be in compliance with the provisions of the Charter of Fundamental Rights of the European Union*" (European Commission, 2017d). Ethics, public engagement, gender equality, open access, open science and open to the world are the RRI keys recognized in Horizon 2020 Security Work Programmes. The concepts of "privacy by design", "data protection by design", "privacy by default", and "data protection by default" are strongly present in the Work Programme 2018-2020 (European Commission, 2017e).

	The important stakeholders that should be engaged vary depending on the security theme as in Policy document level. Practitioners and public authorities are seen as important end-users of new technology in all security themes when citizens are recognised as key stakeholders mostly in themes of radicalisation and cybercrime. This can be well seen in the section where the term "all stakeholders" is used but it is not clear if e.g. citizens are part of this stakeholder group. "*Whilst many infrastructures and services are privately owned and operated, protection of public safety and security are the responsibility of the public authorities. Therefore, security is an issue that can only be tackled effectively if all stakeholders cooperate. In consequence this Work Programme addresses both private companies/industry and institutional stakeholders*" (European Commission, 2015b). Even though the citizens are mentioned in the Work Programmes as stakeholders, they can be dismissed in the more precise examples. "*At the core of research in this (special) area is the development of new products to meet the needs of security practitioners*" (European Commission, 2017e). Multidisciplinary research is recommended in Security Work programmes and this can help RRI keys to get more attention. "*Research is not just about developing new technologies or applying emerging technologies, but also requires understanding phenomena such as violent radicalisation and the development of more effective policies and interventions. This means social sciences and the humanities will be involved*" (European Commission, 2017e).

Call level

YES "some awareness" or "limited awareness" (varies depending on the call)	Keys: Ethics (Fundamental rights), Gender O's: Implicit: Stakeholder engagement, Human factors
Explanation	The Secure Societies Work Programme 2018 - 2020 (European Commission, 2017e) and the Secure Societies Work Programme 2016 - 2017 (European Commission, 2017d) are divided into three calls that are "protecting the infrastructure of Europe and the people in the European smart cities", "Security" and "Digital Security". RRI is present in all three calls but the emphasis of the RRI keys differ between the calls and sub-calls. Ethics is present in the calls especially through fundamental rights including privacy and data protection issues. Depending on the call, some of the more sector specific ethical issues are also recognised. A good example of this can be pointed out in a Call "protecting the infrastructure of Europe and the people in the European smart cities" where the ethical issues concerning people's freedom and liberty in security issues is brought out. "*Threats against crowded areas and disruptions in the operation of our countries' infrastructure may limit the liberties of our citizens and put at risk the functioning of our societies and their economies"* (European Commission, 2017e, p.9). Societal dimensions are part of some security themes inside the calls. For example, actions under the "Fight against Crime and Terrorism" (European Commission, 2017e, pp.28-35) include societal dimensions and human factors as important parts to be taken into account. In the Call "Digital Security" (European Commission, 2017e, pp.55-70) proposals should have relevant human factor and social aspects included when developing innovative solutions. This can also be seen in some of the sub-calls, where ethical and societal acceptance

	is presumed. For example in the sub-call DRS-11-2015[109] it is pointed out how "*the ethical implications and social acceptance of the proposed solution needs to be studied, contributing to an improved cooperation between science and society".* In the Call "Digital Security" (European Commission, 2017e, pp.55-70) it is also brought out that proposals should have gender dimensions taken into account. Stakeholder engagement is also encouraged in the call level. Public engagement, where citizens are recognised as an important stakeholder group, is mostly present in calls of cybersecurity and radicalisation. It is common in the Secure Societies calls that citizens are mentioned as a stakeholder group but more accurate stakeholder explanations focus on practitioners, public authorities and industry representatives. The demands on engaging societal actor also varies a lot inside a call depending on the sub-call content. For example in the 2018-2020 Work Programme call - "Protecting the infrastructure of Europe and the people in the European smart cities" the sub-call SU-INFRA01-2018-2019-2020[110] has citizens strongly present when the sub-call SU-INFRA02-2019[111] focuses on industrial actors (European Commission, 2017e).

Project level

YES "Some awareness" or "limited awareness" **(varies depending on the project)**	Keys: Ethics, Public engagement, Gender equality O's: Open science Implicit: Stakeholder engagement

109 DRS-11-2015: Disaster Resilience & Climate Change topic 3: Mitigating the impacts of climate change and natural hazards on cultural heritage sites, structures and artefacts.
110 SU-INFRA01-2018-2019-2020: Prevention, detection, response and mitigation of combined physical and cyber threats to critical infrastructure in Europe.
111 SU-INFRA02-2019: Security for smart and safe cities, including for public spaces.

Explanation	The project level scanning was made by going through 47 projects'[112] (funded under H2020 Secure societies work programme) project summaries (CORDIS) and work package information that was available online. In addition, the project web pages were scanned on the part of projects that were recognised as top RRI projects[113] in the field of security. RRI as a comprehensive concept including its' six keys is generally missing from the Secure Societies programme projects, excluding some projects with special aim in RRI. Themes of ethics, public engagement, gender equality and open science can however be found separately in security projects' work packages. One project has usually one or two of these keys somehow included in which ethics and public engagement are the most popular ones. Ethics is mostly recognised through human rights, and some of the projects have separate work packages for ethics. For example, the TREUSSEC.EU project has its own work package for legal and ethical factors and one of the VisiOn project's tasks includes a special aim in ethics policies. In addition, many of the scanned projects have interest in ethics through privacy and personal data protection issues e.g. ICT4COP, NOSY, INSPEC2T, FORENSOR and OCTAVE, just to name few. BODEGA project that aims at developing future border checks with human factors expertise has the RRI as its own work package. BODEGA is an exception in this sense because even if RRI keys are found in the projects the use of the concept name (RRI) is very rare in the project level. The selection of key stakeholder groups varies project by project. Law enforcement agencies and practitioners are widely recognized as key stakeholder groups in security theme projects but the role of citizens and civil society varies a

112 Selected projects included projects listed in the reports European Commission (2015a) and European Commission (2017a).

113 TOP RRI projects were selected based on the NewHoRRIzon project's RRI key word survey and the report of European Commission (European Commission, 2015a) in which the projects under the headline Ethics and Justice were selected.

	lot depending on the project. Especially projects that concentrate on themes of radicalisation, terrorism prevention, conflict prevention and societal aspects of security usually recognise citizens as an important stakeholder group that needs to be engaged to the project in order to make it successful. Open science is seen as a part of security projects especially through knowledge sharing. The idea is a wide spreading of research results, which also the Horizon 2020 programme supports. However, in security field projects, there are also some limitations of what information can be public in the first place.

Proposal Template level

YES "Limited awareness"	Keys: Ethics O's: Implicit:
Explanation	Ethical consideration is included in separate ethics issue table in all project proposal templates in Horizon 2020. The table includes questions concerning humans, human embryos and cells, personal data, animals, third countries, environment, health & safety, dual use, civil applications and misuse in project activities. In Secure Societies proposal templates, there can also be theme specific questions concerning project actions that might have an effect on the security situation at hand. In the proposal template[114] used as an example, *"the security section needs to be filled if the project will involve activities or results raising security issues or EU-classified information as background or results"*[114].

Evaluation level

114 European Commission, Participant portal. Proposal template H2020-BES-2014.

YES "Limited awareness"	Keys: Ethics O's: Open access Implicit:
Explanation	The Horizon 2020 key performance indicators on the program level are based on information in the periodic and final reports of financed projects. This means that the substantial data will be available in the later stages of Horizon 2020 programme. Definition of the indicator for monitoring Horizon 2020 Science and Society (Responsible Research and Innovation) crosscutting theme is the "*percentage of projects where citizens, Civil Society Organisations (CSOs) and other societal actors contribute to the co-creation of scientific agendas and scientific contents*" (European Commission, 2015c). In these indicators, gender is separated as its own crosscutting issue that has its own indicators including indicators such as "*percentage of women participants in Horizon 2020 projects*" and "*percentage of projects taking into account the gender dimension in research and innovation content*" (European Commission, 2015c). The key findings of the Horizon 2020 Interim evaluation (European Commission, 2017f) bring out that results on the integration of social sciences and humanities and responsible research and innovation are encouraging, even if highly uneven across the program. Horizon 2020 has made great progress in terms of making the scientific publications and data openly accessible to wider scientific community and public but more can be done in this respect. Based on the evaluation results "*stakeholders are less convinced about the role of Horizon 2020 in the resolution of societal challenges than in the achievement of knowledge-related objectives, which seems to call for better involvement of end-users and communication with citizens on the contribution that research and innovation can make to tackling societal challenges*" (European Commission 2017f). The Secure Societies Interim evaluation indicates that "*many of the projects under the*

	H2020 Secure Societies programme have involved end-users either as a formal consortium member, or in an indirect or informal capacity. Results from the online survey of project coordinators indicate that contributing data/knowledge, testing, demonstration, piloting and advisory role are the main areas to which end-users have contributed. It has been identified that end-users are increasingly involved in Horizon 2020 projects and that end-users' understanding of the benefits of the programme (for their organization) is improving." (European commission, 2017g). Calls for proposals shall be issued in accordance with Regulation (EU, Euratom) No 966/2012 and Regulation (EU) No 1268/12, taking account in particular of the need for transparency and non-discrimination, and for flexibility appropriate to the diverse nature of the research and innovation sectors (European Union, 2013). In the Horizon 2020 Secure Societies Work Programmes the evaluation criteria, scoring and threshold are described in General Annex H of the Horizon 2020 Work programme. Grant proposals will be evaluated by experts, on the basis of the award criteria 'excellence', 'impact' and 'quality and efficiency of the implementation' (European Union, 2013). Ethics review is obligatory in Horizon 2020 programme and this concerns also the Secure Societies programme. Ethics review is conducted in each project before signing grant agreement and project evaluation is conducted at the end of each project.

4.2.2. General use of RRI

RRI as a comprehensive approach is hard to recognize from the program line but variety of RRI keys can be found. Security is seen as a societal value in the program and especially questions of fundamental rights, such as data protection and privacy, are playing a major role throughout the different program levels. Open access to the research data and sharing the security projects' results are supported in all program levels. However, security research has a special characteristic of

including sensitive information and this may set some restrictions for the open science, open access and open to the world targets.

Stakeholder engagement is seen as an important aspect of successful security research and innovation, but how stakeholders are engaged, and who are actually seen as the key stakeholders that should be actively engaged, varies depending on the security theme and project. Public engagement, where citizens are recognised as an important stakeholder group, is mostly present in calls of cybersecurity and radicalisation. It is common in the Secure Societies program that citizens are mentioned as a stakeholder group but more accurate stakeholder explanations and engagement actions focus on practitioners, public authorities and industry representatives.

The three O's are not widely present in the program line. The need for improved sharing of intelligence among Member States and with partners is however recognised in policy document level (European Council, 2003). Dissemination of security research results is encouraged and this is how open science is present in policy level documents.

4.2.3. RRI beyond the keys

The meaning of RRI is growing the further the Horizon 2020 programs are going. This can be seen especially in the Work Program level where RRI is missing in the first Security Work Program 2014-2015 and mentioned first time as a framework in the Security Work Program 2016-2017. Integration of social sciences and humanities and responsible research and innovation is happening in the program line, but it is still highly uneven across the program.

Related to new technological solutions the questions of data security and privacy play a major role, however leaving other ethical aspects like fairness and transparency without further notice. Policy documents are especially worried about social acceptance of new technologies and because of this engagement practices and assessment of social impacts, especially from the perspective of fundamental rights, are needed. Even though stakeholder engagement is already at some level present in the program line, it is concentrated to the engagement of practitioners and public authorities ignoring civil society actors and citizens. The concepts of "privacy by design", "data protection by design", "privacy by default", and "data protection by default" are strongly present in the Work Programme 2018-2020 (European Commission, 2017e).

Ethical and societal aspects of research and innovation and technology development are still many times understood as an extra addition to research and innovation work, instead of being an integral part of research and innovation processes that should be carried throughout the project to answer the societal and ethical demands. RRI is also often seen as a question of following legislative and regulatory demands instead of broader understanding of its wider content.

Security research in Horizon 2020 is many times dealing with the consequences of social change with technologies instead of discussing how to decrease or even abolish existing security threats by solving social challenges or conditions, which create security threats. Integration of responsible research and innovation and social sciences and humanities is happening at the level of the program line, but it is still highly uneven across the program.

4.2.4. Theoretical framework of RRI applied in the program line

In the Secure Societies program, security itself is seen as a societal value. Program is highly concentrated on securing fundamental human rights, rule of law and democracy.

"*The comprehensive assessment confirms that the compliance with fundamental rights is a key characteristic of EU security policy, in line with the legal obligation under the Treaties. In addition to effective judicial control by the Court of Justice of the European Union, the Commission has developed several mechanisms to mainstream fundamental rights in the formulation of legislative and policy proposals* " (European Commission 2017c).

The RRI and ethics related issues are mostly discussed and covered from the legislative point of view, which may leave other RRI aspects with little notice in the program line. The presence of RRI is however growing within the program and more multidisciplinary approach that tackles ethical and societal aspects of security research and innovation is presented in the latest work programmes (European Commission, 2017e; European Commission, 2017d).

RRI as a conceptual framework is presented in the Secure Societies Work Programme 2016 - 2017. "*The calls under 'secure societies –Protecting freedom and security of Europe and its citizens' are in line with the Horizon 2020 Responsible Research and Innovation (RRI) cross-cutting issue, engaging society on sensitive security issues, integrating the gender and ethical dimensions, ensuring the access to security research outcomes whenever possible and encouraging formal and informal science education relating to security. Activities will be multi-actor and underpinned by public engagement*" (European Commission, 2017d; European Commission, 2017e).

The innovation processes in Security Industry are based on the competitive advantages that responsible operations can bring. The overarching aim of the Security Industrial Policy is "*to enhance growth and increase employment in the EU's security industry"* (European Commission, 2012), when the primary aim of the Commission is *"to establish a better functioning Internal European Market for security technologies*" (European Commission, 2012). It is recognised that the security industry has a strong societal dimension and this needs to be understood in order to avoid financial loses. "*Whilst security is one of the most essential human needs, it is also a highly sensitive area. Security measures and technologies can have an impact on fundamental rights and often provoke fear of a possible undermining of privacy"* (European Commission, 2012). "*The problems associated to the societal acceptance of security technologies results in a number of negative consequences. For industry it means the risk of investing in technologies which are then not accepted by the public, leading to wasted investment"* (European Commission, 2012).

For the European security companies, high level of security is seen as an aspect of competitiveness: "*for the ICT sector the promotion of security is an integral part of the equipments and products being offered by ICT companies and is key to future competitiveness* (European Commission, 2012). This differs a lot form the wider perspective of the Secure Societies program where security itself is seen as a societal value.

4.2.5. Overall assessment of RRI in the program line

The overall state of RRI in the Secure Societies program line is somewhere between A "some awareness" and B "limited awareness". RRI as concept is present in the two latest work programs (European Commission, 2017d; European Commission, 2017e), but at project level, RRI as concept is mostly missing, even though some of the keys can be recognised.

Fundamental rights play a major role in the program concentrating especially on the data security and privacy issues related to security technologies. The rule of law is seen as a key for the security program but at the same time, the fast development is causing challenges when the laws

and regulations lack behind. This is also when ethical consideration is needed. Understanding of the importance of ethics, social sciences and humanities is growing in the program line and there is reference to the need for social embeddedness of the research at hand. However, the integration is not yet happening in practice e.g. the stakeholder engagement activities are still mostly concentrated on practitioners, public authorities and industry representatives meaning that public engagement as such is not yet happening in wider scale. RRI and technical parts of research and innovation are often seen as separate, making the cross-discipline information sharing and mutual learning more difficult.

Category	Value	Description
A	High awareness	• RRI as concept is (implicitly or explicitly) present in most documents on all levels; • RRI keys and O's are used and referred to in several documents; • Governance structures reflect societal embeddedness; • Upstream/Downstream engagement is present on multiple levels
B	**Some awareness**	• RRI as concept is(implicitly or explicitly) present in some documents; • Some RRI keys and O's are used and referred to in any document; • There is some process of better social embeddedness through governance or engagement
C	**Limited awareness**	• Responsibility or ethical awareness is referred to in any document • Any RRI key is mentioned; • There is reference to the need for social embeddedness of the research at hand.
D	No awareness	• RRI as concept is not present in any document; • No RRI key is mentioned implicitly or explicitly; • There is no reference to societal embeddedness or civic engagement;

4.3. Interview findings

4.3.1. Shared understanding of RRI

The results of the interviews were mainly in line with the results of the Secure Societies document scanning. The RRI concept as such was not clear for most of the interviewees but when asked about ethical and societal aspects of security research and innovation the question was better understood, however, often seen hard to answer comprehensively because of its broad scope.

Based on the interviews ethics is part of security research and innovation to some extent. Especially fundamental rights, information security and data protection issues were recognised as ethical issues but they were understood usually rather formally through regulation. This regulation-based view of ethics can be seen as a barrier for wider ethical reflection in some cases.

"Challenges are concerning privacy issues and possible misuse of new innovation. Questions of data ownership, IPRs, and where data can be used aren't always clear." (Interview 5.4.2018)

"When we are executing research, data protection and protection of fundamental rights are challenges that we need to be aware and keep in mind." (Interview 7.3.2018)

Advisory boards and ethical boards that serve only as formality and lack ethical expertise are barriers for ethics. It is also seen that in private sector the interest of management plays a major when it comes to ethical reflection. However, growing ethical requirements, ethical expertise, supportive organisational culture and functioning ethical boards and advisory boards are seen as enablers for ethics.

"To have a partner with societal an ethical expertise is very helpful, and in our case we have an association that represents community of citizens which is very important as well" (Interview 2, 5.3.2018)

According to the interviews, stakeholder engagement is taking place in security research and innovation to some extent. However, stakeholder engagement is understood more as customer engagement including end-users such as practitioners and public authorities to the innovation processes instead of citizens. When asked separately about citizen engagement it is clear that many times citizens are seen unconnected to the research and innovation activities at hand. In these cases citizens are not the first-hand users of the technologies and solutions that are being developed, even though these technologies and solutions might have indirect effect to their lives later on. Based on this consideration public engagement as such is not strongly present in the program line. However, multidisciplinary project partners, stakeholder workshops and events, pilot actions, contacts with civil society organizations, stakeholder boards and customer surveys are seen as enablers for public engagement. Meanwhile the lack of demand for stakeholder engagement in the application phase, limited resources, and engagement only as formality are seen to hinder stakeholder engagement activities.

According to the interviews, gender equality is not seen RRI issue as such but as a part of wider phenomenon regarding equality. The focus of equality in security field is not only on gender but also in on all kinds of avoidance of discrimination.

"The project is targeted to find universal solutions that are accessible to all. It was seen that technological capability of using these services isn't related to gender." (Interview 2, 5.3.2018)

"One of the issues is that how to design approach that isn't for example discriminating." (Interview 2.2.2018)

Gender equality has a long history of regulation and practices embedded in the organisations. Especially in companies, gender equality is seen as a matter of human resources and most of the interviewees do not see straight connection between one's own work and gender equality questions. In conclusion gender equality is present in security related research and innovation from some extent to low extent.

Open access is the most difficult RRI key in the security research because of the sensitive data and secrecy requirements that some of the security research and innovation activities hold. When it comes to open access, case based evaluation and discussion are needed, and societal total benefit needs to be evaluated. According to the interviews, open access is present to low extent.

"It is characteristic for security research that research publicity and open access needs to be decided case by case." (Interview 1, 5.3.2018)

Science education is present in the program line from low extent to no extent and mostly it is not seen as a relevant question. It turned out to be difficult for the interviewees to separate science education from public engagement and open access activities. However, the opportunity of science education was brought out in educating technology users against cyber threats and increasing understanding of these threats among citizens. According to science education objectives, some companies and projects are supporting courses and producing teaching materials related to cyber security.

The governance is understood as all the practices, which relate to the advancement of RRI keys. Based on the interviews governance is present from some extent to low extent in the program line. RRI supporting structures include ethical guidelines, work packages for ethics and RRI, ethics advisors and ethical advisory boards. However, supporting structures are not in wide use and interaction between experts representing different disciplines as well as interaction between work packages is mostly seen insufficient.

"Ethics is hiding and should be made more visible. – – Only certain people, partners, in the projects are focused on the ethical aspects of the project." (Interview 16.4.2018)

4.3.2. Beyond RRI

Based on the interviews the societal and ethical challenges in the Secure Societies program line include themes of:

- growing requirements (law and regulation);
- multi-dimensionality of actions including technical, juridical, ethical and social aspects;
- value sensitivity of security research;
- data security and privacy;
- availability of data;
- missing and/or out of date regulation (emerging technologies);

- equally available and non-discriminatory innovation;
- multi-actor environment and hidden agendas;
- dual use of innovation and
- balance between investments and added value

As one solution to these challenges interviews brought out the importance of crosscutting expertise including ethical and societal expertise in research and innovation processes. Integration of responsible research and innovation and social sciences and humanities is happening in the program line, but it is still highly uneven across the program. At project level, crosscutting expertise was brought into the projects via partners with ethical and societal knowledge, ethics advisors or ethical advisory boards and data protection officers. Lawyers, data protection officers and corporate responsibility or ethics specialists were offering expert support for these issues at company level.

Regulation and legislation that supports ethical behaviour was seen important for the responsible research and innovation, but at the same time, the challenge was recognised in following the growing regulation. Especially when it comes to new emerging technologies (e.g. drones, AI and autonomous systems), the lack of updated guidelines, practices and legislation was seen as a challenge in dealing with ethical and societal questions. Ethics requirements from European Commission (e.g. ethics self-assessment), national data protection authorities' permissions for certain kind of research, and good research practices (e.g. informed consent) were mentioned as a visible part of RRI. In project structures, also work packages or tasks including RRI were sometimes included. Based on the interviews the need for more dialogue between different actors was recognised. Especially informing policy level representatives about the importance of ethical and societal aspects was seen important. All in all more dialogue and communication between different actors and disciplines was needed and hoped.

4.3.3. Assessment of RRI based on interviews

The RRI as concept was not well known among the interviewed stakeholders, excluding some exceptions, but ethical and societal aspects of security research and innovation were recognised at some level. RRI was understood mostly through good research practices, risk management and following legislation. Sensitive data and secrecy requirements of security research were seen as challenge for the open access requirement. Interviewed stakeholders represented different organisations and backgrounds and this caused big differences in their ways of understanding RRI. Interviewees with more technical background had usually more limited awareness of RRI and saw little connection between RRI and their own work. Some ideas of operationalisation of RRI were presented e.g. establishing ethical boards, consulting multidisciplinary experts and engaging end-users. However, these were often seen to have little impact on the results of the research and innovation actions and more multidisciplinary communication was hoped.

Category	Value	Description
A	**High Awareness**	• RRI as concept well understood by all stakeholders; • RRI keys and O's are used and referred to by most stakeholders; • Operationalization of RRI already present

B	**Some awareness** • Ethics • Stakeholder engagement • Gender • Governance	• RRI as concept understood by some stakeholders; • Some RRI keys and O's are referred to by some stakeholders; • The need for mainstreaming through operationalization is referred to by some stakeholders
C	**Limited awareness** • RRI as a concept • Public engagement • Open access	• Vague awareness of RRI as concept by a few stakeholders; • Any RRI key referred to by some stakeholders; • Some ideas of operationalization of RRI present
D	**No awareness** • Science education	• RRI as concept is not present; • No RRI key is mentioned; • No reference to or explicit refusal of societal embeddedness or civic engagement;

4.4. Case briefs

In this chapter, four projects under Secure Societies are introduced from the RRI point of view to give insights on how RRI appears in the security projects. Characteristic for the projects funded under Secure Societies is that the projects might include delicate information that cannot be openly shared to wider audiences. This causes challenges especially concerning the Horizon 2020 target to boost the open science through Horizon 2020 projects. In practice, depending on the project's content, some or all of the information produced during the project might be released only for limited audiences.

The four projects introduced below are BODEGA, TRUESSEC.eu, WOSCAP and FutureTrust.

BODEGA
Project ID: 653676
Funding scheme: RIA
Funding amount: EUR 4 999 238
From 2015-06-01 to 2018-09-30

"BODEGA for Proactive Enhancement of Human Performance in Border Control will investigate and model Human Factors in border control to provide innovative socio-technical solutions for enhancing border guards' performance of critical tasks, support border management decision-making, and optimize travellers' border crossing experience. BODEGA will develop a PROPER toolbox, which integrates the solutions for easy adoption of the BODEGA's results by stakeholders in border control. PROPER toolbox which will integrate ethical and societal dimensions to enable a leap of border control towards improved effectiveness and harmonisation across Europe."115

115 Accessed via Cordis. BODEGA project. Available: http://cordis.europa.eu/project/rcn/196892_en.html

Bodega is financed through call H2020-BES-2014 under the Ethical and Societal Dimension topic 1: Human Factors in border control. The project consortium has 14 participant organisations from seven different countries including Finland, France, Austria, Belgium, Spain, Italy and Greece.

The RRI approach is an integral part of the BODEGA project.

"WP2 will develop a Responsible Research and Innovation (RRI) framework for the BODEGA project. The framework will be integrated into other work packages. Work Package 2 creates an analytical overview of existing approaches to the consideration of human factors in border control. Particular attention will be paid to the integration of ethical and societal issues in order to clarify a clear mapping of possible areas for innovation and unclear problems." (BODEGA project consortium)

The human factor approach of the project supports public engagement. This can be seen in the project activities where different stakeholders e.g. border guards, top management and travellers were included into different parts of the project in order to understand the human factors in border control. One of the work packages also includes understanding the ethical and societal issues of the project. The methods used in the project concerning human factors and stakeholder engagement are found in the article (Le Guellec, E. et al., 2018).

The dissemination of project results and the exchange of knowledge and good practices of BODEGA is the focus area of two different work packages. In one of the work packages border control authorities, law enforcement agencies, experts in privacy and ethical issues, psychologists, artificial intelligence practitioners, manufacturers of border control technologies (both hardware and software), teaching and training institutions, governmental and enterprise decision-makers are mentioned as a possible stakeholder groups that could be interested in, and benefit from, the project results. The Bodega Dissemination report brings out that individual members of the consortium have been presenting the project at international conferences, seminars and other dissemination events and a new issue of the project newsletter concerning the latest project achievements has been shared to the relevant stakeholders (Bonzio, A., Ruini, F. & Zanasi, A., 2017). These actions support open science.

TRUESSEC.eu
Project ID: 731711
Funding scheme: CSA
Funding amount: EUR 999 992,50
From 2017-01-01 to 2018-12-31

"TRUESSEC.EU is a CSA on certification and labelling of trustworthiness properties from a multidisciplinary SSH-ICT perspective and with emphasis on human rights. The current complexity of ICT products and services makes it difficult to appraise their trustworthiness. Thus, certification becomes a must to restore transparency and trust. TRUESSEC.EU aims at exploring the situation, the barriers, and the benefits of security and privacy labels; engaging stakeholders in the discussions, and issuing recommendations that may foster the adoption and acceptance of labels."[116]

TREUSSEC.EU is financed through call H2020-DS-LEIT-2016 under the topic Assurance and Certification for Trustworthy and Secure ICT systems, services and components. The project

116 Accessed via Cordis. TRUESSEC.EU project. Available: http://cordis.europa.eu/project/rcn/207202_en.html

consortium has seven participant organisations from four different countries including United Kingdom, Austria, France and Spain.

The RRI approach is present in the TRUESSEC.EU project especially through ethics concerning the questions of data privacy and security issues. Already in the project objective description[116], human rights, transparency and trust of ICT products and services and stakeholder engagement are brought out – all of themes which are related to RRI approach.

The RRI approach is also present in the work packages of the project (TRUESSEC.EU project consortium). Stakeholder engagement is supported via stakeholder online platform that is built for the project's community building and iterative assessment in one of the work packages. Industry, academia, governments and civil society are all included to the stakeholders, which indicates a good understanding of the importance of wide stakeholder engagement. Sociological and cultural aspects as well as ethical factor are included to the project work packages.

TREUSSEC.EU project has implemented the multidimensional requirements including ethical and socio-cultural aspects to the technical parts of the project.

"The main goal of WP5 is to provide technical design guidance on the assessment/evaluation of trustworthy ICT systems, considering the outcomes coming from WP3 (socio-cultural aspects), WP4 (legal and ethical aspects), and WP6 (organizational, economic, and business aspects). This entails social, cultural, legal, ethical, organizational, economic, and business dimensions in the different engineering activities, so we should keep in mind that engineers may find it difficult to understand these dimensions, being necessary to bring the multidimensional requirements closer to the technical realm." (Guamán, D., del Álamo, J., Martín, S. &Yelmo, J., 2017.)

This shows that the project is genuinely based on understanding trustworthiness, including attributes of security, privacy, reliability, and safety within the context of TREUSSEC.eu, supporting also the wider RRI approach.

WOSCAP
Project ID: 653866
Funding scheme: CSA
Funding amount: 1 990 114,25
From 2015-06-01 to 2017-11-30

"WOSCAP seeks to enhance the capabilities of the EU for implementing conflict prevention and peacebuilding interventions through sustainable, comprehensive and innovative civilian means. It intends to address some of the dilemmas and paradoxes of external interventions that aim for local ownership in third countries, by exploring principles, processes and tools that can enhance EU capabilities."[117]

WOSCAP is financed through call H2020-BES-2014 under the Conflict prevention and peace-building topic 1: Enhancing the civilian conflict prevention and peace building capabilities of the EU. The project consortium has nine participant organisations from Netherlands, Germany, Spain, France, Ukraine, United Kingdom, Yemen, Georgia, and Mali.

117 Accessed via Cordis. WOSCAP project. Available: http://cordis.europa.eu/project/rcn/194904_en.html

Stakeholder engagement is present in WOSCAP project where stakeholders are seen as important actors in validating and supporting the assessment of civilian conflict prevention and peacebuilding capabilities of the European Union. "*WP4 will focus on identifying best practices, analysis and stakeholder engagement on the cross-cutting themes of local ownership, gender, multi-stakeholder coherence, civil-military synergy and the use of ICTs*" (WOSCAP project consortium) and "*WP5 will convert the research findings into actionable policy recommendations and engage key stakeholders in policy discussions about their implementation*" (WOSCAP project consortium).

Crosscutting themes of local ownership, gender and multi-stakeholder coherence are all RRI related topics. The project has RRI aspects especially societal aspects and stakeholder engagement included to its different parts. Ethics are not mentioned in project work package descriptions separately but the peacebuilding theme, which the project is concentrated on, is strongly connected to ethics through themes such as civilian protection, human rights and humanitarian aid.

FutureTrust
Project ID: 700542
Funding scheme: IA
Funding amount: 6 338 948,89
2015-06-01 to 2017-11-30

"Against the background of the regulation 2014/910/EU on electronic identification (eID) and trusted services for electronic transactions in the internal market (eIDAS), the FutureTrust project aims at supporting the practical implementation of the regulation in Europe and beyond. For this purpose the FutureTrust project will address the need for globally interoperable solutions through 1) basic research with respect to the foundations of trust and trustworthiness, with the aim of developing new, widely compatible trust models or improving existing models, 2) actively driving the standardisation process, and 3) providing Open Source software components and trustworthy services as a functional base for fast adoption of standards and solutions.

FutureTrust will demonstrate positive business cases for the reliance on electronic signatures, sealing services, and long-term authenticity of data and documents, all with a focus on accountability, transparency and usability. For a subset of use cases, carefully selected for relevance and visibility, the FutureTrust consortium will devise real world pilot applications for the public and private sector with a focus on legally significant global electronic transactions in between EU member states and with non-EU countries."[118]

FutureTrust is financed through call H2020-DS-2015 under the topic Trust eServices. The project consortium has 16 participant organisations from ten different countries including Germany, Luxembourg, Belgium, Austria, United Kingdom, Portugal, Georgia, Turkey, South Africa and Serbia.

Ethics become an important part of the project where questions of trustworthy use of ICT services including electronic identification and electronic transactions are studied. Data protection and privacy requirements are part of the WP2 and the deliverable 2.7 produces an analysis of current state of the art in relation to privacy and data protection requirements (FutureTrust project consortium).

The FutureTrust project has its focus on practical regulation implementation. There are no references to public engagement, gender equality or science education in the publicly available

118 Accessed via Cordis. FutureTrust project. Available: http://cordis.europa.eu/project/rcn/202698_en.html

project materials. However, the terms accountability, transparency and usability, that are used to describe the wanted project outcomes, include societal and ethical dimensions.

5. Conclusions

Security research in H2020 is many times dealing with the consequences with technologies instead of discussing how decrease or even abolish existing security threats by solving challenges or conditions, which create security threats. Due to this relatively mechanical view, RRI as a holistic process might be partially challenging to implement in this field. This seems to be due to the fact, that the participants of the program are rather "selected" group, which can be seen in the relatively large share of certain countries and actors (especially large firms). This, in turn, seems to lead to relatively strong emphasis on technological development and advancement of specific technological interest of these "big" actors.

Security research and innovation consists many complex issues that have an effect on individuals, societal groups and wider society. From the ethical point of view, it is important to have discussions about, and understand the meaning of security, and the effects that changes in security concepts, technologies and innovation can have on different levels of society. These discussions are needed to avoid unwanted consequences. In ideal situation, these ethical discussions would guide the development making the outcomes more acceptable and usable. Multidisciplinary research is already recommended in Security Work programs and this can help RRI keys to get more attention in future.

In order to make security research and innovation more influential, citizens should be engaged in security related innovation already from the beginning of development processes. This kind of openness could also increase trust towards security actors. However, the way of seeing public safety and security only as a responsibility of public authorities may slow down the public engagement activities in security research. This means that more information should be offered about the possibilities of active role of citizens in producing their own security together with public and private sector.

The rule of law is seen as a key for the security program but at the same time, the fast development is causing challenges when the laws and regulations lack behind. This is also when ethical consideration is needed. Related to new technological solutions the questions of data security and privacy play a major role, however leaving other ethical aspects like fairness and transparency without further notice. Seeing RRI as a question of legislation and regulation instead of broader understanding of its wider content might slow down the RRI implementation. Because of this, it is important to continue to increase understanding of RRI concept among security program.

6. Timeline for Diagnosis

Month	Task(s)
4	Start of Diagnosis
4	Get to know the program line
5	Identify relevant stakeholders/experts for interviews
6-7	Interviews with experts (in total 15-.20)
7-10	Transcribe interviews, analysis
10	Finalizing Report
15	DX.1 due in M15 – ensure you send your reports to WP lead on time

7. Literature, links, resources

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