SURVEY RESULT REPORT

Deliverable 3.5

NUCLEUS

DELIVERABLE DESCRIPTION

This report describes the results of the analysis of the interdisciplinary interviews conducted within the NUCLEUS Study on RRI Obstacles. For detailed information about the Survey Concept and Design, the Survey Conduct, and the Study Recommendations for Implementation Roadmap, please consult Deliverables 3.1, 3.2 and 3.4.

DELIVERABLE

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	[ ] Others (specify):

PROJECT

NUCLEUS is a four-year, Horizon 2020 project bringing Responsible Research and Innovation (RRI) to life in universities and research institutions. The project is coordinated by Rhine-Waal University of Applied Sciences. For more information, please visit the NUCLEUS website, follow our social media, or contact the project management team at info@nucleus-project.eu.

NUCLEUS ONLINE

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EXECUTIVE SUMMARY

Through the analysis of interviews with Leading Researchers and Research Executives we gained insights into their views on RRI and barriers to its implementation. Our most important findings are the following:

Most of the scientists interviewed welcomed RRI in the double sense of interacting with society (both stakeholders and lay people) and of selecting research topics according to social importance. Many scientists explained they were eager to serve society and appreciated social input for identifying pressing problems that they could set out to solve. Of course, it is not obvious whether this positive attitude actually translates into relevant action, but judging from the opinions given in the interviews, the atmosphere among scientists toward RRI is friendly and welcoming. There is a basis to be built upon. Suitable measures have been outlined in Deliverable D3.4 (recapitulated briefly in 5.1.4 ff. below) which develops recommendations to further elaborating and advancing the sense for RRI in the scientific community.

Input from industry, and stakeholders in general, was largely welcomed as a source of funding and ideas about useful pathways of research. However, Leading Researchers were worried about the influence of social forces on topic selection and the risk of bias. Concerns were articulated, in particular, regarding the impact of pharmaceutical companies on medical research. In contrast, Research Executives were merely afraid of a possibly negative reception of industry-funded research among the wider public. Such research might appear to be biased. However, the primary cause of concern was this appearance among the general audience and its impact on the reputation of science. A remedy suggested for keeping the one-sided stakeholder influence, imagined and real, at bay was involving a multiplicity of stakeholders.

A recurrent theme of the interaction between science and the public was the goal to augment the interest of the general audience in scientific results. Science was frequently believed to have a low reputation among the public, and RRI was seen as an opportunity to enhance the image of science among lay people. Thus, in this interaction it was the direction from science to the public that was underscored, but the reverse influence on science was welcomed too (see above).

We found three kinds of reservations about RRI. They represent obstacles to the implementation of relevant practices and need to be dealt with appropriately if RRI considerations are to be introduced broadly.

The first kind of reservation has to do with **fundamental research**. The usefulness of RRI is viewed by participants to be strongly dependent on the field at hand. In application-oriented sciences, input from outside of science is accepted, while the preference for fundamental research is for it to proceed freely and without intervention. Scientists believe that the distance between fundamental research and public needs and preferences is too great to allow for a meaningful input of lay people or stakeholders. In

their view, fundamental research is, as a rule, not socially relevant and should not be judged by standards of social relevance.

The second sort of reluctance had to do with the felt **loss of autonomy**. Some scientists expressed their concern that non-scientists are not familiar enough with the issues in question to make a useful input possible. They rather feared that an uninformed public could distort fruitful avenues of research. In line with our earlier recommendations in D3.4, this concern should be taken care of by maintaining a wide variety of research endeavours and to see to it that fundamental research as well as competing lines of practice-oriented research be pursued. A sustained pluralism of pathways of research could be an effective antidote against the fear of being overpowered, as scientists, by an ignorant lay audience. This is tantamount to saying that researchers would welcome a research system that bestows a limited influence on the public, but preserves a leeway of discretion for the researchers as well.

The third worry had to do with the **expenditure required for RRI**. Scientists emphasised that RRI demands a lot of effort which needs to be supported or offset by suitable resources. The effort invested into RRI endeavours is feared to be taken away from addressing other challenges. In particular, researchers were afraid that institutionalising RRI would mean imposing an additional bureaucratic superstructure on them. A frequent demand concerned the effective and practicable design of the engagement process. As a result, RRI activities are demanded to remain a voluntary effort and to be recognised in terms of funding or career opportunities.

These findings confirm the recommendations for implementing RRI given in Deliverable D3.4 and emphasize one more time the need for practical guidelines. As a next step, we will subject these findings to a conceptual analysis to see whether worries and resistance harboured in the scientific community are justified. This will lead to an adapted and enriched concept of RRI needed for successful implementation.

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1 INTRODUCTION

The NUCLEUS project aims at implementing RRI in Higher Education Institutions across Europe as well as in South Africa and China. To inform the process, we conducted a large-scale empirical survey among Leading Researchers [LR] and Research Executives [RE]. Its purpose is to gain insights into how the scientific community perceives RRI. In this way, we seek to pinpoint possible barriers for its implementation on the structural, cultural and individual level and to outline conditions for overcoming such barriers in the future.

We begin the analysis of the survey by recapitulating the conceptual approach to Responsible Research and Innovation (RRI) that underlies our study. Our conceptual approach has already been described in Deliverable "D3.4 Study Recommendations for Implementation Roadmap." The widespread understanding of RRI requires aligning research with the interests, needs and values expressed by or assigned to social agents. The vision outlined by René von Schomberg advances RRI as a strategy (i) of stakeholders to become mutually responsive to one another, (ii) to anticipate research and innovation outcomes, (iii) that are relevant for the grand challenges of our time (von Schomberg 2013). In this framework, von Schomberg distinguishes between RRI as a procedure of participation and a product meeting certain standards. *Product-oriented RRI* means research proceeding on behalf of the people (or *science for society*), while *process-oriented RRI* is research conducted in a dialogue with the people (or *science with society*). The survey focuses on these two items as the two most interesting and presumably controversial facets of RRI. That is, we did not expect to find any resistance to goals like gender equality, open access publication, ethical standards in performing experiments, and science education. Since the aim of the survey is to identify obstacles to implementing RRI, we singled out the two supposedly contentious dimensions involved, namely, selecting research items by appealing to goals and considerations originating from outside of science.

"Science for society" or "product-oriented RRI" means that the direction of research is determined on social grounds such as practical urgency or societal desirability. The expected outcome of a research undertaking should be beneficial to society. "Science with society", "process-oriented RRI", or "inclusion" (von Schomberg 2013, 59, 63-67; Stilgoe, Owen & Macnaghten 2013, 1561-1562) emphasizes public participation. The expectation is that scientific research is received in a more favourable way by a wider lay audience if the public had been granted the opportunity to affect the pathways of research. The two social groups relevant for such public involvement are stakeholders and lay persons. Stakeholders have a specific interest in certain results; relevant bodies range from economic companies to patient groups. Lay persons, by contrast, are assumed not to be directly affected by the research (they are no stakeholders) and thus to evaluate issues from a more detached stance and without a vested interest. Science operating with society proceeds in interaction with these social bodies and thereby

shows an enhanced “responsiveness” to social needs and desires. Such research takes up socially urgent issues, transforms them into research projects, and is thus prepared to adjust research targets in this light. The survey was intended to explore what Leading Researchers and Research Executives think of involving people from outside of science in the research process (see D3.4 for additional details).

Based on the results of our survey and other studies undertaken during the first phase of the project, 30 “RRI test beds” across Europe as well as in China and South Africa will be installed. Ten embedded Nuclei at institutions and twenty mobile Nuclei at events will develop tangible and transferable criteria for implementing RRI into practice.

2 METHOD OF THE STUDY

The interdisciplinary study aims at "an experience-based picture of how leading actors in the field think about RRI and how they view the odds and obstacles of implementing its key features" (see signed proposal, p. 10). Most of the interview partners were suggested by NUCLEUS consortium members and are from consortium partner universities. Additional universities and institutions which were suggested by the NUCLEUS consortium partners were interviewed as well. We have interviewed Leading Researchers and Research Executive by using problem-centred questionnaires injecting open questions when appropriate (see Appendix for questionnaires). These two questionnaires are comparable because the structure and most of the questions are the same. We analysed the study with qualitative techniques of interpretation, content analysis according to Meuser & Nagel (1991), and methods of descriptive statistics. More specifically, we used frequency, valence and intensity analysis for content analysis and summary statistics and histograms. Thereby we were able to determine to what extent views on RRI are shared within the scientific community and could assess similarities and differences among our interview partners.

The original idea outlined in the project proposal had been to combine qualitative and quantitative analysis. However, as explained in Deliverable 3.2 (Resubmission, 2.1 Response to the Review Report, p. 5), the analysis of the study had to be confined to qualitative methods. That is, the study has now assumed an exploratory character. The reason is that the interviewees our NUCLEUS project partners were able to recruit were not numerous enough and were not selected at random. Therefore, no representative sample could be produced. Additionally, answers were more heterogeneous than expected and reflected major differences in the level of information participants had on RRI. Also, the importance attributed to RRI depended strongly on the conditions under which science operates in general and thus differed among different countries. This influenced how questions were understood and led to a broad diversity in the answers received. This change required adjustments of the methods of analysis employed. Applying methods of inferential statistics was out of the question. For this reason, we were prevented from interlacing quantitative and qualitative results, as envisaged in the project proposal; after all, no quantitative results could be derived. However, the project part devoted to the philosophical analysis of Responsible Research and Innovation will continue (as explained in the proposal), and our intention is to proceed to more coarse-grained findings which will hopefully allow us to construct ideal types and contrast cases (as envisaged in the proposal). Also, the heterogeneity of participants' answers and understanding of RRI is an insight worthy in itself. As the aim of this study is to identify barriers to RRI implementation, differences within the scientific community as well as among different countries need to be taken into account for a successful implementation. The following analysis provides an overview of the diverse attitudes to RRI endorsed by Leading Researchers and Research Executives across Europe.

2.1 ANALYSIS OF UNIVERSITY DOCUMENTS

Our original intention was to supply the qualitative data gained from the interviews with quantitative data from financial reports (and other documents if applicable) of universities, their sponsors, and professional associations. Thereby we wanted to investigate whether and how aspects of RRI are considered in the allocation of external funds and usage of internal funds (cf. signed proposal p. 10). The underlying idea had been that the profile and importance of RRI commitments would be revealed by relevant budget figures. The hope had been that such university documents show how RRI schemes are evaluated and implemented in the day-to-day practice of academic research. However, over the course of the study this approach turned out to be inappropriate or rather not feasible. The reasons are:

1. Major differences in allocation of funds exist between surveyed countries. To evaluate and interpret them, intense investigation would have been necessary, if this had been possible at all. Therefore, the role of RRI for external funding structures is difficult to answer, if not impossible.
2. Even on a national level, allocation of external funds differs. In Germany, for example, each federal state has a different policy for allocation of funds to universities.
3. Financial reports of universities are quite heterogeneous regarding structure and content. While some universities make funding structures transparent, others are more guarded. This questions the comparability of data. Additionally, access to the reports of some universities turned out to be a major difficulty. Even more difficult was access to other meaningful documents and their interpretation, especially in terms of comparability. We found some information about development plans and incentive schemes but these are written in a style of brochures. We were at a loss to extract meaningful conclusions from such advertising material.
4. If RRI aspects are not present in a financial report, this does not necessarily show their irrelevance for allocation of funds. For example, some universities only grant funds if ethical standards are met. However, this does not show up in the financial reports. So, RRI does not directly but indirectly influence allocation of funds.
5. If RRI aspects are not present in a financial report, it is still unclear if this is the outcome of a conscious decision (i.e. RRI is intentionally not considered) or rather RRI was not considered as relevant at all (i.e. as a possible decision factor).

In conclusion, comparability of data from financial reports is not given. It could only be achieved by major expenditure, if at all. Also, it would require intense communication with administrative offices of the relevant universities, especially with the finan-

cial departments. This could not be achieved given time and personnel resources available.

Additionally, to connect the data to personal views of researchers regarding RRI would be quite difficult because it requires an intense knowledge of administrative procedures by the researchers. This is unlikely to be the case.

After careful consideration, we consider an empirical analysis combining quantitative and qualitative data of those universities that host an embedded NUCLEI as useful (with special regard to an appropriate time frame). During the implementation of the NUCLEI, the affected universities might be asked to record the impact of RRI on allocation of funds in a standardised way (RRI accounting, so to say). This would guarantee comparability of data and enable a sound impact analysis.

3 RESULTS OF THE INTERDISCIPLINARY STUDY

In the following chapter, we are going to present the results of each question of the interdisciplinary study.

3.1 CHARACTERISTICS OF THE PARTICIPANTS

First, we start with describing the participants.

3.1.1 LEADING RESEARCHERS

The survey was performed in 2016 among 54 **Leading Researchers**. The interviews were conducted at a face-to-face basis, mostly by electronic communication. Suitable interview partners were identified by members of the Nucleus consortium in their universities. The sample consists of 18 **female** and 36 **male** interview partners. The mean **age** is 50 years. The youngest Leading Researcher is 30 years old and the oldest is 73 years old. The figure below shows that one third of Leading Researchers are between 40 and 49 years old. The second largest group is between 50 and 59 years old.

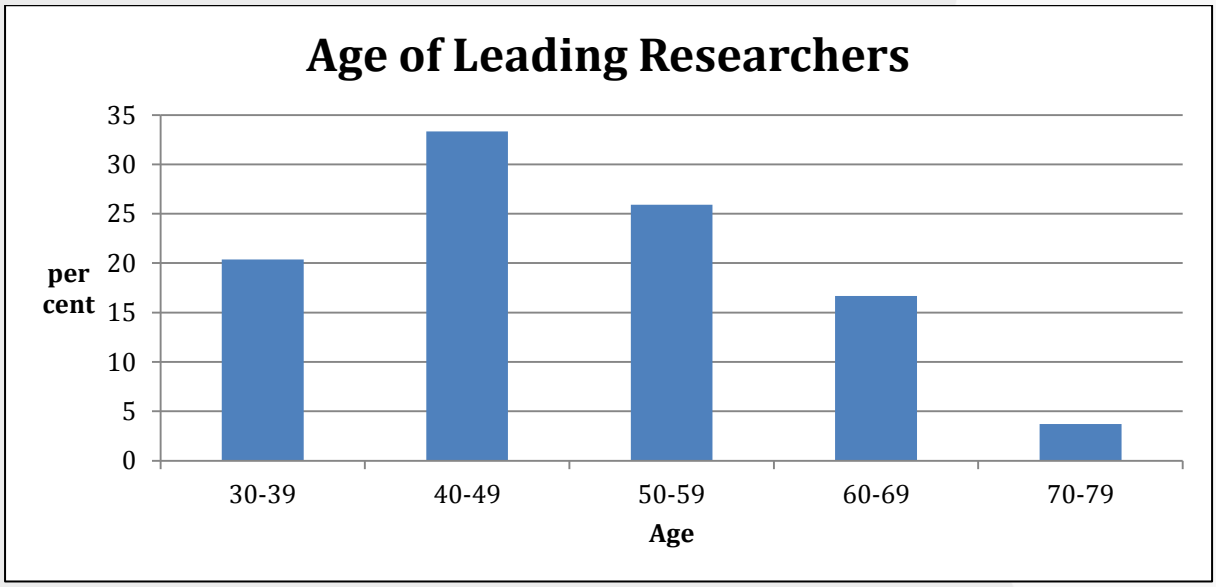

Figure 1: Age of Leading Researchers

The mean age of female researchers is 45 years. The youngest woman is 31 years old and the oldest female researcher is 63 years old. One third of female researchers is between 30 and 39 years old and another third is between 40 and 49 years old. The mean age of male researchers is 52 years. The youngest man is 30 years old and the oldest researcher is 73 years old. One third of male researchers are between 40 and 49 years old.

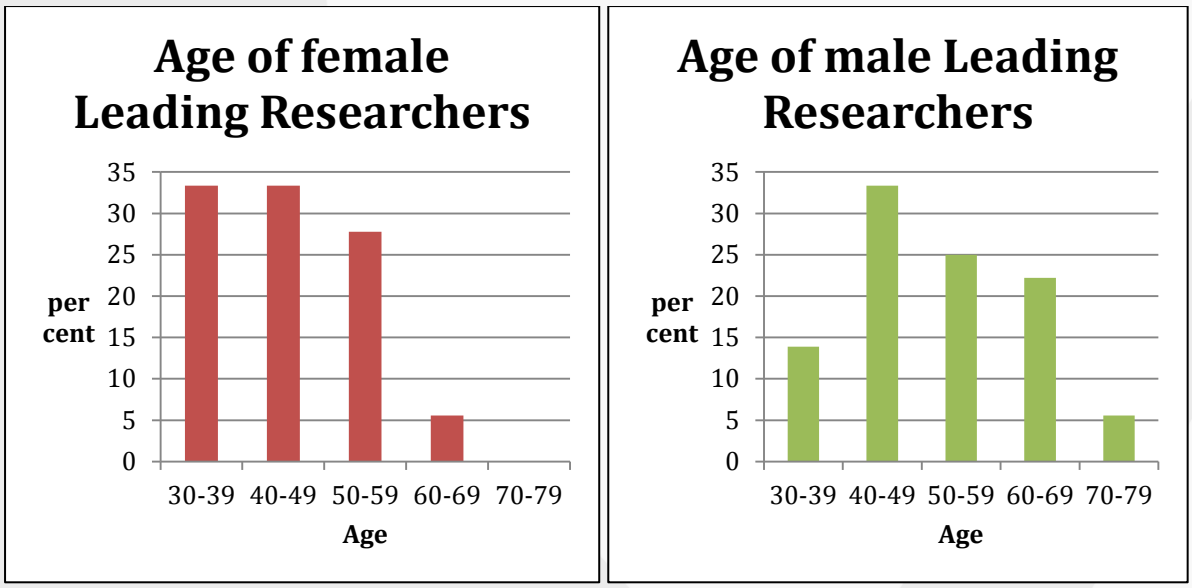

Figure 2: Age of female Leading Researchers and age of male Leading Researchers

48 Leading Researchers have received a **PhD** and 6 do not hold a PhD. Four interview partners mentioned that they are Medical Doctors but two of them have a PhD, too. 47 Leading Researchers told us the **year of their PhD**. Most of the interview partners got their PhD between 2000 and 2009. The second largest group obtained their PhD between 1990 and 1999.

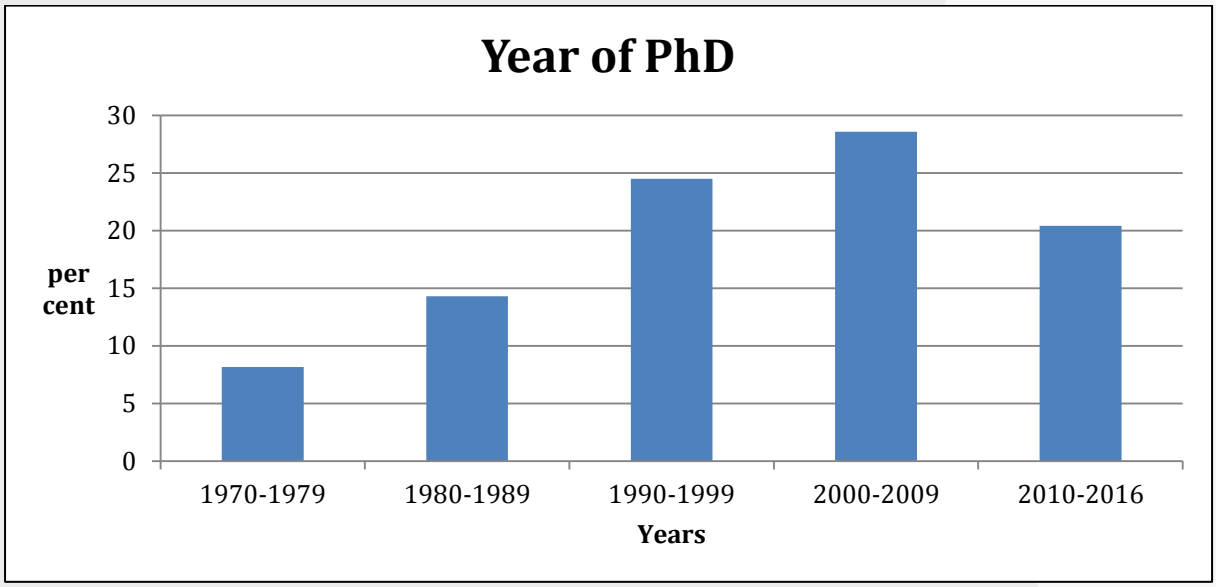

Figure 3: Year of PhD

The mean time they have **worked in research since their PhD** is 18 years. The figure below shows that most of the interview partners worked in research since 10 to 19 years.

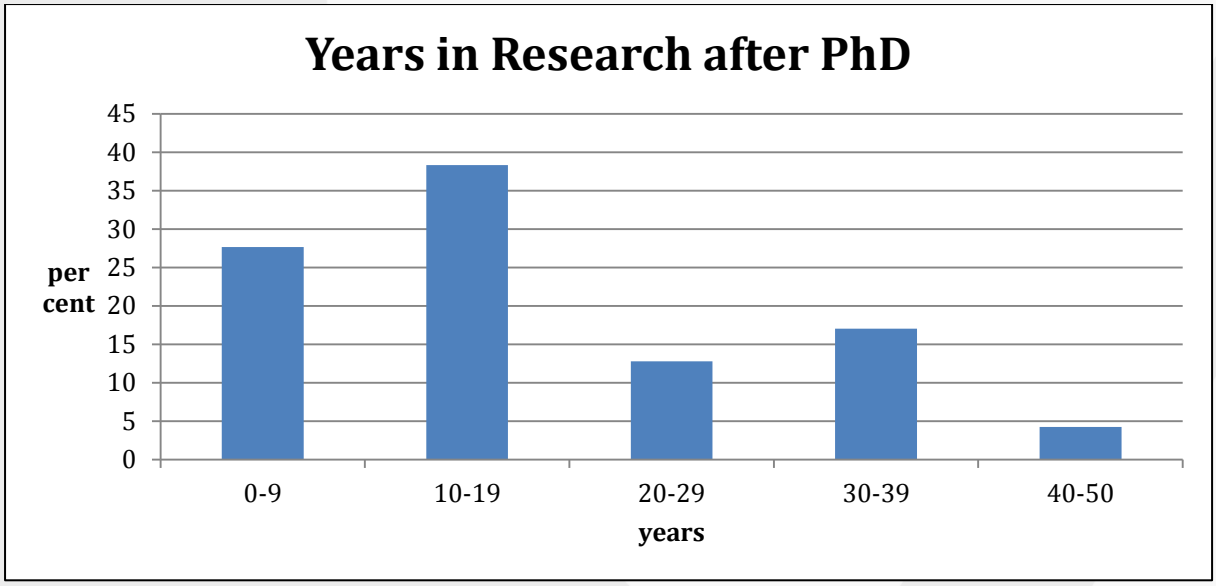

Figure 4: Years in Research since PhD

We have interviewed Leading Researchers from different kinds of research. Most of the interview partners are working in Natural Sciences. The second largest group of researchers is from Technology and Engineering. The following table is about the **field of research** of the Leading Researchers:

Field of Research	Number of Interview Partners
Architecture & Design	4
Computer Sciences & Mathematics	4
Education	1
Health Sciences & Medicine	7
Humanities	2
Natural Sciences	15
Social Sciences	7
Technology & Engineering	12

*One Leading Researcher is Consultant and one is working in a Science Shop.

Table 1: Field of Research of Leading Researchers

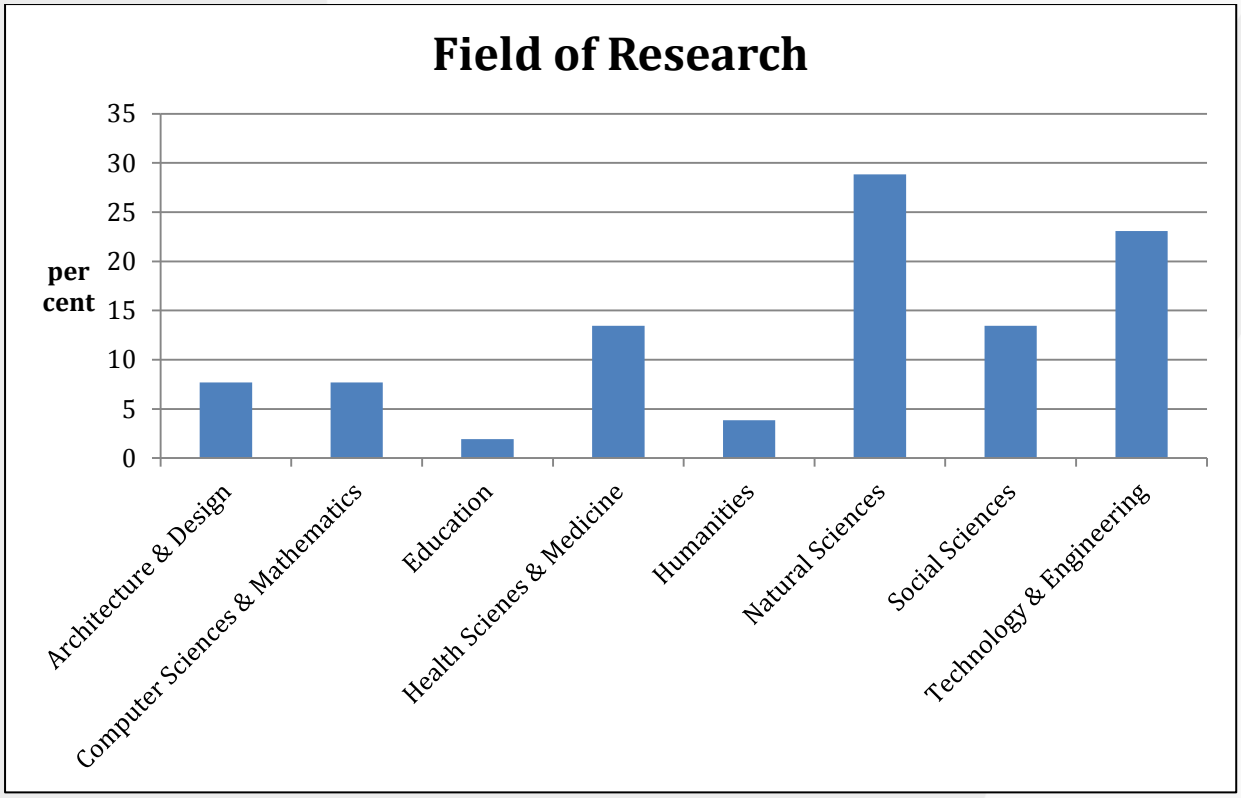

Figure 5: Field of Research

3.1.2 RESEARCH EXECUTIVES

We interviewed 32 **Research Executives**, among them 16 **female** and 16 **male** interview partners. Their mean **age** is 50 years. One interview partner refused to give his or her age. The youngest Research Executive is 38 years old and the oldest is 64 years old. The figure below shows that most of the Leading Researchers are between 50 and 59 years old. The second largest group is between 40 and 49 years old.

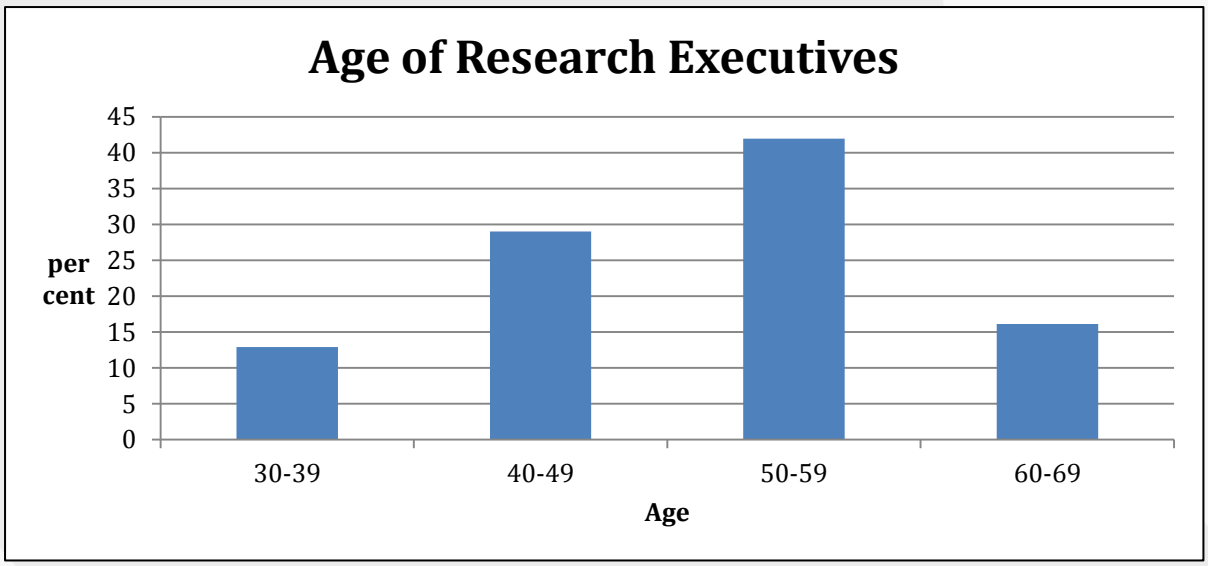

Figure 6: Age of Research Executives

The mean age of female Research Executives is 45 years. The youngest woman is 38 years old and the oldest female executive is 60 years old. The mean age of male researchers is 54 years. The youngest man is 38 years old and the oldest one is 64 years old. The lower average age of female Research Executives might be taken to indicate a more recent shift toward a higher representation of women in such functions.

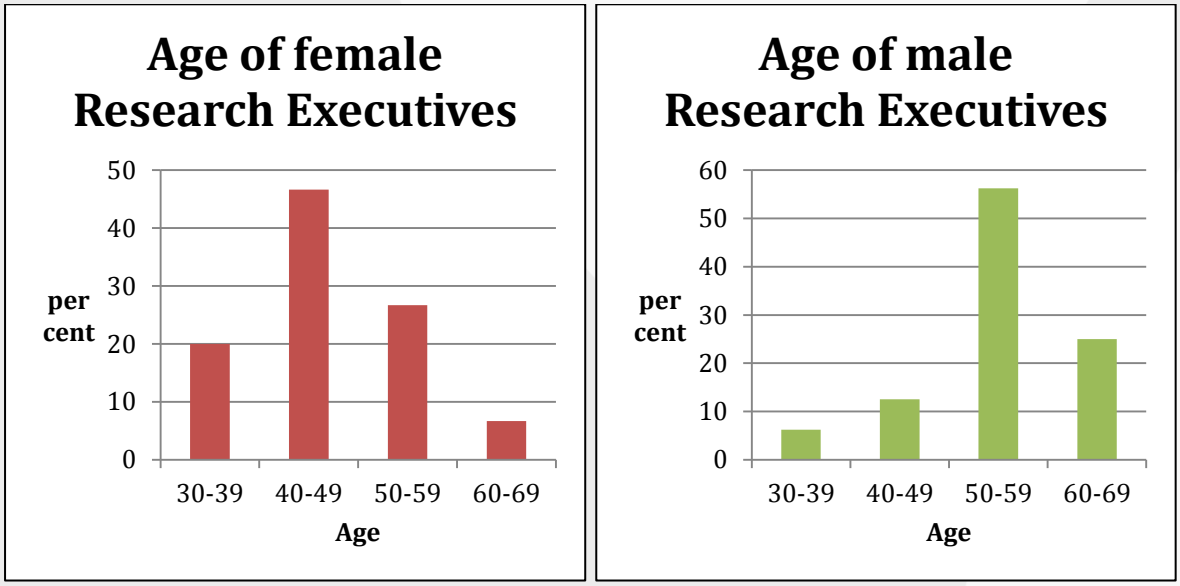

Figure 7: Age of female Research Executives and Age of male Research Executives

We interviewed Research Executives from different kinds of management. This table should be considered carefully because the positions have different meanings in different countries. The largest group of Research Executives is directors. The second largest group is rectors. The following table is about the **current position** of the Research Executives:

Current Position of Research Executive	Number of Interview Partners
Dean	5
Director	12
Rector	8
Others	3
Support Officer	4

Table 2: Current Position of Research Executive

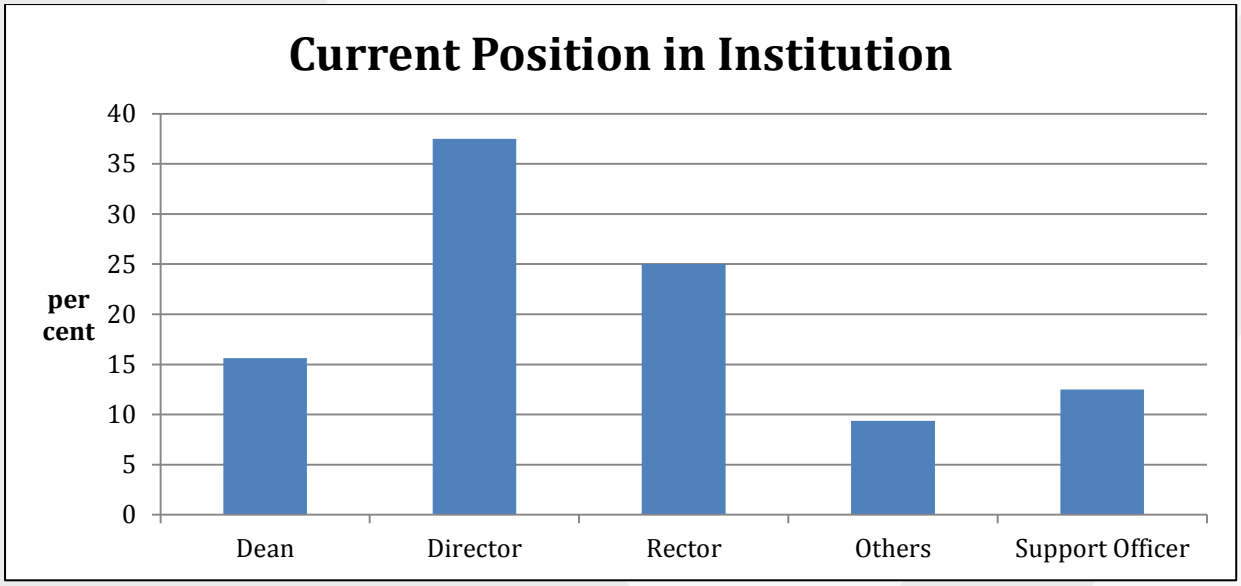

Figure 8: Current Position in Institution

We asked the interview partners how long they had been **working in their current position**. Most of the Research Executives fullfil their position from zero to four years. The second largest group has worked from five to nine years in their position. Only one participant did not answer this question.

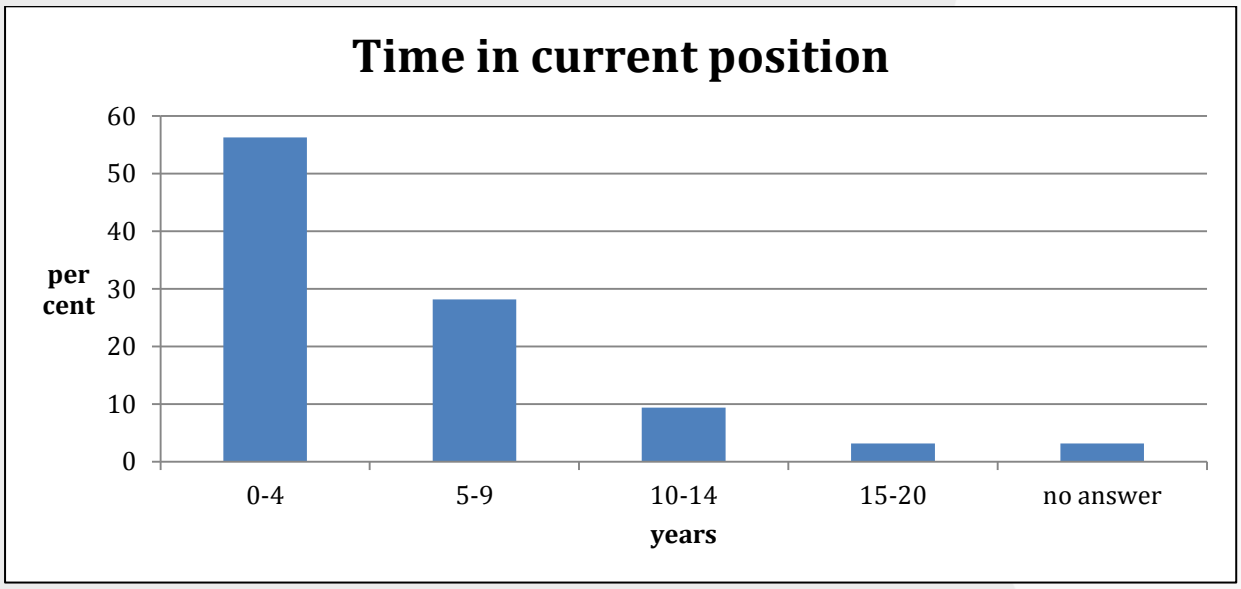

Figure 9: Time in current position

We asked the Research Executive about their **profesional background**. Some of the interview partners mentioned more than one background. Most of the Research Executives have a background in Social Sciences but the second largest group is in Natural Sciences. The following table is about their professional background:

Professional Background	Number of Interview Partners
Computer Sciences & Mathematics	3
Health Sciences & Medicine	4
Humanities	2
Natural Sciences	9
Others	3
Social Sciences	13
Technology & Engineering	2

Table 3: Professional Background of Research Executives

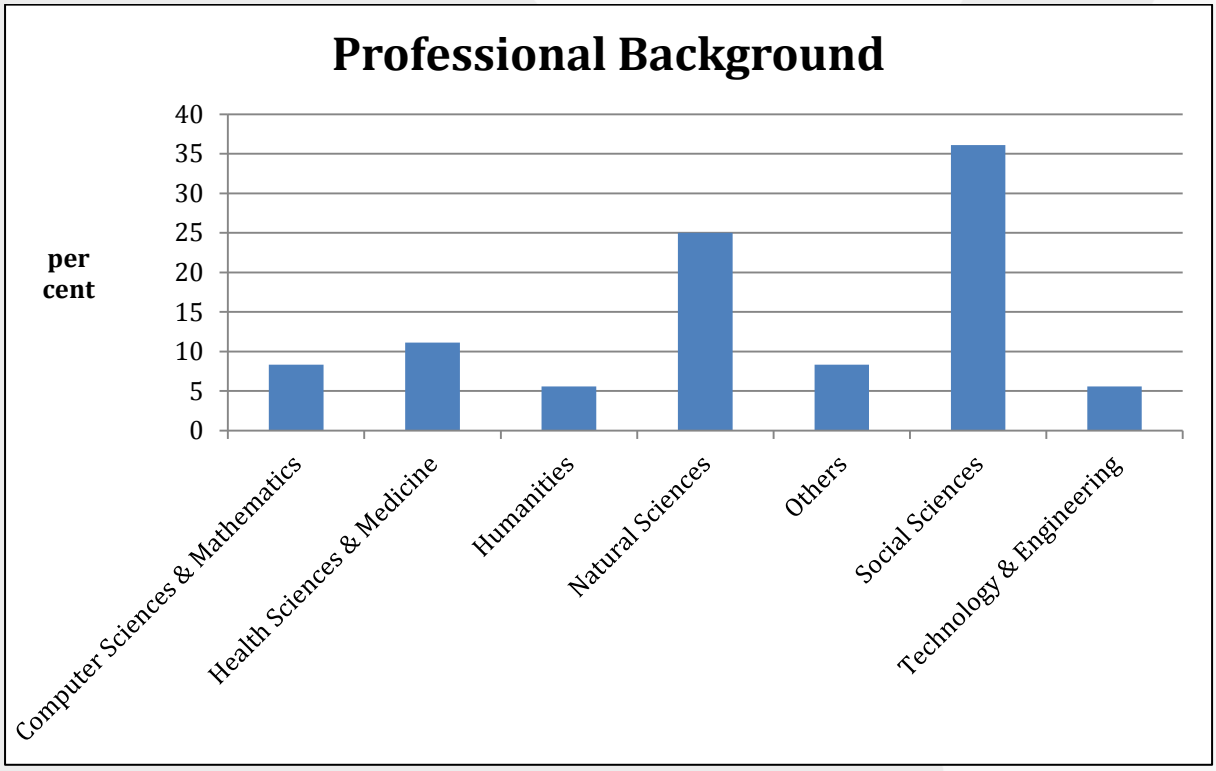

Figure 10: Professional Background

We asked the interview partners about the **number of research staff in their institution**. The numbers range between 12 and 11,000 people. The mean of this group is 916 people. This should include professors and post-docs. Due to different understandings in different countries, different kinds of researchers could be counted as research staff. We asked the interviewees about the **number of research students in their institution**. The relevant figures range between 4 and 17,000 students. The mean is 2,525 students. Research students should include PhD students and Master's students. Many universities did not take acount of the number of Master's students separately and only registered the number of all students in their institutions. These usually include Bachelor's and Master's students. Some of the interview parterns added

their PhD students to their researchers. As a result, no coherent distinction is made between research staff and research students.

3.1.3 ORIGIN OF PARTICIPANTS

We interviewed Leading Researchers and Research Executives from eleven different countries. Most of the interview partners are from Germany. One reason is that the management of the NUCLEUS project is in Rhine-Waal University. Another reason is that six consortium partners are from Germany. The second largest group is from the Netherlands and the third largest group is from Serbia. The following table is about the **number of interview partners per country**:

Country	Number of Interview Partners
England	8
France	3
Georgia	7
Germany	24
Greece	1
Ireland	6
Italy	1
Malta	5
Netherlands	15
Scotland	8
Serbia	10

*One interview partner is from Canada but we did not analyse the interview.
Table 4: Number of Interview Partners per Country

70 interview partners are from consortium partner universities. Only 19 interview partners are from other institutions with whom the consortium partners are working or have a connection to. For the "Number of Interview Partners from Each Consortium Partner", please look into Appendix 3. We interviewed respondents from 26 different institutions. The largest group of interview partners from one institution is from the Mathematical Institute of the Serbian Academy of Sciences and Arts, they suggested 10 interviewees. The second largest institution is Delft University of Technology with 9 interview partners. On the third place with 8 interviewees is Ruhr-University of Bochum.

We interviewed 18 female **Leading Researchers** and 35 male Leading Researchers. Delft University of Technology and Mathematical Institute of the Serbian Academy of Sciences and Arts suggested both the largest number of Leading Researchers, we interviewed seven of them. The second largest group of Leading Researchers is placed by

three institutions, each of them suggested 5 Leading Researchers for our Interdisciplinary Study. These institutions are Ilia State University, Ruhr-University of Bochum and University of Malta.

We interviewed 16 female **Research Executives** and 16 male Research Executives. Dublin City University suggested the largest group of Research Executives but unfortunately, we could analyse only 3 of the 5 suggested interview partners. The second largest group of Research Executives is placed by four institutions, each of them suggested 3 interviewees. These institutions are Mathematical Institute of the Serbian Academy of Sciences and Arts, Nottingham Trent University, Ruhr-University of Bochum and University of Aberdeen.

The following table is about the **institutions of the interview partners**:

Institution	Leading Researchers female	Leading Researchers male	Research Executives female	Research Executives male	**All**
Bielefeld University	0	0	0	1	**1**
Delft University of Technology	3	5	1**	0	**9**
Dublin City University	0	1	2****	1****	**4*** **
Hannover Medical School	1	1	0	1	**3**
Ilia State University	2	3	2	0	**7**
Leibniz Universität Hannover	1	1	0	0	**2**
Mathematical Institute of the Serbian Academy of Sciences and Arts	3	4	1	2	**10**
Nottingham Trent University	1	2	1	2	**6**
Queen Margret University	0	0	1	0	**1**
Research Association	0	0	0	1	**1**
Research Consultant	1	0	0	0	**1**
Rhine-Waal University of Applied Sciences	1	1	1	0	**3**
Ruhr-University of Bochum	0	5	1	2	**8**
Science Shop	0	1	0	1	**2**
University of Aberdeen	0	2	2	1	**5**
University of Edinburgh	2	0	0	0	**2**

University of Groningen	0	1	0	0	**1**
Unbiversity of Konstanz	0	0	1	0	**1**
University of Lyon	0	2	1	0	**3**
University of Malta	1	4	0	0	**5**
University of Notting-ham	1	0	1	0	**2**
University of Peloponi-sos	0	0	0	1	**1**
University of Perugia	0	0	1	0	**1**
University of Twente	1	2**	0	2	**5**
University of Vechta	0	1	0	0	**1**
University of Veterinary Medicine Hannover, Foundation	0	0	0	1	**1**
All	**18**	**36***	**16**	**16**	**86***

*One additional interview partner is from Canada but we did not analyse the interview.

**One additional interview could not be used because the voice is not recorded.

***All interviews are conducted by consortium partner.

****We did not receive one additional interview yet.

Table 5: Institutions of Interview Partners

3.2 WILLINGNESS TO COOPERATE

The following question was not posed to the interview partners in the test run. It was added as a kind of ice breaker question for Leading Researchers. While this introductory question gives no direct insight into participants' views of RRI, it created a connection between the topics of the interview and their every-day work, thus increasing their motivation to answer the questions. It was also aimed at making participants more relaxed and getting used to the interview setting. A more substantial goal was setting a baseline for the subsequent questions regarding the inclusion of non-scientific actors.

"Do you think that the willingness of scientists to cooperate with one another has declined over the last years?"

26 interview partners thought that the **willingness to cooperate** has **increased** over the last years.[1] Some of the interview partners also answered that the willingness

[1] The following footnotes refer to the number of the interview transcript and the page. The # refers to the internal number given to each interview transcript. Upon request, we provide anonymised excerpts of relevant interviews. #006, p. 1; #009, p. 1; #010, p. 1; #015, p. 2; #017, p. 1; #018, p. 2; #026, p. 2; #029, p. 1; #031, p. 1; #032, p. 1; #033, p. 1; #035, p. 2; #041, p. 1; #044, p. 1; #045, p. 1; #050, p. 2; #053, p. 1; #057, p.1; #058, p.1; #060, p. 1; #063, p. 1; #067, p. 1; #068, p. 1; #069, p. 1; #070, p. 1; #083, p. 1

to cooperate has **not declined**.[2] This non-decrease might be meant to include an increase. 15 researchers judged the cooperation as staying on the **same level** as in the last years.[3] Four researchers concluded that cooperation **declined** over the last years[4] and responded that many researchers now work behind closed doors[5] or that "people you worked with before, they now do the same stuff on their own and they don't talk about it."[6] On the other hand, communication was seen as being easier now because of the internet.[7]

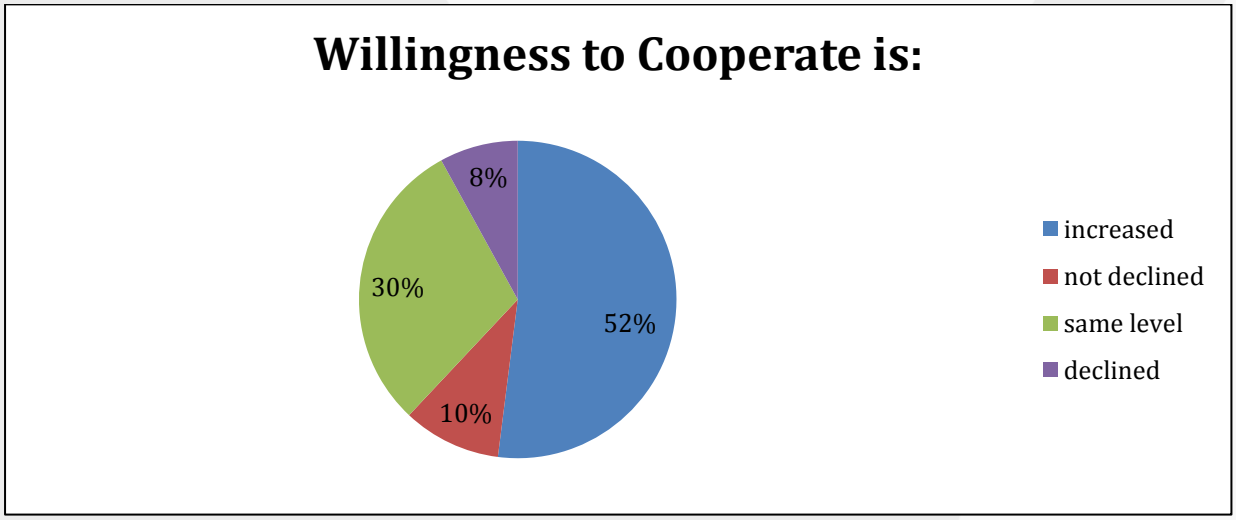

Figure 11: Willingness to Cooperate

3.3 EXPERIENCES AND VIEWS

In the first part of the interview, Leading Researchers and Research Executives were asked for their personal experiences regarding Responsible Research and Innovation. The intention of this topical block of questions was to receive information about the respondents' encounters with RRI and not just about their general views and intuitions about RRI. This emphasis on concrete experiences was supposed to prompt more specific and thus more illuminating answers. This stress laid on the particulars was further strengthened by asking for examples, positive and negative, of RRI.

[2] #009, p.1; #014, p. 2; #019, p. 1; #020, p. 1; #024, p. 1
[3] #005, p. 1; #012, p. 2; #022, p. 2; #027, p. 1; #030, p. 1; #039, p. 1; #052, p. 1; #054, p. 1; #066, p. 1; #071, p. 1; #073, p. 1; #077, p. 1; #079, p. 1; #080, p. 1; #082, p. 1
[4] #011, p. 1; #025, p. 1; #042, p. 2; #049, p. 1
[5] #006, p. 2
[6] #025, p. 1; #035, p. 2
[7] #005, p. 2; #027, p. 1; #050, p. 2; #052, p. 1

3.3.1 LEADING RESEARCHERS

3.3.1.1 Role of Science in Society

"What role do you see for science (or research) in society?"

When Leading Researchers were asked what role they see for **science in society**, they generally responded that it plays an important role for **social progress**, human well-being and overcoming social challenges[8], for example via "Innovation, new technologies, new treatment modalities [...] Better cars, better television sets, better internet progress."[9] Many participants also granted a two-fold role to science, namely addressing social challenges, on the one hand, and creating **understanding** of the world, on the other[10]: "There is a role of science to make sense of the world around us, and there is a role for [...] more application-oriented science and research to solve problems, to create solutions, to find new ways of looking at things."[11] Fundamental research was sometimes seen as forming the basis of socially beneficial applications.[12] Only one participant did not refer to societal impact as an achievement of science but only to the improvement of knowledge.[13] Other roles of science frequently mentioned were **education**[14] as well as communicating with the public and **disseminating knowledge**[15].

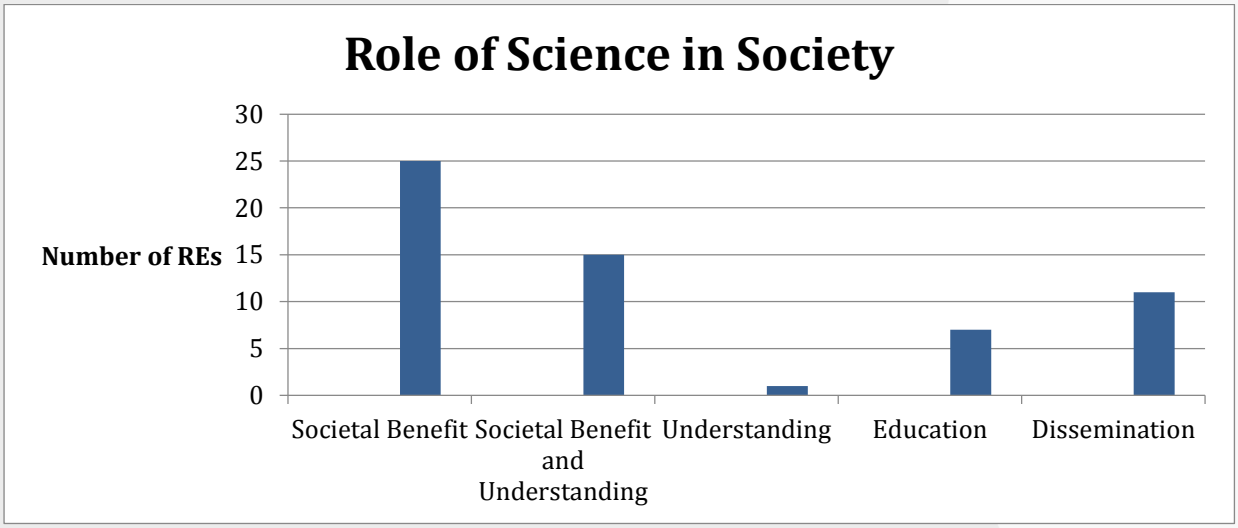

Figure 12: Role of Science in Society according to Leading Researchers

[8] #003, p. 1; #005, p. 2; #009, p. 2; #014, p. 2; #017, p. 2; #018, p. 2; #022, p. 2; #020, p. 1; #025, p. 1; #026, p. 2; #031, p. 2; #032, p. 2; #033, p. 2; #035, p. 2-3; #039, p. 1; #042, p. 2; #044, p. 1; #049, p. 1; #053, p. 1-2; #057, p. 2; #058, p. 1; #063, p. 1; #067, p. 1; #071, p. 1; #082, p. 1-2
[9] #005, p. 2
[10] #004, p. 1; #006, p. 2; #012, p. 2; #019, p. 1; #030, p. 2; #041, p. 1; #045, p. 1; #054, p. 1-2; #066, p. 2; #069, p. 1; #073, p. 1; #077, p. 1-2; #079, p. 2; #080, p. 1; #083, p. 1-2
[11] #066, p. 2
[12] #019, p. 1; #030, p. 2; #041, p. 1; #080, p. 1
[13] #011, p. 2
[14] #006, p. 2; #011, p. 2; #019, p. 1; #020, p. 1; #042, p. 2; #068, p. 1; #077, p. 1-2
[15] #006, p. 2; #015, p. 3; #020, p. 1; #025, p. 1; #029, p. 1-2; #031, p. 2; #068, p. 1; #069, p. 1; #073, p. 1; #077, p. 1-2; #079, p. 2

3.3.1.2 Experience with Science in Society

"What is your personal experience with science or research in society? For example, how do you engage people in your research? Or do societal challenges influence the research projects which you have conducted or have sought funding for?"

Leading Researchers also talked about their **experience with science or research in society**. The majority stated that **societal challenges** influence their research.[16] For example, a professor for landscape architecture said: "[…] we're interested in research that is useful and usable."[17] Whether societal challenges are addressed in research also depended on funding opportunities and requirements.[18] Another relevant factor named by Leading Researchers was the field of research. Social challenges were seen as playing a bigger role in applied than fundamental research.[19] A researcher working in biophysics stated: "Sometimes I do not know what the applications are, but I am happy that there are other people [who] find the applications for some of the science that we discover."[20] When asked for their experiences with engagement, the vast majority of Leading Researchers mentioned **dissemination activities** for public involvement. Some participants also mentioned that they involve stakeholders[21], partly because it is a funding requirement[22]. Two interviewees commented that they do not view engagement as a precondition for addressing social challenges.[23] Correspondingly, their idea was to do research for the benefit of society, without actually inviting lay-participation.

3.3.2 RESEARCH EXECUTIVES

3.3.2.1 Role of Institutions in Society

The distinctive feature of questions directed at Research Executives is asking for RRI in relation to their institution rather than their personal experience as in the case of Leading Researchers.

"How would you describe the role of your institution in society?"

[16] #002, p. 2; #004, p. 3; #005, p. 3; #006, p. 3; #010, p. 2; #014, p. 3; #017, p. 2; #018, p. 2-3; #020, p. 2; #028, p. 2; #029, p. 3; #030, p. 3; #032, p. 4; #044, p. 2; #054, p. 3; #057, p. 2; #066, p. 3; #068, p. 2; #073, p. 2; #079, p. 4
[17] #083, p. 2-3
[18] #002, p. 2; #011, p. 3; #006, p. 3; #029, p. 3; #054, p. 3; #067, p. 2; #069, p. 2; #079, p. 4; #083, p. 2-3
[19] #002, p. 2; #019, p. 2; #067, p. 2
[20] #069, p. 2
[21] #010, p. 2; #020, p. 2; #033, p. 3; #077, p. 3; #080, p. 2
[22] #003, p. 2; #054, p. 3; #066, p. 3
[23] #004, p. 3; #030, p. 3

The vast majority of Research Executives defined **their institution's role in society** as promoting **education** and/or **research**.[24] Many also mentioned contribution to societal benefit.[25] Often this was seen as an outcome of doing research and education, either by preparing students for taking on positions in society or by research being practically relevant, e.g., for policy or industry[26]. Generating **economic impact** was also frequently mentioned.[27]

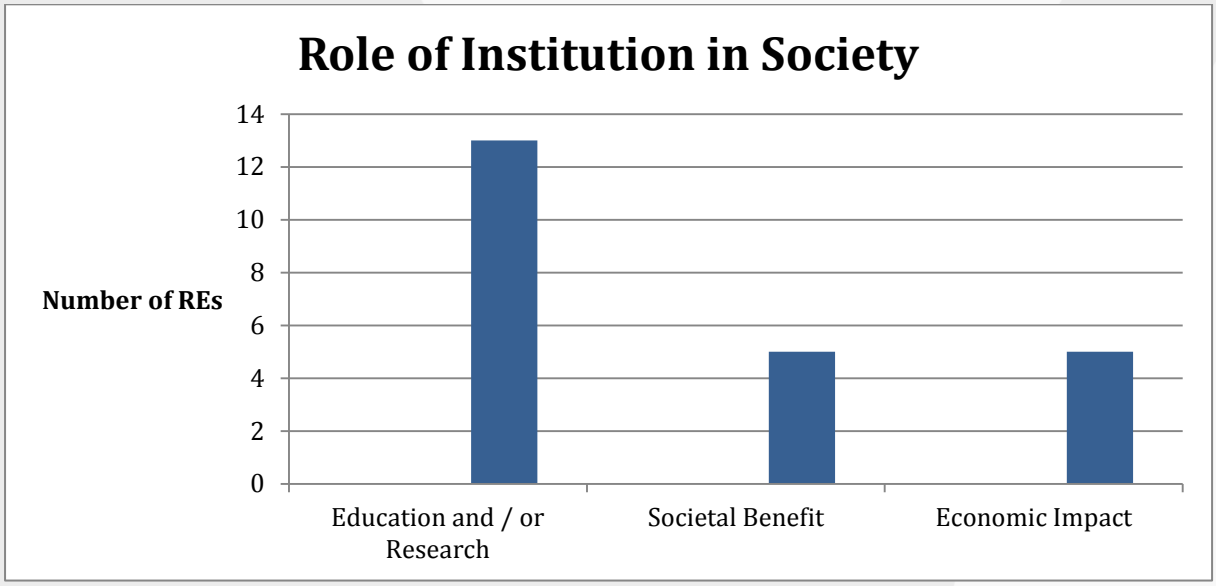

Figure 13: Role of their institution in society according to Research Executives

3.3.2.2 Experience With Science in Society

"What is your institution's experience with science or research in society? For example, how does your institution engage people in research? Or do societal challenges influence the research projects that your institution seeks funding for?"

When being asked to report their **experience with science in society**, most of Research Executives stated that **societal challenges** affect the research done at their institutions.[28] Whether topics are influenced by societal challenges also depended on whether it is a funding requirement.[29] Most Research Executives also said that their in-

[24] #001[RE], p. 2-3; #008[RE], p. 2; #012[RE], p. 2; #023[RE], p. 2; #062[RE], p. 2; #064[RE], p. 2; #065[RE], p. 1; #074[RE], p. 2; #075[RE], p. 1-2; #076[RE], p. 1-2; #081[RE], p. 1; #084[RE], p. 1; #087[RE], p. 1
[25] #007[RE], p. 2; #021[RE], p. 2; #056[RE], p. 1; #086[RE], p. 1; #087[RE], p. 1
[26] #016[RE], p. 2; #034[RE], p. 2; #046[RE], p. 3; #047[RE], p. 1; #055[RE], p. 1; #056[RE], p. 1; #062[RE], p. 1; #064[RE], p. 2; #065[RE], p. 1; #072[RE], p. 2; #074[RE], p. 2; #078[RE], p. 1-2; #084[RE], p. 1
[27] #001[RE], p. 2-3; #038[RE], p. 2; #062[RE], p. 2; #076[RE], p. 1-2; #085[RE], p. 2
[28] #007[RE], p. 3; #034[RE], p. 3; #038[RE], p. 2-3; #046[RE], p. 4; #047[RE], p. 2; #048[RE], p. 2; #051[RE], p. 2; #055[RE], p. 2; #056[RE], p. 2; #059[RE], p. 2; #062[RE], p. 2; #064[RE], p. 2; #065[RE], p. 2; #072[RE], p. 3; #074[RE], p. 3; #078[RE], p. 2-3; #081[RE], p. 2; #084[RE], p. 2
[29] #001[RE], p. 4; #074[RE], p. 3; #078[RE], p. 2-3; #089[RE], p. 2

stitution has experience with engaging non-scientists in research.[30] The extent of engagement differs, with **dissemination activities** being far more common than involvement in shaping research questions.[31]

In **conclusion**, both Leading Researchers and Research Executives respond that **societal challenges** play an important role in shaping the research agenda. However, Leading Researchers also highlight **fundamental research** that is chiefly aimed at understanding phenomena. Both groups agree that funding influences whether societal challenges are addressed. Regarding experiences with external engagement, both groups predominantly mention **dissemination activities**, while some respondents also report experience with more interactive formats.

3.3.2.3 Positive and Negative Examples for RRI

"Can you describe a positive example of Responsible Research and Innovation?"

"Can you describe a negative example?" [only Leading Researchers]

Both Leading Researchers and Research Executives were asked to give a **positive example** of RRI, Leading Researchers were also asked to give a **negative example**. The reason for this asymmetry was that Leading Researchers were asked more detailed questions about examples of RRI because they were expected to be more familiar with such cases (including negative ones) than the administrators.

Leading Researchers named diverse research projects and topics from different disciplines as examples. The common feature of the majority of positive examples was that they were aimed at either **fulfilling the needs of society** at large or of particular social groups. Most examples came from the medical area[32] with two respondents even stating that *all* research tackling diseases is responsible because it helps people[33]. Another large group of examples addressed demands for environmental protection and sustainability.[34] Other societal demands taken up in the examples were, among others, safety and security[35], technology assessment[36], development aid[37], prevention of conflicts and violence[38], gender equality[39] and the creation of jobs[40].

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[30] #001[RE], p. 4; #007[RE], p. 3; #008[RE], p. 3; #013[RE], p. 3; #023[RE], p. 2; #034[RE], p. 3; #038[RE], p. 2-3; #046[RE], p. 4; #047[RE], p. 2; #048[RE], p. 2; #055[RE], p. 2; #056[RE], p. 2; #059[RE], p. 2; #062[RE], p. 2; #065[RE], p. 2; #078[RE], p. 2-3; #081[RE], p. 2; #085[RE], p. 2

[31] #001[RE] p. 4; #007[RE], p. 3; #008[RE], p. 3; #023 [RE], p. 2; #038[RE], p. 2-3; #055[RE], p. 2; #062[RE], p. 2; #078[RE], p. 2-3; #085[RE], p. 2

[32] #002, p. 1-2; #004, p. 2; #015, p. 3; #022, p. 2; #024, p. 2; #025, p. 2; #028, p. 1-2; #030, p. 2-3; #034[RE], p. 2; #039, p. 2; #041, p. 2; #042, p. 2; #044, p. 2; #049, p. 1; #056[RE], p. 2; #061[RE], p. 1-2; #063, p. 2; #065[RE], p. 2; #067, p. 2; #068, p. 1; #073, p. 2; #080, p. 1; #081[RE], p. 1, 2; #084[RE], p. 1; #086[RE], p. 1

[33] #031, p. 2; #048[RE], p. 2

[34] #010, p. 2; #018, p. 2; #020, p. 1; #022, p. 2; #033, p. 2; #039, p. 2; #041, p. 2; #054, p. 2; #058, p. 1; #064[RE], p. 2; #073, p. 2; #075[RE], p. 2; #078[RE], p. 2; #080, p. 1; #082, p. 2; #083, p. 2; #085[RE], p. 2; #088, p. 2

[35] #005, p. 2; #014, p. 2; #023[RE], p. 2; #082, p. 2

[36] #001[RE], p. 3; #003, p. 1; #011, p. 2; #066, p. 2

Many participants also referred to a demand that was urgent in their local context like supporting local businesses[41], improving local infrastructure[42], health[43] or working conditions[44], supporting homeless people[45] or local adaptation to climate change[46], reducing traffic[47], lowering rates of students dropping out of university[48] and fighting poaching in national parks[49] or noise pollution[50].

In their positive examples of RRI, participants also frequently mentioned **engaging the public and stakeholders** to identify and meet their demands.[51] For instance, one participant brought up medical research on burns which was expanded to the itching associated with the burns after a focus group with patients.[52] Accordingly, several negative examples from Leading Researchers were based on a lack of engagement[53]: "So there's a lot of pushing forward of research agendas by not listening to the consumers and the society."[54], e.g., in research on GMOs[55]. Some positive examples also included communication with the public and the dissemination of knowledge.[56]

One respondent emphasised that RRI requires fulfilling societal demands:

> *"[Y]ou relate your research towards something which is of current, high interest for the society as well, not only for science. So, you are somehow spending tax payers' money in an appropriate way, not just to enjoy, let's say, science as an art or something which is of potential interest in the future [...] I think it is closer related to applications."*[57]

Correspondingly, some Leading Researchers chose research that fails to fulfil societal needs as a negative example for RRI. Two respondents from Serbia criticised research rather aimed at understanding:

> *"[...] some research activities are too much oriented towards something which is just of some potential interest. So you're developing something which provides you with some additional knowledge in a certain area, but it is uncertain why it is important. [...] But sometimes, in particular in my country where the budgets for research are very limited,*

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[37] #072[RE], p. 2-3; #080, p. 1
[38] #084[RE], p. 1
[39] #016[RE], p. 2; #053, p. 2
[40] #062[RE], p. 2
[41] #007[RE], p. 3; #033, p. 2, #070, p. 2-3
[42] #045, p. 2; #064[RE], p. 2; #082, p. 2
[43] #056[RE], p. 2
[44] #038[RE], p. 2
[45] #074[RE], p. 2-3
[46] #010, p. 2
[47] #083, p. 2
[48] #059[RE], p. 2
[49] #046[RE], p. 3-4
[50] #088, p. 2
[51] #007[RE], p. 3; #010, p. 2; #012[RE], p. 2-3; #018, p. 2; #021[RE], p. 2; #033, p. 2; #038[RE], p. 2; #044, p. 2; #046[RE], p. 3-4; #047[RE], p. 1-2; #053, p. 2; #054, p. 2; #064[RE], p. 2; #072[RE], p. 2-3; #076[RE], p. 2-3; #077, p. 2; #079, p. 2; #084[RE], p. 1; #086[RE], p. 1
[52] #024, p. 2
[53] #010, p. 2; 024, p. 2-3; #053, p. 2; #082, p. 2; #077, p. 3
[54] #033, p. 2
[55] #003, p. 2; #082, p. 2
[56] #003, p. 1; #035, p. 3; #088, p. 11
[57] #014, p. 2

you should think about research topics which are somehow focused towards improvement of the overall conditions in the country."[58]

The other one questioned doing research on human origins instead of diseases: "Why is it important who came from where and when?"[59]

By contrast, several Leading Researchers emphasised that RRI should not exclusively focus on applications but should also pursue **basic research** aimed at understanding[60]. Often, this was seen to lay the foundations for successful applications later on:

"But we also run formats that are more explorative in nature where we have a sometimes vague idea that a certain form of mechanism can be useful. And luckily it is also the case that we get that kind of research funded. And then we have a greater chance of arriving at unexpected results which then in the longer term become useful in another project."[61]

However, some also stated that even basic research should be aimed at fulfilling societal demand in the end in order to be responsible:

"[…] It does not have to be funding directly and visible to a product on the market placement that is new to medicine that will help people. It is more about a thinking behind it, and accepting that one's research at the end of the day ought to have some usefulness, although we never know what that usefulness will necessarily be."[62]

In contrast, one Leading Researcher named the decrease of funding for curiosity-driven research in Great Britain due to the accent placed on societal impact as a negative example of RRI.[63]

While many positive examples of RRI were aimed at improving the lives of people, many negative examples caused **harm**. Most prominently among them figured the development of nuclear weapons[64], research for military use and double-use technologies[65]. However, one respondent also mentioned the use of mathematical models by banks in the financial crisis of 2008: "I always joke after this crisis in 2008, now mathematicians join the club of physicists in producing weapons of mass destruction."[66] These answers indicate that scientists feel responsible for the use made of their research beyond their laboratories. This is also supported by the negative examples of RRI which

[58] #014, p. 2-3
[59] #017, p. 3
[60] #003, p. 2; #006, p. 3; #019, p. 1-2; #041, p. 2; #069, p. 2
[61] #041, p. 2
[62] #069, p. 2; see also #003, p. 2
[63] #032, p. 2-3
[64] #004, p. 2; #005, p. 2-3; #044, p. 2; #049, p. 1; #066, p. 2
[65] #002, p. 2; #026, p. 3; #067, p. 2; #068, p. 2; #070, p. 3; #073, p. 2
[66] #028, p. 2

referred to **harmful side effects** of research that were either not foreseen or not heeded by researchers[67], e.g., ignoring the possible impact of DNA sequencing technologies on conceptions of human beings[68] or cutting out ethical issues when developing self-driving cars[69]. Two respondents' positive examples of RRI included interdisciplinary collaboration to assess societal impact of research.[70] A few participants thought that the commitment to RRI in general may cause harm. One participant criticised societal restrictions on research topics and one respondent stated that prohibition of controversial innovations like GMOs or cloning can hinder social progress.[71]

An additional aspect of RRI highlighted by Leading Researchers was respect for **ethical restrictions**[72], e.g., informed-consent procedures or the ethical treatment of laboratory animals. Also, **scientific integrity** was mentioned several times as a requirement for RRI.[73] Misconduct like plagiarism and fabrication of results was cited as irresponsible research.[74] A specific example that was brought up several times was research erroneously linking MMR vaccines and neurological disorders in children.[75] This flawed study attracted a lot of attention among the wider public and led to a decrease in vaccination rates and thus to a loss of herd immunity. The irresponsible character of the study was attributed to its poor scientific quality,[76] but also to negligent peer review that had enabled its publication in the first place[77]. In addition, it was likewise held to be irresponsible to make the mistaken results available to the press prior to publication[78], which violated the code of conduct among researchers. Another group of negative examples given by Leading Researchers focused on **biased interests** influencing research[79]. This mostly concerned profit-seeking of companies who design clinical trials specially to obtain desired results[80] or block publication of unfavourable studies[81].

[67] #005, p. 2-3; #041, p. 2
[68] #011, p. 2-3
[69] #066, p. 2
[70] #011, p. 2-3; #030, p. 2-3
[71] #012, p. 3; see also #063, p. 2
[72] #012, p. 3; #029, p. 2; #032, p. 3; #057, p. 2, #012, p. 2-3; #019, p. 2; #025, p. 2; (#031, p. 2; #032, p. 4; #057, p. 2; #073, p. 2; #083, p. 2
[73] #009, p. 3; #032, p. 3; #079, p. 2
[74] #006, p. 3; #025, p. 2; #029, p. 2; #067, p. 2; #068, p. 2; #071, p. 2
[75] #022, p. 3; #039, p. 2; #079, p. 3
[76] #022, p. 3; #039, p. 2
[77] #022, p. 3
[78] #079, p. 3
[79] #032, p. 2-3; #045, p. 2; #069, p. 2
[80] #022, p. 3
[81] #079, p. 7

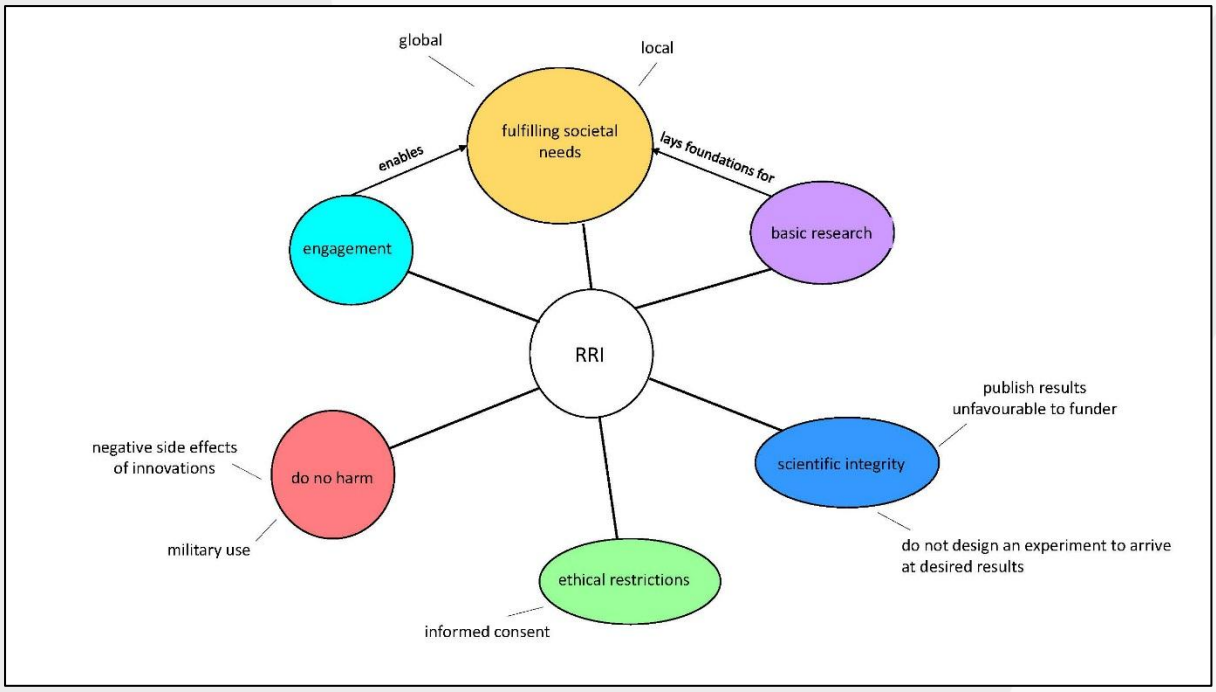

Figure 14: Features of RRI examples given by participants

All in all, the most common feature of positive RRI examples was fulfilling societal needs, sometimes via participatory formats. However, Leading Researchers also emphasised the need for basic research. Opinions were divided over the justification for sponsoring basic research. Some stressed its long-term impact on socially productive results, others highlighted a genuine, non-instrumental role for understanding in scientific knowledge production. In their negative examples, Leading Researchers frequently mentioned causing harm, also via harmful side effects of innovations. Additionally, ethical considerations and scientific integrity were cited as aspects of RRI, while biased influence on research was seen as doing damage to RRI.

3.4 ENGAGEMENT

The following set of questions was intended to explore views and intuitions regarding taking influences from outside of science into consideration for one's own work. These questions were aimed to encourage participants to think about the potential of social engagement in research. The two groups in question are stakeholders and lay people. Participants were invited to ponder both the positive and negative impact of input from the general audience.

3.4.1 LEADING RESEARCHERS

3.4.1.1 POSSIBILITIES FOR SOCIAL ENGAGEMENT IN RESEARCH

"What possibilities do you see for engaging stakeholders or lay people in your own research?"

All Leading Researchers who answered the question about **possibilities for engagement from outside of science in their own research** saw options to introduce **stakeholders and lay people** into their own research. Lay people are members of the society at large without any vested interest in particular research outcome. Stakeholders, by contrast, do pursue such interests. Stakeholder groups range from industry to patient groups. Whereas stakeholders work for their own benefit, lay people are taken to represent the common good.

Out of 53 interview partners 34 mentioned examples of interacting with stakeholders and lay people[82], 13 gave examples only for interactions with **stakeholders**[83] and four only with **lay people**[84]. But this does not mean that they were working with only one group. As to the channels of interaction, eleven interview partners mentioned especially public talks, lectures or events[85], four are working with television[86], three with newspapers[87], five with schools[88] and one with charities[89].

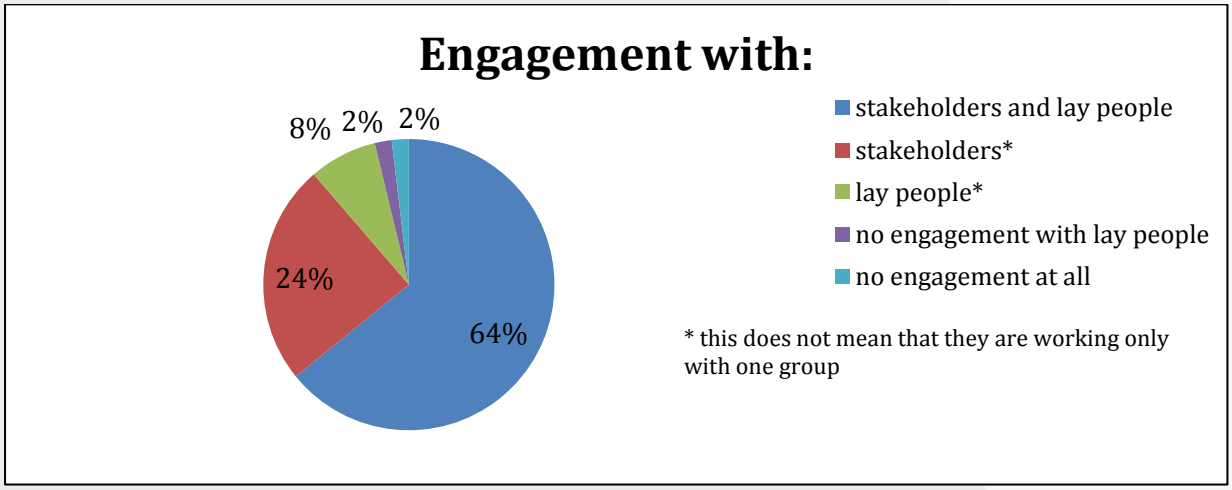

Figure 15: Engagement

[82] #003, p. 3; #005, p. 3-4; #006, p. 4; #010, p. 3; #011, p. 3-4; #015, p. 4; #017, p. 4; #018, p. 3; #019, p. 3; #020, p. 2; #022, p. 4-5; #026, p. 4; #029, p. 3; #030, p. 3-4; #032, p. 5-6; #033, p. 3; #035, p. 4-5; #039, p. 2-3; #041, p. 3; #042, p. 3; #045, p. 3; #050, p. 3; #053, p. 3; #054, p. 3; #057, p. 2; #063, p. 3; #066, p. 3; #067, p. 2-3; #071, p. 2-3; #073, p. 2; #079, p. 4; #080, p. 2, 6; #082, p. 3; #083, p. 3

[83] #002, p. 3; #004, p. 3-4; #014, p. 3-4; #024, p. 4; #025, p. 2; #027, p. 2-3; #028, p. 2; #031, p. 3; #044, p. 3; #060, p. 2; #069, p. 3; #070, p. 3; #077, p. 4

[84] #012, p. 4; #052, p. 3-4; #058, p. 2; #088, p. 9

[85] #005, p. 3; #011, p. 3; #015, p. 4; #019, p. 3; #020, p. 2; #022, p. 4; #026, p. 4; #032, p. 5; #033, p. 3; #041, p. 3; #063, p. 3

[86] #005, p. 3; #026, p. 4; #029, p. 3; #039, p. 3

[87] #032, p. 5; #033, p. 3; #041, p. 3

[88] #003, p. 3; #012, p. 4; #050, p. 3; #063, p. 3; #088, p. 9

[89] #022, p. 4

Venues envisaged for interacting with **lay people** included **public events** where researchers can present their research.[90] Writing for newspapers and general magazines and giving public talks are other options mentioned.[91] As a result, Leading Researchers generally thought of lay participation in terms of science communication and public education. [92] Society at large is thought to familiarise itself with scientific findings and their benefits. Another type of involvement mentioned for lay people was assistance, e.g., in data collection.[93] In this vein, Citizen Science is advanced as an aspect of RRI: "The whole idea of Citizen Science, I think, has many positive aspects which can include collection of data, again the challenge is robustness of the data and what is missing and whether you're getting a very biased set of data. […]."[94] In other words, this researcher thought of an active role of lay people in collecting data and supplying evidence. But this idea of Citizen Science is certainly not widespread in the scientific community.

Another possible contribution of lay people was directing the research agenda to topics of societal importance[95]: "people can ask sometimes better questions than we can."[96] However, this kind of influence is much more frequently mentioned in connection with stakeholders[97]: "They are the users of the potential product and therefore can define the conditions best. In this way we can consider far more realistic conditions than if we carried on without consulting them."[98] One respondent working at a Science Shop envisaged a particularly wide and influential role for stakeholders:

"[T]hey can bring in the questions, so they can set the research agenda, they can be advisors because of the knowledge they have, they can be some kind of a reality check on what is happening in research and if the research is leading into a direction, which is applicable. They can cooperate in the research, starting from data collection, but not just data collection, they can bring in their own expertise and run their own experiments in the research setup. They can analyse the results of the research, they can evaluate the research. And of course, they can take part in advisory boards set up by funders to make sure that the research is following societal interests and considers ethical concerns in the understanding of Responsible Research and Innovation."[99]

As a result, interaction with non-scientists was widely welcomed by Leading Re-

[90] #004, p. 4; #039, p. 3; #041, p. 3; #044, p. 4; #063, p. 4
[91] #039, p. 3
[92] #003, p. 3; #005, p. 4; #015, p. 5; #019, p. 3; #020, p. 2; #026, p. 4; #029, p. 3; #032, p. 5; #033, p. 3; #039, p. 2-3; #041, p. 3; #044, p. 4; #049, p. 2; #063, p. 3; #066, p. 3; #069, p. 3; #079, p. 4; #082, p. 4
[93] #017, p. 4-5; #049, p. 2; #058, p. 2; #068, p. 2; #083, p. 3-4
[94] #083, p. 3-4
[95] #010, p. 3; #028, p. 3; #052, p. 4-5
[96] #018, p. 3
[97] #002, p. 3; #004, p. 3-4; #015, p. 4-5; #20, p. 2; #030, p. 3-4; #041, p. 3; #052, p. 3-4; #053, p. 4; #054, p. 3; #063, p. 3; #066, p. 3; #069, p. 3; #077, p. 4; #079, p. 5; #080, p. 3
[98] #079, p. 5
[99] #053, p. 4

searchers. The public (lay people and stakeholders alike) is seen as the customer putting scientific results to use. Input regarding possible research topics is broadly appreciated.

3.4.1.2 Differences of engagement possibilities between research areas

"What possibilities do you see for engaging stakeholders in fields of research other than your own?"

The possibilities Leading Researchers see for lay and stakeholder **engagement in various research areas** differ. Fundamental research fields[100], such as mathematics and theoretical physics, were assumed to offer fewer options for engagement[101]: "I think the more applied the topic is, the more important it is."[102] All in all, **applied research fields** were seen as more suited for engagement than fundamental or theoretical fields.[103] **Relevance** of a topic for stakeholder and lay people was also required.[104] For example, one interviewee stated that research on prevention of earthquakes is better suited for engagement than philosophical inquiries because citizens are more aware of safety problems than of philosophical questions they might have.[105]

3.4.1.3 Hopes Regarding the Possibilities of Engagement

"What hopes and worries do you have?"

37 interview partners mentioned **hopes** for engaging stakeholders and lay people[106]. Eleven interview partners stated specifically that they hope to get more engagement with stakeholders and lay people[107] because, for example, people ask better questions[108] or the quality of research[109] should be improved by the involvement. Five interview partners hoped that they might "find some problems or issues in society where you can contribute, somehow, to solve it."[110] One interview partner welcomed public input "for what I have seen and I have read, people can really have very positive

[100] #020, p. 3; #077, p. 4; #080, p. 3
[101] #012, p. 4; #024, p. 4; #028, p. 2
[102] #080, p. 3
[103] #002, p. 3; #003, p. 3; #012, p. 4; #020, p. 3; #028, p. 2; #060, p. 2; #077, p. 4; #080, p. 3
[104] #018, p. 3; #031, p. 3; #066, p. 3; #071, p. 3
[105] #024, p. 4
[106] #002, p. 4; #003, p. 3; #005, p. 4; #006, p. 4; #010, p. 3; #011, p. 5; #012, p. 4; #014, p. 4; #015, p. 6; #018, p. 3; #020, p. 3; #022, p. 7; #024, p. 4; #027, p. 4; #028, p. 3; #029, p. 4; #030, p. 4; #031, p. 3; #032, p. 6-7; #035, p. 6; #042, p. 3; #044, p. 4; #045, p. 3; #049, p. 2; #054, p. 4; #057, p. 3; #060, p. 3; #063, p. 4; #066, p. 4; #067, p. 3; #069, p. 3; #070, p. 4; #071, p. 3; #077, p. 4; #079, p. 6; #080, p. 3-4; #082, p. 4
[107] #010, p. 3; #012, p. 4; #015, p. 6; #018, p. 3; #020, p. 3; #024, p. 4; #027, p. 4; #031, p. 3; #042, p. 3; #057, p. 3; #060, p. 3; #071, p. 3; #079, p. 6; #082, p. 4
[108] #018, p. 3
[109] #015, p. 6; #077, p. 4;
[110] quotation from #028, p. 3; #002, p. 4; #069, p. 3; #070, p. 4; #077, p. 4

thoughts"[111]. Interview partners had the hope to foresee consequences and avoid undesirable directions for society.[112] Another one hoped that "results get distributed more, that results don't just end up in a report which will never be read." So, one major hope is to raise **practical relevance** and **social robustness** of research via engagement. Another hope is tied to raising **understanding** and thus **support** for science: society should be more open and have a better understanding of research[113]. Another one would like to "correct people's misgivings sometimes, and to inform people about what science actually does"[114]. Other researchers hoped to get more support, for example, support for communication[115], donated equipment[116] or budget from the government[117].

Two kinds of hopes are tied up with heeding input from outside of science. First, lay people and especially stakeholders may pass worthwhile judgment on which kinds of research produce potentially socially detrimental impact. As a result, this involvement is granted a constructive role in shaping the direction of research. Second, other researchers thought of interacting with groups from outside of science, especially lay people, primarily in terms of science communication. These Researchers saw RRI as an opportunity for sharing their own findings with the public. Such a wider distribution of research results was also hoped, in addition, to increase the sense of relevance of the projects in question among university leaders and political institutions and thus to contribute to additional funding. Stakeholders were also seen as a potential funding source. However, Leading Researchers did not always distinguish unambiguously between stakeholder and lay involvement and conflated the two as societal response.

3.4.1.4 Worries Regarding the Possibilities of Engagement

"What hopes and worries do you have?"

47 Leading Researchers talked about their **worries**[118]. One interview partner worried about not producing useful research or that the "research will just be left unused or ignored".[119] A worry concerning **lay people** engagement that was mentioned by seven participants was their **lack of knowledge** on scientific topics.[120] This was feared

[111] #011, p. 5
[112] #030, p. 4; #054, p. 4
[113] #003, p. 3; #005, p. 4; #032, p. 6; #044, p. 4; #049, p. 2; #066, p. 4
[114] #069, p. 3
[115] #006, p. 4
[116] #029, p. 4; #067, p. 3
[117] #014, p. 4
[118] #002, p. 4; #003, p. 3; #006, p. 4; #009, p. 4; #010, p. 3; #011, p. 4; #012, p. 4-5; #014, p. 4; #015, p. 6; #018, p. 3; #019, p. 4-5; #020, p. 3; #022, p. 6; #024, p. 4-5; #025, p. 3; #026, p. 5; #027, p. 3-4; #029, p. 4; #030, p. 4; #031, p. 3-4; #032, p. 7; #033; p. 4; #035, p. 6; #039, p. 3; #041, p. 4; #042, p. 3; #044, p. 4; #049, p. 2; #050, p. 4; #052, p. 4; #053, p. 4-5; #054, p. 4; #057, p. 3; #058, p. 2; #060, p. 3; #063, p. 4; #066, p. 4; #067, p. 3; #068, p. 3; #070, p. 4; #071, p. 3; #073, p. 3; #077, p. 5; #079, p. 4-6; #080, p. 3; #082, p. 4; #083, p. 4
[119] #002 p. 4
[120] #004, p. 3-4; #011, p. 4; #019, p. 4,5; #020, p. 3; #028, p. 2; #029, p. 4; #033, p. 4; see also #019, p. 3

to hinder useful input, for example if lay people are not up to date with research: "So if you ask the society about: 'What should we do on the environmental problems?' they come up with things like: 'Well, let's separate paper from glass or so' and we already do that. So what worries us then is that, you see, there is a long way to go from what people in general think about a topic and what actually scientists are able to do."[121] Researchers saw a gap between the desires and preferences of the public and what science may be able to accomplish.[122] It was a general concern that scientific messages would not come across well in the interaction with the public and that the image of science could be hurt. Someone worried that newspaper writers "are normally not specialists, and are almost always not scientists either."[123] This can lead to **miscommunication** and misrepresentation.[124] Another one thought that scientists themselves were not able to deliver messages to the public well because they lack the required competency.[125] So, incompetent science communication was feared to backfire. Also, lay people were seen as being not interested in specialised university research.[126] Therefore, it was said to be a waste of money to try to engage them.[127]

Ten interview partners worried that less **time** is left for research because of too much effort spent on communication.[128] Therefore, RRI engagement might put researchers behind in the **competition** for excellence and funding.[129] Some of them explained that their role in and for RRI engagement is not clear.[130]

Regarding **stakeholder** involvement, the influence of economic companies but also politics is viewed rather negatively as the pursuit of **biased interests** regarding topics but also results that could infringe on the freedom or research.[131] Engagement was feared to be pushed in inappropriate respects[132], e.g., research could be affected by political opportunities[133]. It was thought that politicians might use their power to instrumentalise science,[134] or that stakeholder influence might not always seek the public good. The pharmaceutical industry does not necessarily care about curing patients.[135] One interviewee described a worry about research funded by the pharmaceutical industry: "you might end up in a situation where you find out that a particular drug is not working or something, and that these results are not published, because they are not favourable to the party that is funding the research."[136] Companies put pressure on re-

[121] #033, p. 4
[122] #033, p. 4; #071, p. 3
[123] #039, p. 3
[124] #039, p.3; #079, p. 5
[124]#039, p. 3; #041, p. 4
[125] #033, p. 4; #073, p. 3
[126] #049, p. 2; #079, p. 6
[127] #044, p. 4; #053, p. 4; #054, p. 4; #058, p. 2
[128] #009, p. 4; #015, p. 6; #035, p. 6; #053, p. 4; #054, p. 4; #058, p. 2; #060, p. 3; #063, p. 04; #080, p. 3; #082, p. 4
[129] #017, p. 5; #025, p. 3; #060, p. 3
[130] #006, p. 4; #020, p. 3; #077, p. 5
[131] #002, p. 4; #010, p. 3; #011, p. 4; #022, p. 6; #028, p. 3; #030, p. 4; #031, p. 3-4; #044, p. 4
[132] #052, p. 4
[133] #019, p. 5
[134] #011, p. 4;#044, p. 4 #079, p. 4
[135] #022, p. 6
[136] #002, p. 4

sults and outcomes which might lead to "los[ing] sight of the more fundamental side of the research that needs to be done."[137]

In conclusion, the worries reported by Leading Researchers concerned the fear that the public could encroach on the autonomy of research and that its lack of familiarity with research matters could overstrain scientists. Stakeholders are feared to promote their own interests that are not always in conformity with the common good.

3.4.1.5 Conditions Regarding the Possibilities of Engagement

"What conditions must be fulfilled in order for these possibilities of engagement to be realised?"

51 interview partners talked about the **conditions** that must be fulfilled in order for engagement to be realised[138]. **Openness** on both sides to talk, and to listen and understand[139], as well as good communication with stakeholders and citizens is needed[140]. This can be achieved, for example, with public debates[141], or universities should be connected to primary schools[142] and there could also be more intensive cooperation with non-academic institutions[143].

"There must be an astral coincidence, so that it is the right timing, you find the right person when you want to find. There are a lot of politicians out there, lot of stakeholders, not all are equal, publics are different, so you need to engage and find the right one, to find the right message. And the right tool to portray this message. So, as I said, it's really intricate, sometimes you need also some luck."[144]

But there should be a balance between engagement and research[145] and engagement should be relevant for the **competition** between researchers[146] and should be acknowledged and rewarded[147]. A few interview partners claimed that they needed more **money**[148] and **time**[149] to bring in more parties. Lay people should be trained[150] to

[137] #066, p. 4, #060, p. 3
[138] #002, p. 4-5; #003, p. 3; #004, p. 4; #005, p. 4; #006, p. 5; #009, p. 4; #010, p. 4; #011, p. 5-6; #012, p. 5; #014, p. 4; #015, p. 2, 5; #017, p. 6; #018, p. 3; #019, p. 5; #020, p. 3-4; #024, p. 5; #025, p. 2-3; #026, p. 5; #027, p. 4; #028, p. 3; #029, p. 4; #030, p. 5; #031, p. 4; #032, p. 7; #033, p. 4-5; #035, p. 6, ; #039, p. 3; #041, p. 4; #044, p. 5; #045, p. 3; #049, p. 2; #050, p. 4; #052, p. 5; #053, p. 5; #054, p. 4; #057, p. 3; #058, p. 3; #060, p. 3; #063, p. 4; #066, p. 4; #067, p. 3; #068, p. 3; #069, p. 3; #070, p. 4; #071, p. 3; #073; p. 3; #077, p. 5; #079, p. 6; #080, p. 3; #082, p. 4; #083, p. 4
[139] #003, p. 3; #044, p. 5; #052, p. 5;# 053, p. 5; #066, p. 4; #067, p. 3; #083, p. 4
[140] #006, p. 5; #010, p. 4; #024, p. 5; #032, p. 7; #041, p. 4; #054, p. 4; #058, p. 3; #070, p. 4; #073, p. 3; #077, p. 5
[141] #028, p. 3
[142] #017, p. 6
[143] #027, p. 4
[144] #071, p. 3
[145] #015, p. 2
[146] #025, p. 3
[147] #079, p. 6
[148] #006, p. 5; #015, p. 2; #018, p. 3; #026, p. 5; #045, p. 3; #050, p. 4; #057, p. 3; #080, p. 3; #082, p. 3

get the experience that is needed[151] but scientists should be trained, too[152]. The goal of the engagement and what all sides can expect from each other should be clear.[153]

In summary, three conditions were highlighted that would promote RRI engagement. First, researchers want to see their commitment to RRI pay off in terms of their **career**. They demand that such activities be recognised and that they are tied to career opportunities. Second, entering into a dialogue with the public presupposes **funding** specifically directed to this purpose. Scientists feel that they need assistance if they are supposed to productively interact with the general audience in terms of time, rewards, money and training.[154] A third condition that was brought up frequently was that science as well as external parties need to make an effort to enter into a genuine **dialogue**.[155] This requires willingness and openness on the side of the scientists as well as interest in scientific matters on the part of the public and stakeholders. In addition, the reciprocal expectations should be communicated clearly.

3.4.2 RESEARCH EXECUTIVES

"What possibilities do you see for engaging stakeholders or lay people in your own institution?"

"How do these possibilities of engagement differ between different research areas?"

"What hopes and worries do you have with regard to these possibilities for engagement?"

"What conditions must be fulfilled in order for these possibilities of engagement to be realised in your institution?"

3.4.2.1 Lay people Engagement

When being asked for the **possibilities of engagement** in their institutions, 12 Research Executives talked about lay people engagement. Research Executives viewed **lay people** primarily as recipients of **information** about science. They mentioned dis-

[149] #009, p. 4; #018, p. 3; #063, p. 4; #069, p. 3; #077, p. 5; #080, p. 3; #082, p. 3
[150] #011, p. 5; #066, p. 4
[151] #029, p. 4
[152] #039, p. 3; #073, p. 3
[153] #020, p. 3; #030, p. 5; #035, p. 6; #039, p. 3; #068, p. 3
[154] #006, p. 5; #009, p. 4; #015, p. 5; #018, p. 3; #025, p. 3; #026, p. 5; #039, p. 3-4; #045, p. 3; #057, p. 3; #063, p. 4; #073, p. 3; #077, p. 5; #079, p. 6; #080, p. 3; #082, p. 4
[155] #003, p. 4; #015, p. 2; #024, p. 5; #028, p. 3; #030, p. 5; #032, p. 7; #035, p. 6; #041, p. 4; #044, p. 5; #049, p. 2; #053, p. 5; #057, p. 3; #066, p. 4; #070, p. 4; #073, p. 3

semination activities like talks, open days, festivals and school programmes.[156] Science Shops were also brought up.[157] However, a more active role of lay people in influencing the research agenda was also envisaged. An example cited was the Dutch National Research Agenda which welcomes public input. [158]

If Research Executives identified **differences in engagement possibilities** for lay people between research fields, they often distinguished **humanities**, **social sciences** and **health sciences** from more technical or theoretical research fields like nuclear physics, sociological theory or mathematics. The former were seen to have a closer connection to the everyday life of lay people, therefore being more accessible, even without expertise in the field, and better suited for engagement.[159] Interest of and relevance for lay people was perceived to vary between research areas, being higher in applied work[160]: "if you're doing more fundamental research in a lab, then the distance to, let's say, its application and societal impact may be much larger […] if we are talking about new technology or the design of social interventions, this could be with direct engagement of the public because they have a vested interest in the application or situation that you wish to affect."[161] Another reason given for this difference was that lay people are rather able to provide values, worries and relevance assessments than knowledge on technological specificities.[162] Also, scientists from some disciplines were seen as being more inclined to engagement, e.g. social scientists[163], engineers[164] and scientists from applied research fields[165].

A **hope** Research Executives frequently articulated is that involvement of lay people increases the odds for science to address and solve pressing **societal problems**.[166] Hopes to raise **interest** in and **acceptance** of research by communicating its benefits were also mentioned,[167] but there were worries that the options of lay people to shape the pathways of science would be constrained by their **lack of familiarity with scientific topics**.[168] Another worry was that lay people are too easily influenced by emotional arguments rather than expert knowledge and evidence.[169] In a similar vein, one respondent stated that lay people influence is often perceived as lowering the objectivity and thus the quality of research and makes publication more difficult: "So, I think you can do an excellent piece of research with very strong engagement from lay people and

[156] #016[RE], p. 3; #034[RE], p. 3; #038[RE], p. 4; #048[RE], p. 2; #055[RE], p. 2; #072[RE], p. 3-4; #078[RE], p. 3; #081[RE], p. 2; #084[RE], p. 2
[157] #013[RE], p. 3; #064[RE], p. 3
[158] #076[RE], p. 3
[159] #008[RE], p. 4; #047[RE], p. 2; #055[RE], p. 2; #056[RE], p. 3; #059[RE], p. 3; #065[RE], p. 3; #072[RE], p. 4; #075[RE], p. 2; #078[RE], p. 3-4
[160] #065[RE], p. 3; #072[RE], p. 5
[161] #076[RE], p. 4; see also #051[RE], p. 2
[162] #001[RE], p. 5
[163] #056[RE], p. 3
[164] #076[RE], p. 4
[165] #086[RE], p. 6
[166] #001[RE], p. 5, #008 [RE], p. 4-5; #061[RE], p. 3; #074[RE], p. 4; #085[RE], p. 3
[167] #008 [RE], p. 4-5; #038[RE], p. 3, 4; #055[RE], p. 3; #084[RE], p. 2
[168] #007[RE], p. 4-5; #008[RE], p. 3, 5; #051[RE] p. 3; #059[RE], p. 4
[169] #055[RE], p. 3; see also #061[RE], p. 2, 3

actually then run into problems in terms of publications".[170] Among the **conditions** for lay people engagement was ensuring their **competence**, e.g., by educating them beforehand.[171] Also, Research Executives demanded that lay people interested in engagement should be willing to commit the necessary amount of time.[172]

3.4.2.2 Stakeholder Engagement

When asked about the **possibilities of engagement** in their institutions, 21 Research Executives talked about **stakeholder** engagement. Industry was mentioned most frequently as a possible stakeholder.[173] Other stakeholders commonly mentioned were governmental agencies[174] and NGOs[175]. Also, the possibility of engaging patient groups in medical research was brought up several times.[176] The role assigned to stakeholders in the research process varied[177], ranging from funding[178] over formulating needs and setting research topics[179] to active involvement and evaluation[180]. The latter was mainly the case in medical research involving patients.

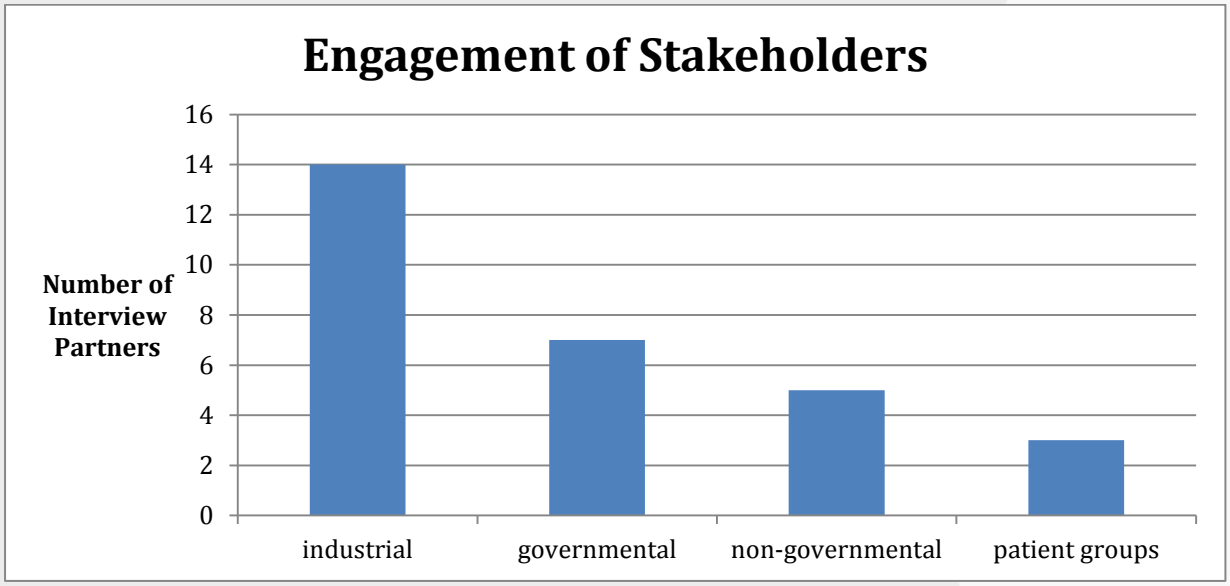

Figure 16: Types of stakeholders mentioned by Research Executives

[170] #074[RE], p. 3-4
[171] #007[RE], p. 5; #013[RE], p. 4; #048[RE], p. 2
[172] #065[RE], p. 3; #072[RE], p. 3-4
[173] #001[RE], p. 4; #016[RE], p. 3; #021[RE], p. 3; #034[RE], p. 3; #047[RE], p. 2; #059[RE], p. 3; #061[RE], p. 2; #062[RE], p. 3; #075[RE], p. 2; #076[RE], p. 3; #085[RE], p. 2, 3; #086[RE], p. 6; #087[RE], p. 2
[174] #016[RE], p. 3; #046[RE], p. 4; #056[RE], p. 2; #059[RE], p. 3; #061[RE], p. 2; #076[RE], p. 3; #086[RE], p. 6
[175] #016[RE], p. 3; #021[RE], p. 3; #059[RE], p. 3; #086[RE], p. 6; #087[RE], p. 2
[176] #047[RE], p. 2; #081[RE], p. 2; #086[RE], p. 6
[177] #087[RE], p. 5
[178] #061[RE], p. 2; #085[RE], p. 3
[179] #001[RE], p. 4; #007[RE], p. 3-4; #013[RE], p. 3; #047[RE], p. 2; #056[RE], p. 2-3; #061[RE], p. 2
[180] #059[RE], p. 3; #065[RE], p. 3; #074[RE], p. 3; #081[RE], p. 2; #086 [RE], p. 1

Engagement possibilities for stakeholders were also reported to **differ between disciplines** regarding the type of possible stakeholders and apt formats[181], e.g., health services in medicine, companies in science and public policy in the humanities; via workshops or questionnaires. **Stakeholder engagement** was mainly hoped to cast light on their actual **requirements** and needs and thus to make research practically relevant.[182] One respondent described the development of a health technology for doing rehabilitation exercises at home: "So, trying to create a technology that in some way can mimic [the patients' social environment] is very difficult but it is a challenge that we would never have been aware of had we not spoken to them."[183] To use stakeholders as a source for research **funding** is another hope mentioned several times.[184] A **worry** regarding **stakeholder engagement** was that stakeholders are *perceived* by the public to exert a one-sided influence on topics and results, even though this is not actually the case.[185] Especially involvement of companies is feared to diminish the **public credibility** of science. Therefore, a condition for their engagement was the public acquiescence that stakeholder involvement is beneficial for all groups involved. One respondent proposed enhanced communication efforts to achieve this: "So, we as researchers have to make an effort to explain society that we are not bought by the industry."[186]

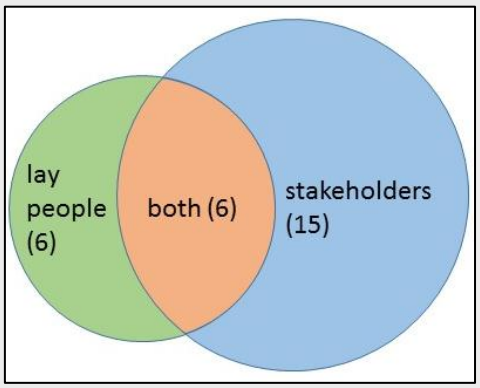

Figure 17: Number of Research Executives mentioning engagement possibilities in their own institutions for stakeholders, lay people or both

3.4.2.3 Engagement in general

A chief barrier to the implementation of RRI engagement schemes was that academics did not perceive such engagement as their **responsibility** but rather as an attack on their independence.[187] Thus, a precondition of successful engagement is an **openness** to this effect on the part of the scientists[188]: "that all [the university's] staff

[181] #034[RE], p. 3-4; #062[RE], p. 3
[182] #007[RE], p. 4; #013[RE], p. 3; #034[RE], p. 3; #038[RE], p. 2-3; #046[RE], p. 4; #061[RE], p. 2; #062[RE], p. 3; #072[RE], p. 4; #078[RE], p. 2-3; #081[RE], p. 3; #085[RE], p. 3
[183] #086[RE], p. 2
[184] #034[RE], p.3; #061[RE], p. 2; #087[RE], p. 11
[185] #021 [RE], p. 3-4; #061[RE], p. 3-4; #078[RE], p. 4
[186] #021 [RE], p. 3-4
[187] #008[RE], p. 4; #038[RE], p. 3, 4; #086[RE], p. 6; #087[RE], p. 1, 2; see also #089[RE], p. 4
[188] #062[RE], p. 3; see also #065[RE], p. 3

recognise the value of public engagement. […] So that takes a bit of time to get that embedded in the culture of the university."[189]

Other Research Executives mentioned preconditions that enable individual scientists to encourage and take up lay input. Most prominent was the demand to **incentivise** engagement, e.g., via career opportunities and calls for proposals.[190] Therefore, several participants called for acknowledging engagement activities in funding and promotion.[191] Some also mentioned funding requirements as a reason for getting involved in public engagement in the first place.[192] Engagement was generally regarded as an activity that does not occur by itself but needs to be prompted and supported by **resources**, i.e., time, money and personnel.[193] For example, one respondent proposed professional structures to facilitate engagement on a par with other governing bodies of universities.[194]

In terms of the design of the actual **engagement process**, Research Executives voiced worries regarding the decision with whom to engage and how to achieve a representative sample of both stakeholders and lay people.[195] Also, the process was feared to create yet another administrative burden and take time and resources away from research.[196] Also, interviewees emphasised the need for open discussion and collaboration between all parties.[197] Therefore, their institutions should make an effort to intensify public outreach.[198] However, Research Executives anticipated **communication problems** between researchers, on the one hand, and lay people and stakeholders, on the other, e.g. because reducing complexity of topics is difficult and some topics might even create fear.[199] Proposed solutions were communication training for researchers[200] and translators speaking the language of both sides[201].

In **conclusion**, options for engagement from outside of science are widely recognised by Leading Researchers as well as Research Executives, with stakeholders being mentioned more often than lay people. Lay people are mainly seen as recipients of **information** and education. These activities are tied to hopes of raising public **acceptance** of science. However, some Leading Researchers and Research Executives also acknowledge that lay people legitimately influence the research agenda in the sense of addressing societal needs. Leading Researchers also saw a role for the lay public in assisting scientists, e.g., by collecting data. The role of stakeholders was mostly taken to

[189] #034[RE], p. 4
[190] #013[RE], p. 4; #021[RE], p. 4; #023[RE], p. 4, #055[RE], p. 3; #078[RE], p. 4; #081[RE], p. 3
[191] #021[RE], p. 9; #034[RE], p. 4; #064[RE], p. 6
[192] #034[RE], p. 3; #078[RE], p. 2-3
[193] #007[RE], p. 12; #023[RE], p. 4; #034[RE], p. 4; #056[RE], p. 3; #074[RE], p. 4; #081[RE], p. 3; #084[RE], p. 2; #086[RE], p. 12
[194] #086[RE], p. 2
[195] #007[RE], p. 4; #023[RE], p. 4; #059[RE], p. 3
[196] #061[RE], p. 3; #074[RE], p. 4
[197] #001[RE], p. 5; #013[RE], p. 4; #047[RE], p. 2; #064[RE], p. 3; #086[RE], p. 2
[198] #023[RE], p. 4; #038[RE], p. 4; #046[RE], p. 5; see also #085[RE], p. 3
[199] #084[RE], p. 2
[200] #078[RE], p. 4
[201] #072[RE], p. 4

give **input** for choosing research problems and thus make science more practically relevant. Another important role ascribed to stakeholders by both groups was providing **funding**. Leading Researchers and Research Executives also agreed that engagement is easier in **applied** research fields than fundamental or theoretical fields. Both groups identified **relevance** of a topic to stakeholders and lay people as a precondition for their engagement.

A worry shared by Leading Researchers and Research Executives was that lay people lack the necessary **knowledge** about scientific topics. Researchers were therefore concerned that they might pose unrealistic expectations and anticipated communication difficulties. A condition for the engagement of laypeople mentioned by Research Executives was educating them beforehand. A difference between both groups exists between views on stakeholder engagement. While Leading Researchers are worried about their **biased influence** on science, Research Executives are only afraid that the **public** could perceive this influence as biased and thus as diminishing the objectivity of research. Research Executives, however, do not share this perception but see cooperation with stakeholders as a useful way of funding research. Leading Researchers laid stress on the requirement that engagement must not impair their freedom of research.

3.5 FACTORS INFLUENTIAL ON RESEARCH

This set of questions was directed at the existing institutional context of research and innovation, more particularly which factors are influential on the research agenda. A variety of driving forces shape research: political goals, business interests, epistemic aspirations, social values and preferences. The questions in this topic block were assumed to bring out the most important of such factors. Interviewees were specifically asked for the relevance of Calls for Proposals, Private Sponsorship, Renowned Experts, Collaborations and Citizen Science. The questions about the individual factors are meant as a preparation for the final ranking; prompting respondents to acquaint themselves with possible factors influencing research. Therefore, they are not analysed in detail here. Regarding the analysis of the ranking, if someone had ranked two Influencing Factors equally[202], the subsequent rank is left blank. If someone thought a category is not important[203], this category is skipped.

> *"This section is about different mechanisms for shaping research. We are interested in the relative importance of different driving forces that shape research – political agendas, business interests, research-internal factors, or more broader societal influences."*

[202] #006, p. 6-7; #031, p. 5; #032, p. 13; #044, p. 7; #068, p. 5; #077, p. 7; #056[RE], p. 5; #061[RE], p. 6-7; #064[RE], p. 5
[203] #009, p. 7; #012, p. 7; #019, p. 7; #025, p. 5; #058, p. 3; #021[RE], p. 6; #059[RE], p. 11-12; #072[RE], p. 6; #084[RE], p. 3

3.5.1 LEADING RESEARCHERS

48 Leading Researchers ranked the **Influencing Factors**.[204] *Calls for Proposals* is mostly seen on **rank 1** (21 interview partners), but is closely followed by *Collaborations among all Researchers including Junior Researchers and Students* (17 interview partners). No one saw *Private Sponsorship* as the most important factor to influence their own research. *Collaborations* are mostly set on **rank 2** (21 interview partners). On **rank 3** there is no clearly highlighted category, 14 saw *Calls for Proposals* on rank 3 but 11 interview partners placed *Private Sponsorship* and 10 *Renowned Experts* on rank 3. 17 interview partners set *Private Sponsorship* on **rank 4**. *Citizen Science* (24 interviewees) is mainly named as **rank 5**, followed by *Private Sponsorship* (12 interview partners). No one saw *Collaborations* as the least important factor to influence the own research.

Position in Ranking	1	2	3	4	5
Calls for Proposals	21	7	14	4	2
Private Sponsorship	0	4	11	17	12
Renowned Experts	11	13	10	10	4
Collaborations	17	21	5	5	0
Citizen Science	0	3	7	11	24

Table 6: Ranking for Leading Researchers

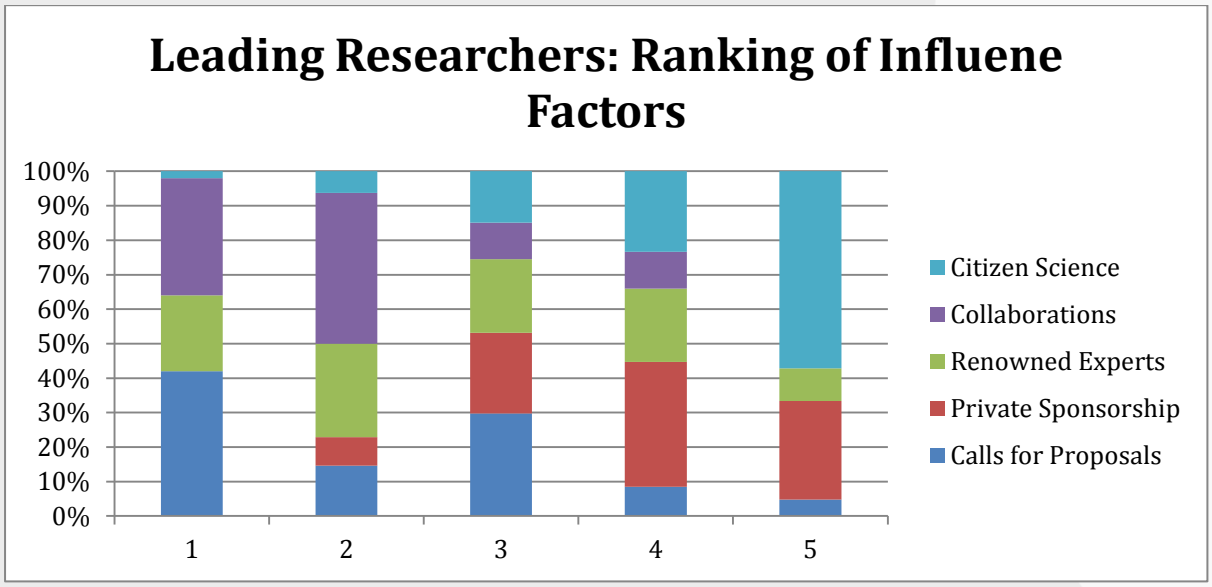

Figure 18: Ranking of Influence Factors for Leading Researchers

[204] #002; #006, p. 6-7; #009, p. 7; #010, p. 5-6; #011, p. 9-10; #012, p. 7; #015, p. 9; #017, p. 9; #018, p. 6; #019, p. 7; #020, p. 5; #022, p. 9; #024, p. 8; #025, p. 5; #026, p. 7; #027, p. 6; #028, p. 4; #029, p. 6; #030, p. 7; #031, p. 5; #032, p. 13; #033, p. 8; #035, p. 9; #039, p. 5; #041, p. 6; #042, p. 4; #044, p. 7; #045, p. 5; #049, p. 4; #050, p. 5; #052, p. 9; #053, p. 7; #054, p. 6; #057, p. 5; #058, p. 3; #060, p. 4; #063, p. 6; #066, p. 6; #067, p. 5; #068, p. 5; #070, p. 6; #071, p. 4-5; #073, p. 5; #077, p. 7; #079, p. 9; #080, p. 4; #082, p. 6; #083, p. 6

In summary, it is Calls for Proposals and the network of colleagues that shape the direction of research. The influence of private funding on the research agenda is surprisingly small (in light of the responses we were able to collect).

3.5.2 RESEARCH EXECUTIVES

25 Research Executives ranked **the Influencing Factors**.[205] *Calls for Proposals* is mostly seen on **rank 1** (11 interview partner) but it is closely followed by *Renowned Experts* (9 interview partners). No one saw *Citizen Science* as the most important factor to influence research in the own institution. *Collaborations* are mostly set on **rank 2** (10 interview partners). On **rank 3** there is no clearly stressed category, 7 saw *Collaborations* on rank 3 but there are also 6 interview partners for *Renowned Experts* and 5 for *Calls for Proposals*. 7 interview partners set *Private Sponsorship* on **rank 4**. *Citizen Science* (13 interviewees) is mainly named as **rank 5**, followed by *Private Sponsorship* (7 interview partners). These are the only influencing factors that are named with the least impact on research in one's own institution.

Position in Ranking	1	2	3	4	5
Calls for Proposals	11	5	5	3	0
Private Sponsorship	1	2	4	7	7
Renowned Experts	9	5	6	5	0
Collaborations	6	10	7	1	0
Citizen Science	0	1	2	5	13

Table 7: Ranking for Research Executives

[205] #007[RE], p. 7; #013[RE]; #016[RE], p. 6; #021[RE], p. 6; #023[RE], p. 6; #034[RE], p. 6; #038[RE], p. 6; #040[RE], p. 4; #046[RE], p. 6-7; #047[RE], p. 3; #048[RE], p. 4; #051[RE], p. 5; #055[RE], p. 4; #056[RE], p. 5; #059[RE], p. 11-12; #061[RE], p. 6-7; #062[RE], p. 5; #064[RE], p. 5; #065[RE], p. 5; #072[RE], p. 6; #075[RE], p.5; #078[RE], p. 5; #081[RE], p. 4; #084[RE], p. 3; #085[RE], p. 4

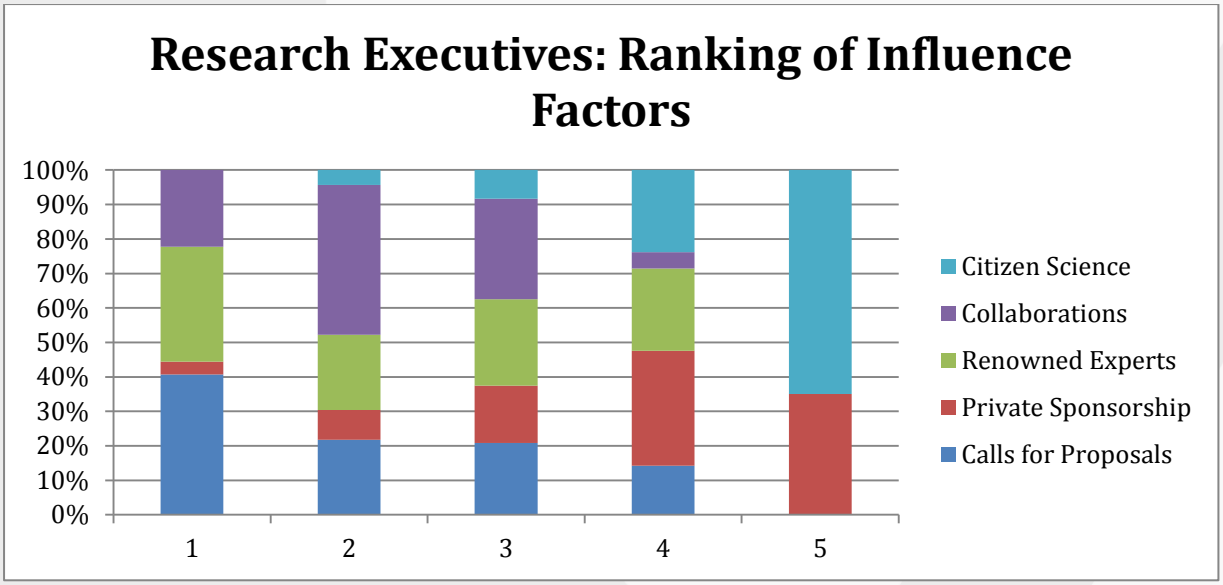

Figure 19: Ranking of Influence Factors for Research Executives

In conclusion, there is no striking difference between Leading Researchers and Research Executives. The relative weight of the Influencing Factors is the same with Calls for Proposals being the most important, followed by Collaborations among researchers and Renowned Experts. Private Sponsorship and Citizen Science was granted less influence or the least influence, respectively, on research.

3.6 EMBEDDEDNESS

In this section, Research Executives were asked to characterise existing relations their institution has with industry as well as non-industry partners, also compared to the past and other institutions. This set of questions was supposed to explore in more depth one particular factor influential on research, namely, industrial sponsoring.

3.6.1 RELATIONSHIP WITH INDUSTRY

"How would you characterise the relation between research performed by your own institution and industry?"

"What partnerships with industry does your institution currently have?"

"How does this differ from the past?"

"How does this differ from other institutions you have worked for?"

The vast majority of Research Executives responded that their institution maintains relations with industry, chiefly in terms of company-funded research[206] or collaboration[207]. Industry partnerships are an increasingly important source of research funding or a precondition for matching public funds.[208] One benefit Research Executives identified for academic institutions was increasing the **relevance** and **impact** of their research.[209] In industry collaborations, research topics were typically determined by the companies' demand.[210]

Benefits mentioned for industry were the utilisation of **academic expertise**, **reputation** and **infrastructure** to create a market advantage: "we have a state of the art nano laboratory here which none of the private companies can afford or wants to waste their money on."[211] **Education** was likewise often mentioned as a field of exchange between science and industry, ensuring that graduates are prepared for a career outside academia.[212] Several interviewees mentioned plans to expand their relations with industry in the future.[213]

When Research Executives explained why their institution has no or few industry relations, they sometimes referred to differences between **research fields**. The social sciences and humanities were regarded as less suited for industry engagement[214], in contrast to fields like engineering, biomedicine, computer sciences and business administration[215]. Regarding types of institutions, technological universities, universities of applied sciences and entrepreneurial universities were seen as more susceptible to industry contacts, while institutions focusing on basic research were seen as less suitable.[216] Another factor influencing industry engagement was how long relationships and structures for engagement had time to grow and become established to form sustainable networks.[217]

When asked for differences in industry relations to the past, most Research Executives reported an **increase**.[218] Two respondents explained that industry-funded research is now **recognised** by scientists while in the past it was sometimes regarded as inferior to publicly funded research.[219] The engagement process was seen to have be-

[206] #008[RE], p. 10; #013[RE], p. 6; #021[RE], p. 7; #034[RE], p. 7; #055[RE], p. 5; #061[RE], p. 5; #062[RE], p. 5; #064[RE], p. 5; #074[RE], p. 7; #076[RE], p. 7; #087[RE], p. 5
[207] #001[RE], p. 7; #021[RE], p. 7; #048[RE], p. 4; #055[RE], p. 5; #061[RE], p. 5; #062[RE], p. 5; #064[RE], p. 5; #074[RE], p. 7; #076[RE], p. 7; #087[RE], p. 5
[208] #001[RE], p. 7-8; #021[RE], p. 7; #078[RE], p. 6; #087[RE], p. 8
[209] #001[RE], p. 7; #021[RE], p. 7; #034[RE], p. 7; #038[RE], p. 7; #055[RE], p. 5
[210] #062[RE], p. 5; #074[RE], p. 7; #087[RE], p. 4; #089[RE], p. 2
[211] #038[RE], p. 6; see also #008[RE], p. 10; #034[RE], p. 7; #081[RE], p. 4
[212] #001[RE], p. 7; #013[RE], p. 6; #016[RE], p. 7; #023[RE], p. 6; #034[RE], p. 7; #062[RE], p. 5; #086[RE], p. 3
[213] #001[RE], p. 7; #007[RE], p. 7-8; #008[RE], p. 10; #051[RE], p. 5; #055[RE], p. 5; #056[RE], p. 5-6; #081[RE], p. 4
[214] #056[RE], p. 5-6; #072[RE], p. 6-7
[215] #034[RE], p. 7-8; #056[RE], p. 5-6; #064[RE], p. 5; #075[RE], p. 5; #084[RE], p. 4
[216] #001[RE], p. 7-8; #008[RE], p. 10-11; #074[RE], p. 7; #076[RE], p. 7-8; #081[RE], p. 5; #084[RE], p. 4
[217] #056[RE], p. 6; #085[RE], p. 5; #086[RE], p. 1, 2-3, 7
[218] #007[RE], p. 8; #013[RE], p. 6-7; #023[RE], p. 7; #048[RE], p. 4; #051[RE], p. 6; #055[RE], p. 5; #056[RE], p. 6; #065[RE], p. 5; #074[RE], p. 7; #075[RE], p. 6; #078[RE], p. 6; #084[RE], p. 3, 4; #085[RE], p. 5; #086[RE], p. 3; #087[RE], p. 8
[219] #034[RE], p. 7; #055[RE], p. 5

come more **structured** over the past years, e.g., relations with industry are now managed professionally.[220]

In **summary**, Research Executives do not view the relationship with industry as an influence distorting the direction or quality of research, but rather as a **respectable interaction** that **benefits** both universities and companies. Again, industry is seen as a source of information about **social demands** and as a source of **funding**. In the relevant literature, critics often argue that industry-sponsored research tends to become superficial (companies are not interested in deepened understanding) and short-term oriented. Judged in light of our findings, Research Executives do not harbour such fears. Research funded by corporations is seen as being on a par epistemically with university research.

3.6.2 RELATIONSHIP WITH NON-INDUSTRY INSTITUTIONS

"How would you characterise the relation between research performed by your institution and external partners other than industry?"

"What partnerships other than those with industry does your institution currently have?"

"How does this differ from the past?"

"How does this differ from other institutions you have worked for?"

Most Research Executives mentioned relationships with non-industry partners. Most prominent were NGOs[221] (e.g. charities and foundations) as well as the government on a national level[222]. Local and regional governments[223] and public sector organisations[224], like schools and hospitals, were also frequently mentioned. Some interviewees also talked about relationships to other research institutions.[225] Although the types of relationships were mostly not specified, national governments and NGOs were distinguished as providing funds[226] and governments as receiving scientific data or advice[227].

While several Research Executives recognised no difference in non-industry relations to the past[228], many saw an **increase**[229]. Reasons given for the increase were fund-

[220] #056[RE], p. 6; #085[RE], p. 5; #086[RE], p. 3
[221] #008[RE], p. 11; #016[RE], p. 7; #034[RE], p. 8-9; #048[RE], p. 4; #051[RE], p. 6; #055[RE], p. 5; #056[RE], p. 6; #059[RE], p. 7; #062[RE], p. 6; #064[RE], p. 5; #065[RE], p. 6; #076[RE], p. 8-9; #086[RE], p. 6; #087[RE], p. 5
[222] #016[RE], p. 7; #021[RE], p. 8; #034[RE], p. 8-9; #038[RE], p. 7; #040[RE], p. 5; #046[RE], p. 7; #047[RE], p. 4; #055[RE], p. 5; #061[RE], p. 8
[223] #001[RE], p. 8; #013[RE], p. 7-8; #048[RE], p. 4; #056[RE], p. 6; #062[RE], p. 6; #064[RE], p. 5; #065[RE], p. 6; #075[RE], p. 6
[224] #048[RE], p. 4; #056[RE], p. 6; #062[RE], p. 6; #064[RE], p. 5; #075[RE], p. 6; #078[RE], p. 6; #086[RE], p. 6
[225] #007[RE], p. 9; #048[RE], p. 4; #061[RE], p. 8; #078[RE], p. 6; #081[RE], p. 5; #084[RE], p. 4
[226] #034[RE], p. 8-9; #051[RE], p. 6; #061[RE], p. 8; #086[RE], p. 6; #087[RE], p. 5
[227] #021[RE], p. 8; #075[RE], p. 6; #087[RE], p. 5
[228] #001[RE], p. 8; #016[RE], p. 7; #038[RE], p. 7, 8; #051[RE], p. 6; #055[RE], p. 6; #062[RE], p. 6
[229] #013[RE], p. 8; #021[RE], p. 8; #046[RE], p. 7; #048[RE], p. 4; #064[RE], p. 5; #072[RE], p. 7; #075[RE], p. 6; #078[RE], p. 6; #081[RE], p. 5

ing opportunities and requirements[230] and a heightened awareness of the importance of external engagement,[231] which becomes apparent in structures, resourcing and recognition at the university level[232]. Differences between institutions in non-industry relations were mainly attributed to how much they appreciate and promote engagement.[233] Also, non-industry engagement was seen as more important for social sciences and humanities than economics and technology[234] and also more important in applied than basic research[235].

All in all, relationships with non-industry actors were also widely spread among institutions, although Research Executives seemed to be less aware of the specificities of those relationships and of their role for research as compared to industry-relations.

3.7 DEFINITION

In the Research Framework HORIZON 2020 the European Commission defines RRI as "a process in which all societal actors (researchers, citizens, policymakers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to align research and innovation outcomes with the values, needs and expectations of society." This set of question was intended to find out what interviewees thought of this definition and whether they considered it useful for guiding RRI activities.

3.7.1 LEADING RESEARCHERS

"What opportunities and risks does RRI as defined by this definition present for your own work/research more generally?"

3.7.1.1 Opportunities

41 Leading Researchers recognised **opportunities** with regard to the definition of RRI.[236] Some of the interview partners mentioned especially that they like this definition.[237] as long as it leaves some space for independent ideas.[238] For two of them it de-

[230] #013[RE], p. 8; #081[RE], p. 5
[231] #021[RE], p. 8; #065[RE], p. 6
[232] #056[RE], p. 6; #065[RE], p. 6
[233] #038[RE], p. 8; #056[RE], p. 7; #065[RE], p. 5; #086[RE], p. 7; #087[RE], p. 1
[234] #064[RE], p. 5
[235] #074[RE], p. 7
[236] #002, p. 11; #005, p. 11; #006, p.9; #009, p. 12; #010, p. 10; #011, p. 14; #012, p. 12; #015, p. 13; #017, p. 14; #018, p. 9; #019, p. 11; #020, p. 8; #022, p. 15; #024, p. 14; #025, p. 9; #026, p. 10; #027, p. 9; #028, p. 8; #029, p. 9; #031, p. 8; #032, p. 21; #033, p. 14; #035, p. 12; #041, p. 9; #042, p. 5; #044, p. 11; #045, p. 8; #049, p. 6; #054, p. 8; #057, p. 7; #058, p. 8; #063, p. 9; #066, p. 8; #070, p. 8; #071, p. 7; #073, p. 8; #077, p. 11; #079, p. 14; #082, p. 9; #083, p. 9; #088, p. 12
[237] #002, p.11; #009, p. 12; #011, p. 14; #017, p. 14; #025, p. 9; #027, p. 9; #029, p. 9; #030, p. 10; #042, p. 5; #049, p. 6; #058, p. 5; #063, p. 9; #073, p. 8; #082, p. 9; #088, p. 12
[238] #073, p. 8

scribes the ideal world.[239] Other interview partners saw this definition as reflecting their own aspirations.[240] RRI is seen as an opportunity to build better bridges from science to society.[241] Three Leading Researchers saw the opportunity to involve more end-users[242], business[243] and third sector organisations[244] (that is non-industrial stakeholders) because RRI opens up research to different groups.[245] The involvement of society is seen as a major opportunity for getting input.[246] One interview partner stated that "anything you do can be more meaningful, it had a great impact."[247] Three researchers mentioned especially that they like the orientation toward "values, needs and expectations of society".[248] So, the main opportunity for Leading Researchers was to get more **input from society** to make their research more socially relevant and robust[249]: "Being able to engage with citizens, policymakers, businesses and everybody is definitely going to make our research far more targeted, far more beneficial and current [...]. And that is very, very important."[250] Another opportunity identified was obtaining new **funds** from industry and policymakers.[251]

3.7.1.2 Risks

41 interview partners saw risks in the definition of RRI.[252] One big risk is that the definition does not contain guidelines for **practical implementation**.[253] Therefore, it was seen as a vacuous statement that describes an ideal rather than a useful instruction. Another big risk is that there are too many stakeholders with too many different opinions that need to be discussed very early on[254]; therefore, much communication is needed[255] that leads to a loss of time[256] and money[257]. A major fear was the creation of an additional **burden** for researchers.[258] The outcome of RRI guided research can be un-

[239] #005, p. 11; #082, p. 9
[240] #018, p. 9; #020, p. 8; #024, p. 14; #041, p. 9; #053, p. 12; #066, p. 8; #070, p. 8; #077, p. 11; #083, p. 9
[241] #011, p. 14; #012, p. 12; #019, p. 11; #031, p. 8; #032, p. 21; #041, p. 9; #079, p. 14
[242] #010, p. 10; #041, p. 9; #042, p. 5; #071, p. 7
[243] #002, p. 11; #010, p. 10; #041, p. 9; #042, p. 5; #044, p. 11; #071, p. 7
[244] #041, p. 9; #042, p. 5; #044, p. 11; #071, p. 7
[245] #054, p. 8
[246] #009, p. 12; #028, p. 8; #033, p. 14; #045, p. 8; #049, p. 6
[247] #057, p. 7
[248] #010, p. 10; #020, p. 8; #024, p. 14
[249] #002, p. 11; 006, p. 9; #008, p. 12; #010, p. 10; #011, p. 14; #015, p. 13; #020, p. 8; #024, p. 4; #025, p. 9; #028, p. 8; #031, p. 8; #032, p. 21; #039, p. 8-9; #041, p. 9; #053, p. 12; #057, p. 7; #063, p. 9; #077, p. 11; #079, p. 14
[250] #063, p. 9
[251] #022, p. 15; #077, p. 11
[252] #002, p. 11; #003, p. 10; #004, p. 12; #005, p. 12; #006, p. 10; #009, p. 12; #010, p. 10; #011, p. 14; #012, p.12; #018, p. 9; #019, p. 10; #020, p. 8; #024, p. 13; #025, p. 9; #026, p. 10; #027, p. 9; #028, p. 8; #029, p. 9; #030, p. 10; #031, p. 9; #032, p. 21; #033, p. 13; #039, p. 8; #041, p. 9; #042, p. 5; #044, p. 11; #054, p. 8; #057, p. 7; #058, p. 5; #060, p. 6; #063, p. 9; #066, p. 8; #068, p. 8; #069, p. 10; #071, p. 7; #073, p. 8; #079, p. 4, 14; #080, p. 7; #082, p. 9; #083, p. 9; #088, p. 7, 12
[253] #002, p. 11; #003, p. 10; #004, p. 12; #005, p. 11; #024, p. 13; #028, p. 8; #058, p. 5; #067, p. 7; #068, p. 8; #082, p. 9
[254] #003, p. 10; #024, p. 13; #026, p. 10; #032, p. 21; #035, p. 12; #042, p. 5; #044, p. 11; #060, p. 6; #079, p. 14; #080, p. 7; #082, p. 9
[255] #002, p. 11; #003, p. 10; #006, p. 10; #012, p. 12; #025, p. 9; #041, p. 9; #057, p. 7; #073, p. 8
[256] #003, p. 10; #012, p. 12; #018, p. 9; #024, p. 13; #025, p. 9; #053, p. 12; #057, p. 7; #069, p. 10
[257] #026, p. 10; #057, p. 7
[258] #002, p. 11-12; #004, p. 12; #025, p. 9; #041, p. 9; #057, p. 7

ethical because RRI is not necessary for all kinds of research[259]. Another risk is the loss of academic freedom.[260] **Policymakers**[261] and **business**[262] can have too much **clout** on research. For example, one interviewee who had been living in the Soviet Union stated: "I have a strong allergy on any attempts of ideological restriction of the research."[263] **Citizens**, on the other hand, might not **understand research**[264] and should not have much impact on research for this reason.[265] Society should not decide about research projects, scientific institutions should rather do that.[266] Interviewees wished to maintain at least some independent research.[267] Also, it was criticised that **fundamental research** is not part of this definition and might get side-lined by applied research.[268] So, Leading Researchers thought that not all research should be directed at societal aims. Especially in its early stages, research needs to develop unconstrained to allow for unusual and risky approaches and to lead to unexpected and important findings and innovations[269]:

> *"If I look at my own research, and I think it's also a bit of misunderstanding of what research is. Research also involves being behind your own desk, having a new idea, being innovative, being creative. And some of the things you cannot do with a whole group of people. Some of the things you have to do yourself. So I think the idea that you can work together and do the entire research and innovation process, just makes no sense. I'm not saying that you cannot involve people but you have to think about when to do this. And for me, part of doing research is also being creative, coming to new ideas that other people, maybe other people would find nonsense at first. I think that's very important for doing good research that you have the room to combine things that maybe people don't like in the beginning or don't see as promising. So I would really see as a risk, if RRI means this, everything you do has to be discussed with everyone from the start because I think that's going to lead to bad research if you do it that way."*[270]

Thus, not all kinds of research can work with this definition[271]. One respondent thought it to rather reflect the views of policymakers, stakeholders, social sciences and humanities than natural sciences.[272] Four interview partners did not see any risks.[273]

In conclusion, Leading Researchers saw the neglect of **fundamental** and explora-

[259] #030, p. 10
[260] #012, p. 12; #031, p. 9; #032, p. 21; #041, p. 9; #063, p. 9; #069, p. 10; #073, p. 8
[261] #009, p. 12; #010, p. 10; #029, p. 9; #044, p. 11; #068, p. 8; #079, p. 4
[262] #010, p. 10; #029, p. 9; #044, p. 11; #079, p. 4
[263] #012, p. 12
[264] #009, p. 12; #011, p. 14; #035, p. 12; #044, p. 11; #054, p. 8; #066, p. 8; #079, p. 3
[265] #002, p. 11; #018, p. 9; #028, p. 8; #049, p. 6
[266] #019, p. 10; #029, p. 9; #054, p. 8
[267] #033, p. 14; #069, p. 10; #073, p. 8
[268] #006, p. 10; #027, p. 9; #044, p. 11; #049, p. 6; #063, p. 9; #066, p. 8
[269] #011, p. 14; #018, p. 9; #020, p. 8; #031, p. 9; #044, p. 11; #063, p. 9; #079, p. 14
[270] #020, p. 8
[271] #033, p. 14
[272] #044, p. 14
[273] #017, p. 14; #035, p. 12; #045, p. 8; #053, p. 12

tory research, the partisan **influence** of business and politics and the **lack of knowledge** of lay people as a risk. Also, they missed concrete guidelines for **practical implementation** and feared the additional **burden** placed on them by RRI.

3.7.2 RESEARCH EXECUTIVES

3.7.2.1 Opportunities

"What opportunities does RRI as defined by the EC's new definition present for your own institution?"

24 Research Executives saw **opportunities** with regard to the definition of RRI.[274] Some of the interview partners mentioned especially that they like this definition[275]. It reflects their own work[276] or it defines their aim[277]. Two executives would like "to solve actual societal problems using applied and basic research" [278]. Communication between all parties is seen as a good opportunity.[279] Some interviewees welcomed the chance to bring in more end-users[280], business[281], third sectors[282] and policymakers[283] into research from early on.[284] The quality of research should be "much better with the citizens"[285] and research benefits from interdisciplinary work[286].

To conclude, as regards the opportunities seen in this definition, Research Executives are more focused on involving policymakers than Leading Researchers. Research Executives see the main advantage of the definition in encouraging research endeavours relevant for **social problems**.[287]

3.7.2.2 Risks

"What risks does RRI as defined by the EC's new definition present for your own institution?"

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[274] #001[RE], p. 10; #007[RE], p. 13-14; #013[RE], p. 10-11; #016[RE], p. 11; #021[RE], p. 13; #023[RE], p. 12; #038[RE], p. 12; #040[RE], p. 7; #046[RE], p. 10; #047[RE], p. 5; #048[RE], p. 7; #051[RE], p. 9; #055[RE], p. 8; #056[RE], p. 9; #059[RE], p. 9; #061[RE], p. 12; #062[RE], p. 8; #064[RE], p. 7; #065[RE], p. 8; #074[RE], p. 10; #075[RE], p. 8; #078[RE], p. 8; #085[RE], p. 8; #086[RE], p. 11

[275] #013[RE], p. 10; #040[RE], p. 7; #046[RE], p. 10; #048[RE], p. 7; #051[RE], p. 9; #056[RE], p. 9; #059[RE], p. 9; #061[RE], p. 12

[276] #001[RE], p. 10; #038[RE], p. 12; #047[RE], p. 5; #065[RE], p. 8; #074[RE], p. 10

[277] #055[RE], p. 8; #016[RE], p. 11

[278] Quotation from #007[RE], p. 13-14; #065[RE], p. 8

[279] #048[RE], p. 7; #051[RE], p. 9

[280] #013[RE], p. 10; #023[RE], p. 12; #038[RE], p. 12; #051[RE], p. 9; #074[RE], p. 10

[281] #013[RE], p. 10; #023[RE], p. 12; #038[RE], p. 12; #061[RE], p. 12; #062[RE], p. 8

[282] #023[RE], p. 12; #062[RE], p. 8; #074[RE], p. 10

[283] #023[RE], p. 12; #051[RE], p. 9; #062[RE], p. 8; #074[RE], p. 10; #078[RE], p. 8

[284] #059[RE], p. 10; #078[RE], p. 8

[285] quotation from #021[RE], p. 13; #055[RE], p. 8; #078[RE], p. 8

[286] #007[RE], p. 14; #038[RE], p. 12; #051[RE], p. 9; #056[RE], p. 9

[287] #007[RE], p. 13-14; #038[RE], p. 12; #051[RE], p. 9; #056[RE], p. 9; #059[RE], p. 9; #061[RE], p. 12; #065[RE], p. 8-9; #078[RE], p. 8; #085[RE], p. 8; #086[RE], p. 11

21 interview partners saw *risks* in the definition of RRI.[288] One big risk is that more **time** is needed, e.g., for communicating with all stakeholders in a sustained fashion.[289] If too many stakeholders are involved in the process, it might be harder for institutions to focus on their strategy.[290] Also, this definition was seen as not useable for kinds of research not directed at societal problems, for example the fine arts.[291] **Fundamental research** needs to be included in responsible research[292], not every research project "has to have a societal impact"[293], research needs time to develop unconstrained in its early stages[294] and academic independence is at risk.[295] Another risk is that research can be **abused** by policymakers or business.[296] As for lay people influence, interviewees saw their **lack of knowledge** as a risk.[297] Also, Research Executives saw the risks of scientists opposing this definition.[298]

This definition was also perceived to miss instruments for implementing it and making it practically relevant.[299] One interviewee stated: "sometimes the EU is providing strange definitions with respect to things which are not well-understood by the Commission. And this definition here on Responsible Research and Innovation is a good example for that. I would like to see […] that the commission would also interact with stakeholders before coming across with definitions which are a little bit difficult to fill in in the real world."[300] Three interview partners did not see any risk in this definition.[301] In conclusion, Research Executives saw the definition as **useless in practice** and also wanted to maintain research **independent** from societal needs.

All in all, both Leading Researchers and Research Executives perceived addressing and **solving societal problems** in research as the main opportunity of the definition. Its gist was broadly welcomed. However, both saw the risk that RRI according to the definition requires **additional efforts**, e.g., in the in terms of skills, commitment and time. Also, they saw the definition as useless in **practice** due to its vagueness and generality. **Lack of knowledge** among lay-people and partisan **interests** of politics and stakeholders were seen as obstacles by both groups, although Leading Researchers emphasised them more strongly. Accordingly, Research Executives predicted resistance on the part of the scientists. Both groups shared the wish to maintain research that is **not** directed

[288] #001[RE], p. 10-12; #0013[RE], p. 11; #016[RE], p. 12; #023[RE], p. 12; #038[RE], p. 12; #047[RE], p. 6; #048[RE], p. 7; #051[RE], p. 9; #055[RE], p. 8; #056[RE], p. 9; #061[RE], p. 12; #062[RE], p. 8; #064[RE], p. 7; #074[RE], p. 10; #075[RE], p. 9: #078[RE], p. 8; #081[RE], p. 8; #084[RE], p. 6; #085[RE], p. 8; #086[RE], p. 5, 6, 9; #087[RE], p. 11
[289] #048[RE), p. 7; #074[RE], p. 10; #078[RE], p. 8; #087[RE], p. 8; #081[RE], p. 8
[290] #055[RE], p. 8; #062[RE], p. 8; #085[RE], p. 8; #081[RE], p. 8
[291] #061[RE], p. 12; #064[RE9, p. 7; #086[RE], p. 9
[292] #001[RE], p. 10; #084[RE], p. 6; #086[RE], p. 6
[293] #001[RE], p. 10; #021[RE], p. 14
[294] #059[RE], p. 9-10; #078[RE], p. 8
[295] #056[RE], p. 9; #085[RE], p. 8
[296] #051[RE], p. 9; #056[RE], p. 9
[297] #055[RE], p. 8; #072[RE], p. 11-12; #078[RE], p. 8
[298] #064[RE], p. 7; #074[RE], p. 10; #075[RE], p. 9; #086[RE], p. 5
[299] #038[RE], p. 12; #040[RE], p. 7; see also #081[RE], p. 8
[300] #072[RE], p. 13
[301] #021[RE], p. 14; #040[RE], p. 7; #065[RE], p. 9

at societal aims and wished to exclude early stages but also whole fields of research from that demand. Although both groups voiced similar worries, Leading Researchers seemed more focussed on conceptual difficulties of RRI, while Research Executives were more concerned with its practical feasibility.

3.8 RESEARCH AND INNOVATION OUTCOMES

RRI is sometimes taken to require the anticipation of research outcomes. Only if the future beneficial and detrimental impact of a research finding or innovation can be assessed with sufficient reliability ahead of time, can social ambitions and fears be sensibly taken as a basis of regulating research. Such predictability is not a necessary part of RRI endeavours, since auxiliary factors such as transparency or the social conditions involved in implementing an innovation can be used for a social appraisal of relevant opportunities and risks (see D3.4). Yet, in many instances a more detailed assessment of research lines presupposes some sort of anticipation of what a research line could accomplish. This set of questions was supposed to explore how scientists view the odds of predicting future pathways of research.

3.8.1 ANTICIPATION OF RESEARCH OUTCOMES

"To what extent is it possible to anticipate research outcomes during the research process?"

47 out of 54 interview partners answered the question about the anticipation of research outcomes during the research process.[302] 38 interview partners thought that it is possible to anticipate or foresee research outcomes to a **certain extent**,[303] for example by using tools or a scientific methodology,[304] or with a clear communication about the design of the project[305]. Some researchers responded that predictability depends on the details of the research, the project or the researcher.[306] Anticipation is only possible for certain goals in a proposal[307], in particular minor modifications of existing knowledge[308] or for well-defined aims[309]. A few interview partners said that it is possi-

[302] #002, p. 12; #003, p. 11; #004, p. 12-13; #005, p. 12; #006, p. 10; #009, p. 13; #010, p. 10-11; #011, p. 14-15; #012, p. 12; #015, p. 14; #017, p. 15; #018, p. 10; #020, p. 9; #022, p. 17; #024, p. 14; #025, p. 7; #026, p. 11; #027, p. 9; #028, p. 9; #029, p. 9; #030, p. 11; #031, p. 9; #032, p. 21; #033, p. 14; #035, p. 13; #039, p. 9; #041, p. 9; #042, p. 6; #044, p. 12; #045, p. 8; #053, p. 13; #054, p. 8; #057, p. 7; #060, p. 7; #063, p. 9; #066, p. 9; #067, p. 7; #068, p. 8; #069, p. 10; #070, p. 9; #071, p. 8; #073, p. 9; #077, p. 11; #079, p. 14; #080, p. 7; #082, p. 10; #083, p. 9

[303] #002, p. 12; #004, p. 13; #005, p. 12; #006, p. 10; #009, p. 13; #010, p. 10; #011, p. 14; #012, p. 12; #017, p. 15; #018, p. 10; #020, p. 9; #024, p. 14; #025, p. 7; #026, p. 11; #027, p. 9; #028, p. 9; #029, p. 9; #030, p. 11; #031, p. 9; #032, p. 21; #033, p. 14; #035, p. 13; #039, p. 9; #041, p. 9; #042, p. 6; #044, p. 12; #045, p. 8; #054, p. 8; #057, p. 7; #063, p. 9; #066, p. 9; #067, p. 7; #068, p. 8; #069, p. 10; #077, p. 11; #080, p. 7; #082, p. 10; #083, p. 9

[304] #003, p. 11; #011, p. 14; #012, p. 12

[305] #010, p. 10

[306] #006, p. 10; #009, p. 13; #030, p. 11; #031, p. 9; #042, p. 6; #044, p. 12; #045, p. 8; #069, p. 10; #080, p. 7; #083, p. 9

[307] #004, p. 13

[308] #005, p. 12

ble to predict outcomes in some fields of research while this is out of the question in other research areas.[310]

Many respondents thought that foreseeing outcomes is **easier in applied research than in fundamental research**[311]: "In engineering, it is possible to anticipate where the research will lead to. For [chemistry], it is more difficult to say."[312] Fundamental research is often perceived as generating the more important findings for science although with little reliability, it also bears a higher risk of failure.[313] In contrast, small improvements are easier to foresee.[314]

On the other hand, seven interview partners said that it is **not possible** to anticipate research outcomes because of inherent uncertainties.[315] If research can be anticipated, it would not be research.[316] One respondent explained that "most of the big ideas of mankind were serendipity"[317].

Although, anticipated outcomes needed for writing the proposal and for defining what the research group wants to achieve[318], one respondent saw a big problem with the anticipation of results for funding programmes:

> *"So this is one problem of funding issues now that very often you have to define what your deliverables and outcomes are going to be. […] I have had certain projects that they literally tick every deliverable that you had listed to make sure you have done it. And during the project you have to make really, really sure that we do everything, even though it is not necessarily making sense any longer to do it, because things evolve in a project, in a research project. Science evolves. Sometimes it directs you elsewhere. A finding can open up new questions and close others. And funding organisations need to be more aware of this process. "*[319]

In conclusion, most Leading Researchers saw the anticipation of research outcomes as being **possible only in part**, if possible at all. The outcomes of small changes to existing knowledge and outcomes of applied research were seen as easier to predict than outcomes of risky research or fundamental research.

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[309] #017, p. 15; #063, p. 9
[310] #018, p. 10; #025, p. 7; #054, p. 8
[311] #003, p. 11; #004, p. 13; #025, p. 7; #031, p. 9
[312] #044, p. 12
[313] #005, p. 12; #015, p. 14; #019, p. 11, #026, p. 11; #028, p. 9
[314] #005, p. 12; #015, p. 14; #028, p. 9
[315] #003, p. 11; #015, p. 14; #022, p. 17; #053, p. 13; #060, p. 7; #070, p. 9; #079, p. 14
[316] #003, p. 11; #032, p. 21; #066, p. 9; #077, p. 11; #079, p. 14; #080, p. 7; #082, p. 10
[317] #005, p. 12; see also #068, p. 8
[318] #018, p. 10; #030, p. 11; #073, p. 9
[319] #073, p. 9

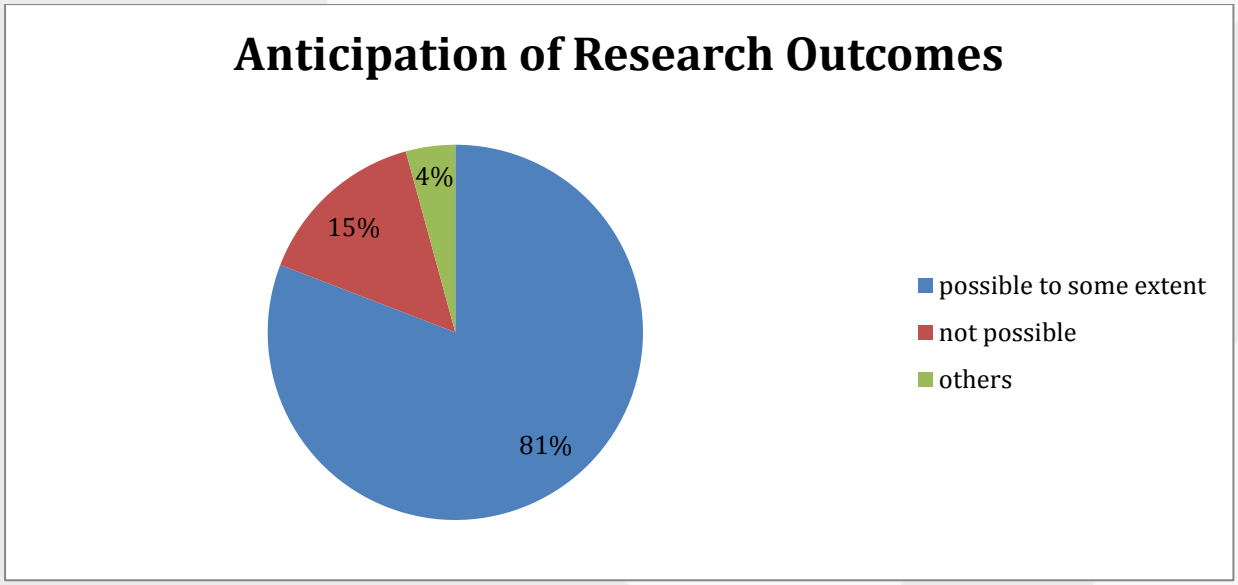

Figure 20: Anticipation of Research Outcomes

3.8.2 ANTICIPATION OF SOCIETAL IMPACT

"To what extent do you think the societal consequences of technological innovations can be anticipated?"

46 out of 54 interview partners answered the question about societal consequences of technological innovations[320]. While seven interviewees regarded anticipation of societal impact as possible, at least to a large extent[321], the majority (28 respondents) was more **cautious**[322]. In their opinion, social consequences of new technologies could be foreseen only in some measure, depending on whether similar technologies already exist and how marked the differences are.[323] Also, such judgement was seen as very difficult at the **beginning** of the research process, while it was thought to get easier as research approaches developed[324]: "But to really say 'We're going to solve this problem beforehand', I think is vanity."[325] Some interview partners mentioned that time to reflect the research is missing[326] and time is needed to develop scenarios[327]. Many researchers also mentioned the importance of **stakeholders** as well as input from other

[320] #002, p. 13; #003, p. 11-12; #004, p. 13-14; #005, p. 12-13; #006, p. 10; #009, p. 13; #010, p. 11; #011, p. 15; #012, p. 13; #015, p. 14; #017, p. 16; #018, p. 10; #019, p. 11; #020, p. 9; #022, p. 17; #024, p. 14; #025, p. 9; #026, p. 11; #027, p. 9; #028, p. 9; #030, p. 11; #031, p. 9; #032, p. 21; #033, p. 15; #035, p. 13-14; #039, p. 9; #041, p. 9; #042, p. 6; #044, p. 12-13; #045, p. 9; #049, p. 6; #053, p. 13; #054, p. 8; #057, p. 7; #060, p. 7; #063, p. 10; #066, p. 9; #067, p. 7; #069, p. 11; #070, p. 9; #071, p. 8; #073, p. 9; #077, p. 11; #079, p. 15; #080, p. 7; #082, p. 10
[321] #005, p. 12-13; #010, p. 11; #018, p. 10; #031, p. 9; #042, p. 6; #054, p. 8; #082, p. 10
[322] #002, p. 13; #003, p. 11; #004, p. 13; #006, p. 10; #011, p. 15; #012, p. 13; #017, p. 16; #019, p. 11; #020, p. 9; #024, p. 14; #025, p. 9; #030, p. 11; #032, p. 15; #033, p. 15; #035, p. 13-14; #039, p. 9; #041, p. 9; #044, p. 12-13; #049, p. 6; #053, p. 13; #057, p. 7; #063, p. 10; #066, p. 9; #067, p. 7; #069, p. 11; #073, p. 9; #077, p. 11; #079, p. 15
[323] #003, p. 11-12; #035, p. 13
[324] #002, p. 13; #019, p. 11; #020, p. 9; #053, p. 13; #079, p. 15
[325] #002, p. 13
[326] #057, p. 7; #073, p. 9
[327] #073, p. 9; #077, p. 11

fields for anticipating societal impact[328]: "And with the help of people working with us on applied science, sociology of science, applied ethics, things like that, we can make technological choices that are enlightened by various perspectives."[329] Participants also emphasised that even though anticipation may not always be possible, researchers should still try.[330] However, opinions that social impact depends only on the user of a device[331] are also expressed[332].

Nine interviewees **rejected** any possibility of anticipating societal consequences of technological innovations.[333] One statement showed an example from the past: "I mean, the good example is the building of the bank of England, they built the biggest building, a very big building in London in order to put the biggest computers there, so it was in the 70s. And even they could not predict that computers were going to be smaller and smaller, so nowadays, you can put a computer in a… (laughing and showing a mobile phone). So this kind of thing cannot be predicted."[334]

All in all, respondents expressed **caution** regarding the predictability of societal impact. Only the consequences of small changes to existing technologies and of technologies near the end of their development process were seen to be foreseeable. Also, the involvement of stakeholders was seen to facilitate anticipation of societal impact.

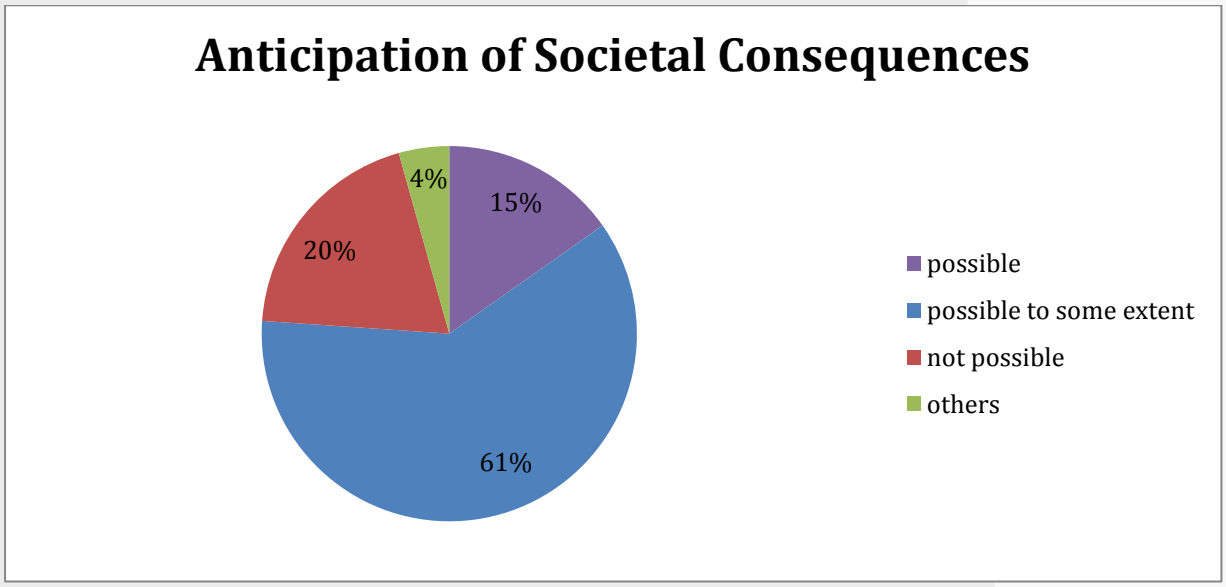

Figure 21: Anticipation of Societal Consequences

[328] #004, p. 13-14; #006, p. 10; #010, p. 11; #018, p. 10
[329] #011, p. 15
[330] #004, p. 13-14; #024, p. 14; #030, p. 11; #033, p. 15
[331] #015, p. 14
[332] #017, p. 16
[333] #015, p. 14; #022, p. 17; #026, p. 11; #028, p. 9; #045, p. 9; #060, p. 7; #070, p. 9; #071, p. 8; #080, p. 7
[334] #060, p. 7

3.9 VISION

The following set of questions was intended to explore ideas and visions for the future of RRI and the next steps that need to be taken to achieve them.

3.9.1 LEADING RESEARCHERS

"What are your ideas for the future of Responsible Research and Innovation? What kind of support (institutional, economic, etc.) do you need in order to realise these possibilities? What obstacles do you anticipate?"

When Leading Researchers were asked about their **ideas and visions for the future of RRI**, their answers were very diverse. Several expressed support for the concept of RRI, as defined by the European Commission. Their visions included **educating scientists** to raise awareness and acceptance of RRI.[335] For example, one respondent stated: "I still notice that nobody, really nobody knows about it."[336] Also, taking RRI seriously and ensuring that it is adopted in practice is mentioned.[337] Directing research towards **socially beneficial aims** was frequently brought up, too.[338] Many respondents also focused on specific aspects of RRI in their visions, most prominently public engagement[339] and research ethics[340]. Two others mentioned interdisciplinary collaboration between technology development and assessment.[341]

When asked about the **support** needed for realising those RRI visions, Leading Researchers most frequently mentioned **funding**.[342] Funding was also seen as a precondition for researchers to make the time commitment necessary for RRI to be possible[343] and to establish supporting institutions for communication and engagement like specialised personnel[344], institutional support in general[345], stimulation for discussions about RRI, collaboration between parties and disciplines,[346] and RRI education for researchers[347]. Some also asked for political support of RRI.[348]

Difficulties of translating RRI into **practice** were seen as an **obstacle**[349], also because the design of an appropriate engagement process is still unclear[350], e.g., when sci-

[335] #024, p. 14-15; #025, p. 10; #029, p. 10; #057, p. 8
[336] #077, p. 11-12
[337] #003, p. 12; #020, p. 9-10; #035, p. 14
[338] #009, p. 13-14; #014, p. 12; #019, p. 12; #028, p. 9; #044, p. 13; #060, p. 7
[339] #004, p. 14; #005, p. 13; #010, p. 12; #014, p. 12; #015, p. 14; #022, p. 18; #024, p. 14-15; #026, p. 11-12; #028, p. 9; #031, p. 9-10; #044, p. 13; #049, p. 6-7; #066, p. 9
[340] #015, p. 14; #018, p. 11; #039, p. 9; #070, p. 9; #079, p. 15; #083, p. 10
[341] #011, p. 15; #066, p. 9
[342] #010, p. 12; #015, p. 15; #018, p. 11; #020, p. 9; #025, p. 10; #026, p. 12; #029, p. 10; #035, p. 14; #060, p. 7; #066, p. 9-10; #077, p. 12; #082, p. 11; #088, p. 12
[343] #010, p. 12; #017, p. 17; #024, p. 15; #083, p. 10
[344] #005, p. 13-14; #015, p. 15; #017, p. 17; #018, p. 11; #049, p. 7; #077, p. 12; #088, p. 8
[345] #024, p. 15; #029, p. 10; #060, p. 7; #083, p. 10
[346] #003, p. 12; #004, p. 15; #030, p. 11; #057, p. 8; #088, p. 8
[347] #025, p. 10; #066, p. 10; 077, p. 12-13; #083, p. 10
[348] #009, p. 14; #020, p. 9; #026, p. 12; #030, p. 11; #079, p. 15
[349] #020, p. 9-10
[350] #010, p. 13; #028, p. 10; #057, p. 8; #063, p. 10

entific results for political decisions need to be delivered under time pressure[351]. Additional bureaucratic expenditure was feared.[352] Also, communication difficulties between disciplines as well as scientists and non-scientists were anticipated.[353] One participant stated: "if you really want to see this as a concept that can be operationalised by people in a research process, then it needs to be far more concrete and we also need to think about that. I mean there is a naïve tendency, let's say it like that."[354]

The **influence of companies** on research was seen critically, e.g., their ability to choose which results to publish.[355] A remedy for that was seen in involving many different stakeholders to balance biased interests.[356] **Involvement of the public** at large was controversial. One interviewee anticipated resistance of mathematicians to addressing societal problems: "So, in one extreme you have many leading mathematicians who say: 'We don't want to be bothered with these trivial, nonsensical problems which come from society. We have sky ideals and want to do pure mathematics, and not some bastard, very down-to-earth problems.'"[357] One reason for this reservation was that members of the public were seen as not sufficiently competent to provide useful input as they **lack knowledge**.[358] One respondent stated that society has to accept that scientists in general know more about the subjects discussed: "not every opinion is equal, but [...] there is some point in somebody having studied something for a number of years and then voicing an opinion based on something else than five minutes of Google."[359]

Additionally, Leading Researchers wanted the RRI concept to take differences between research fields into account.[360] One respondent also identified differences between European **countries**: "But now Europe wants to, you could say, create a definition that works for all European members. We have a problem because it means that some countries simply lack the history of doing this in a good way. And I think we should be critical on that."[361] Differences between Leading Researchers from different countries also became evident in their answers. Researchers from countries like Georgia, Serbia and Malta envisioned quite different future scenarios for RRI than scientists from Germany, the Netherlands or the UK. The former often focused on improving the national conditions for research in general, e.g., by increasing funding and internationalisation or enhancing infrastructure[362] and were worried about political tensions impairing such changes[363]. One respondent from Serbia stated that scarce public budgets in his country give priority to things other than research, let alone RRI: "Science is important,

[351] #024, p.15-16
[352] #044, p. 14; #067, p. 7; #083, p. 10
[353] #005, p. 14; #010, p. 13; #028, p. 10; #030, p. 12
[354] #054, p. 9
[355] #044, p. 14; #079, p. 16.
[356] #044, p. 13
[357] #028, p. 11
[358] #019, p. 12; #028, p. 11; #067, p. 7
[359] #002, p. 14
[360] #041, p. 10; #052, p. 15
[361] #033, p. 16-17
[362] #006, p. 11; #009, p. 13-14; #012, p. 13; #015, p. 15; #017, p. 16; #026, p. 11-12; #027, p. 10; #058, p. 5
[363] #009, p. 15; #012, p. 13

but if you need to decide what is more important, to have lunch or to invest in science, of course you must provide food first, otherwise no science at all."[364] Another respondent from Serbia identified different priorities than RRI for scientists in his country: "I know that researchers in Serbia are inactive in this RRI process since they are fighting for better working conditions, for new equipment, contemporary, cutting-edge technology."[365] Improving funding conditions for science in general was also a recurrent theme of interviewees from other countries. Fostering the diversity of funding and the opportunities for small research groups was underscored frequently.[366] As a result, priorities were sometimes set differently and RRI was not heading the wish list.

Another major requirement cited by Leading Researchers was to **reward** RRI activities via promotions and allocation of funds.[367] One respondent identified a dilemma for scientists: "I know a lot of people who have sympathy for this way of thinking of science. But they just think they are killing their job."[368] Yet another one complained that interdisciplinary proposals and proposals that feature external engagement are often not accepted: "It turns out, again and again, that very mono-disciplinary proposals are easier to assess and evaluate, so they typically end up higher in rankings."[369]

Respondents demanded **openness** and the willingness to collaborate from all parties in the RRI process, which is often still lacking.[370] For example, one scientist described lacking recognition of RRI activities from his peers: "I take huge part of my time by interviewing, answering, by meeting all the public stakeholders, one to three times in order to get a relationship, a quite established relationship. And some of my colleagues said: 'Oh, you are not in the lab today, you are outside' and they were thinking that I was having a good time."[371] However, such a mentality change was seen to be a great challenge and takes a lot of time.[372]

Several respondents also expressed a more deeply rooted resistance to RRI. Two respondents viewed RRI only as a fashionable policy concept with a short life-span[373], another one stated: "I think it's nonsense."[374] Reasons for resistance became also clear. Many researchers thought it to be vital to maintain at least some research that is **not influenced by societal needs**[375] because it might become useful later on[376] or because societal benefits are hard to measure[377] or because innovation cannot be planned[378]. Another reason to reject RRI, as defined by the European Commission, was to shield

[364] #014, p. 13, see also #015, p. 15
[365] #015, p. 15
[366] #022, p. 18-19; #031, p. 10; #039, p. 10; #044, p. 13; #073, p. 10 ;#080, p. 7-8
[367] #003, p. 12; #020, p. 9-10; #024, p. 15-16; #025, p. 11; #077, p. 12; #079, p. 15; #082, p. 11
[368] #011, p. 16-17
[369] #066, p. 9-10
[370] #003, p. 12; #020, p. 9
[371] #010, p. 12
[372] #003, p. 13; #052, p. 15
[373] #054, p. 9; #082, p. 10-11
[374] #067, p. 7
[375] #003, p. 13; #019, p. 12; #041, p. 10; #042, p. 6; #069, p. 11
[376] #041, p. 10; #042, p. 6
[377] #088, p. 11
[378] #067, p. 7

science against societal, economic and political **influences** and ensure its independence.[379] For example, one interviewee wanted experienced scientists to decide about societal needs.[380] Another one found political demands to be nonsensical, e.g., when writing proposals: "requirement for numbers, requirement for the North and the South to work together, requirement for equal amounts of female researchers, and female researchers of certain age, young researchers and old researchers, all these kinds of political correctness in my opinion is beyond how science happens."[381]

Several Leading Researchers asked for more **trust** in and **support** for science and urged that science should not be bound by justifications of its usefulness and responsibility[382]: "speaking out to government or to business is to remind them that their primary responsibility is to create a good research environment for the researchers who work in their institutions, and to protect that domain."[383] Correspondingly, two respondents warned against imposing RRI on the scientific community[384]: "So if one group of people tells the others what to do, it might not work as well as if this complete system of scientists and public and politicians learn together how to reach it, instead of having one group telling others how to do it. So, that would be my idea for this. I do not want to exclude anyone from this process but I would like to have it happen in an evolutionary way and not in a revolutionary or dictatorial way."[385]

3.9.2 RESEARCH EXECUTIVES

> *"What is your personal vision for Responsible Research and Innovation?*
>
> *How would you characterise the ideal outcome of Responsible Research and Innovation?*
>
> *How would you characterise the ideal process for achieving this outcome?*
>
> *Given the vision for Responsible Research and Innovation you have just described, where do you see your own institution?*
>
> *If you had all the resources required, what steps would you take within the next year or two to move your institution closer to the envisaged ideal?"*

In a similar vein, Research Executives were asked about the ideal outcome of RRI. They mentioned predominantly **societal impact of research**[386] as well as **public engagement**[387]. When asked about the ideal process to achieve this outcome or the next

[379] #002, p. 13-14; #019, p. 12; #027, p. 10; #044, p. 13; #057, p. 8; #068, p. 9; #069, p. 11
[380] #027, p. 10
[381] #022, p. 19; see also #044, p. 14
[382] #002, p. 13-15; #012, p. 13; #039, p. 9; #044, p. 13: #073, p 10
[383] #032, p. 22
[384] #057, p. 8
[385] #068, p. 9
[386] #001[RE], p. 11; #007[RE], p. 14; #013[RE], p. 11; #021[RE], p. 14; #034[RE], p. 15; #038[RE], p. 13; #047[RE], p. 6; #048[RE], p. 7; #065[RE], p. 9; #056[RE], p. 9-10; #059[RE], p. 10; #074[RE], p. 10; #075[RE], p. 9; #081[RE], p. 8
[387] #021[RE], p. 14; #055[RE], p. 9; #056[RE], p. 9-10; #059[RE], p. 10; #062[RE], p. 9 and research ethics #008[RE], p. 14-15; #081[RE], p. 8

steps necessary, most focused on public engagement to identify societal needs and how to design a structured process.[388] For example, items such as achieving a balance between different external parties[389] and how much influence to grant them[390] were brought up as points of concern. Other envisioned features of the implementation process were funding and incentivising RRI[391], educating researchers and university staff on RRI[392] and institutions adopting the RRI approach[393]. One respondent emphasised that the practical implications of RRI need to be spelled out: "you will find little opposition to the general idea that we are responsible and should do things, but then, what does this mean in practice?"[394]

Most saw their own institution still at the beginning of the RRI process[395] or on the way but more needs to be done[396]. Several also thought their institution is already well placed[397], e.g. because it is an entrepreneurial university[398] or because it is doing applied research[399].

One obstacle Research Executives perceived in the way of RRI implementation was its **lack of acceptance by researchers**. It might become a "tick-the-box exercise"[400], merely pretending social responsibility. This was illustrated with the following example: "I remember my wife was a molecular biologist, and then some decades ago there was this popular war against cancer and then every molecular biologist somehow presented what they really wanted to do as relevant for cancer."[401] Research Executives also thought that societal impact is the responsibility of **applied research**, not of fundamental research.[402] They wished to continue basic research as well as research independent from societal demands and influence.[403] Also, participants wanted the public and politics to accept scientific competence and authority.[404]

In **conclusion**, Leading Researchers and Research Executives expressed their **support** for RRI as defined by the European Commission. However, they often only focused on specific aspects, mostly **public engagement** and **research ethics**. Knowledge of RRI and its different features seems to be still in its infancy. One Research Executive identified a common misunderstanding: "I think there is a bit of danger that people

[388] #001[RE], p. 11; #007[RE], p. 14; #013[RE], p. 11; #021[RE], p. 15; #055[RE], p. 9; #056[RE], p. 10; #059[RE], p. 10; #062[RE], p. 9; #064[RE], p. 8; #072[RE], p. 12; #074[RE], p. 10; #081[RE], p. 8; #085[RE], p. 8; #086[RE], p. 11, 12; #087[RE], p. 2, 9
[389] #013[RE], p. 11; #081[RE], p. 8
[390] #055[RE], p. 9; #059[RE], p. 10
[391] #016[RE], p. 12; #047[RE], p. 6; #062[RE], p. 9; #076[RE], p. 11; #087[RE], p. 14
[392] #007[RE], p. 15; #047[RE], p. 6; #055[RE], p. 9-10; #065[RE], p. 9; #078[RE], p. 9; #087[RE], p. 16
[393] #078[RE], p. 9; #087[RE], p. 14
[394] #076[RE], p. 11
[395] #013[RE], p. 11; #062[RE], p. 9; #075[RE], p. 9; #078[RE], p. 9; #085[RE], p. 8
[396] #051[RE], p. 10; #055[RE], p. 9; #056[RE], p. 10; #074[RE], p. 10; #081[RE], p. 8
[397] #016[RE], p. 13; #023[RE], p. 13; #038[RE], p. 13; #065[RE], p. 9
[398] #001[RE], p. 11
[399] #047[RE], p. 6; #072[RE], p. 13
[400] #076[RE], p. 11; see also #087[RE], p. 15,16
[401] #028, p. 3
[402] #021[RE], p. 14; #072[RE], p. 12
[403] #008[RE], p. 14-15; #089[RE], p. 10; see also #084[RE], p. 6-7
[404] #040[RE], p. 8; #061[RE], p 12; #078[RE], p. 8

think RRI is ethics, and it is not, it is a very different thing."[405] Next to increasing the knowledge about RRI in the scientific community, participants frequently mentioned the need to foster RRI via **funding**, **incentives**, **career opportunities** and **support structures**. Also, translating RRI into practice was seen as a major challenge. Especially the public engagement process was brought up as a point of concern because its concrete design is still unclear. So, participants are unsure what is expected from them when RRI is put into practice. Leading Researchers also feared the biased **influence** of stakeholders as well as **incompetence** of lay people, while Research Executives were more focused on how to design the engagement process in a useful way.

Leading Researchers as well as Research Executives also emphasised differences between research fields, expressing the view that responsibility entails different things in **applied and fundamental research**. Consequently, many advocated maintaining basic research not directed at societal needs. Also, participants from both groups wanted to shield science against external influences and saw science as better able to make competent decisions. The answers of Leading Researchers also made clear that RRI is not seen as a **priority** in countries were science in general struggles for funding and support.

[405] #078[RE], p. 10

4 CHALLENGES WITH INTERVIEW PARTNERS

Some of the interview questions were not understood as we thought they would be. This applies specifically to questions about the institutional environment (part 5 of the questionnaires). Most of the interview partners wanted to talk about how research is supported in their country and what difficulties they have in their everyday work. For example, they took the opportunity to demand more stable positions for researchers, less emphasis on impact factors in the publication system or easier access to funds. They did not get to answer the questions regarding RRI. We now understand better what our interview partners from different countries consider their pressing needs and concerns, and we see this as a collateral benefit of our international study. However, we did not include these answers in our analysis because they were mostly irrelevant and delivered no new insights for RRI implementation.

We have interviewed one interview partner from Canada who was suggested by one of our consortium partners. We accepted to interview this person because we were not sure how many interview partners we would have until the end of the study. Afterwards we decided not to include the answers of this interview partner because the interviewee is no European and therefore this interview is not useable. Two interview recordings from Dublin were not sent to us and therefore we could not analyse them. This means that the European Study contains 86 interview partners instead of 89 interview partners as mentioned in Deliverable 3.2.

5 CONCLUSION, STUDY RECOMMENDATIONS FOR IMPLEMENTATION ROADMAP AND OUTLOOK

5.1 CONCLUSION

The above analysis is based on the outcome of a large-scale empirical study among Leading Researchers and Research Executives at European universities. It delivers important insights into how the scientific community views RRI and what barriers might disturb or obstruct its implementation. In the interviews, we focused on the two potentially contentious features of RRI, namely, research directed by societal needs ('Science for Society') and the involvement of non-scientists into research ('Science with Society'). Based on our findings, the following conclusions can be drawn:

SCIENCE FOR SOCIETY: ADDRESSING SOCIETAL PROBLEMS IN RESEARCH

- Leading Researchers and Research Executives were generally prepared to address societal problems in their research and let such problems influence their research agendas.
- Many participants regarded solving societal problems as an essential feature of responsible research and as desirable for research in general.
- Funding requirements and career opportunities are highlighted as a factor influencing whether societal challenges are addressed.
- Especially Leading Researchers, and to a lesser extent Research Executives, emphasise the need for fundamental research that is not directed at societal aims. Reasons given are:

    - Leading Researchers were sceptical regarding the anticipation of research outcomes and therefore also the anticipation of their usefulness for society, especially in the early stages of research; fundamental research is seen as building the basis for innovations later on.
    - Leading Researchers and Research Executives emphasised differences between research fields and expressed the view that responsibility means different things in applied and fundamental research.
    - Leading Researchers were also sceptical of anticipating the societal impact of technologies; anticipation is considered easier in applied research, for technologies close to completion and for small improvements; involvement of technology-assessing disciplines was expected to facilitate the anticipation of the potential future impact.

SCIENCE WITH SOCIETY: INVOLVING NON-SCIENTISTS IN RESEARCH

- Options for engagement from outside of science are widely recognised by Leading Researchers and Research Executives, with stakeholders being mentioned more often than lay people.
- Both groups chiefly reported about experiences with dissemination activities; more interactive formats are known to a lesser extent.
- Participative research is seen as important for addressing needs of society during the research process.
- Mostly Leading Researchers emphasised that engagement must not impair freedom of research and want to shield science against external influences.
- Engagement was regarded as easier in applied research than in fundamental or theoretical fields; relevance of a topic to stakeholders and lay people is seen as a precondition for their engagement.
- Leading Researchers and Research Executives saw Calls for Proposals (as issued by political bodies or foundations) as the most important factor for shaping their research, followed by Collaborations among researchers and leadership of Renowned Experts.
- The appropriate design of the engagement process was a major concern for Leading Researchers and Research Executives.
- **Stakeholders** were mostly seen as sources of funding and to a lesser degree as providers of information about which problems are practically pressing.
- Involvement of stakeholders was regarded as a means for anticipating the possible societal impact of technological innovations. Leading Researchers were worried about the biased influence of business and politics on science regarding topics and desired results.
- Research Executives viewed research done with industry as respectable interaction that benefits both universities and companies; they are mainly afraid that stakeholder influence leads to a skewed public perception of science as being biased and less objective.
- Relationships with non-industrial institutions were also widely spread among universities, although Research Executives seem to be less aware of them as compared to industry-relations.
- **Lay people** were mainly seen as recipients of information and education which is tied to hopes of raising public support for science.
- Some Leading Researchers and Research Executives acknowledged that lay people legitimately influence the research agenda by stressing societal needs; Leading Researchers also envisaged options for Citizen Science, that is, by assisting scientists in collecting data.

- Leading Researchers and Research Executives were worried about lay people's lack of knowledge about scientific topics, possibly leading to unrealistic expectations, nonsensical demands or communication difficulties.

RRI AS DEFINED BY THE EUROPEAN COMMISSION

- By and large, Leading Researchers and Research Executives supported RRI as defined by the EC with some important qualifications (see above).
- Often respondents only focused on either public engagement or research ethics.
- Knowledge of the concept of RRI, its different features and their implications seems not well developed in the scientific community; many participants demanded to educate researchers on RRI.
- The practical usefulness of the definition of RRI was called into question by both groups of participants due to its vagueness and generality.
- Translating RRI into practice was seen as a major challenge by Leading Researchers and Research Executives; especially the engagement process was said to be in need of clarification.
- Both groups feared the additional burden of RRI in terms of administrative tasks and communication efforts.
- Participants frequently demanded funding, incentives, career opportunities and support structures to foster RRI implementation.
- Leading Researchers were more focused on conceptual difficulties of RRI, while Research Executives were more concerned with its practical feasibility.
- Leading Researchers from countries where science struggles for funding and support made clear that RRI is not seen as a priority.

5.2 RECOMMENDATIONS FOR RRI IMPLEMENTATION

Based on these conclusions, recommendations can be developed for the successful implementation of RRI in Higher Education Institutions across Europe. These recommendations confirm those made in Deliverable D3.4 ("Study Recommendations for the Implementation Roadmap") and add important aspects to effectively overcome barriers.

5.2.1 SCIENCE FOR SOCIETY

Regarding Science for Society, participants considered it important to address societal problems in their research. However, they also feared to lose scientific autonomy and productivity if societal impact is indiscriminately required for all fields, types and

stages of research. Research directed at understanding and early phases of the research process were seen as not suitable for being subjected to advice from society. Therefore, RRI should be implemented with moderation in order to prevent an antagonistic response in the scientific community. However, the drawback is that societal demand only gets heeded after a lot of resources have already been spent on a line of research which then might be rejected eventually. One way to prevent premature closure of research lines is to support a diversity of research upstream. Society can effectively intervene in later stages when uncertainty of outcomes is reduced. Also, to anticipate social resistance to technologies, analysis of their social context is relevant. This can be accomplished early on by scientists collaborating with technology-assessing disciplines. Therefore, the following recommendations for RRI implementation suggest themselves:

GENERAL

- Appeal to the desire of scientists to solve societal problems and to do socially relevant research.
- Maintain fundamental research not directed at societal aims and grant room for exploratory research.
- Do not privilege or block specific research lines upstream but pursue a plurality of research lines to widen the leeway for societal choice and to enable serendipitous findings.
- Take societal demands into close consideration in research stages approaching practical use.
- Anticipate societal resistance beforehand by instigating an interdisciplinary dialogue with social groups.

FOR THE NUCLEI

- Communicate to scientists the opportunities of RRI for solving societal problems and improving lives.
- Be aware of differences regarding demand-driven research between research fields, types and stages.
- Bring researchers producing technology and assessing its societal impact together for anticipating possible societal resistance.

5.2.2 SCIENCE WITH SOCIETY

Engagement possibilities for dissemination were widely recognised among study participants. Knowledge of the variety of engagement formats, especially more interac-

tive ones seemed to be lacking and should be improved. Stakeholders were seen as an important source of information about demands but their biased interests were seen as obstacles to a more substantial involvement. A possible remedy is the inclusion of a variety of different stakeholders who bring different interests to bear so that research is not skewed by singular interests. Engagement of lay people was said to be hindered by their lack of knowledge about scientific topics. Educating them beforehand might make their influence more acceptable to scientists. In general, the design of the engagement process is a major concern of participants and needs clarification and conceptual work to alleviate worries. Regarding different research fields, applied research with relevance to non-scientists was seen as most suited for engagement.

GENERAL

- Communicate benefits of external engagement, e.g., identification of needs, anticipation of societal impact, but also raise interest and support for science.
- Prevent one-sided stakeholder influence by appeal to a variety of differently biased stakeholders; do not only rely on industry.
- See to it that influences from all social actors come from a broad range of values and interests so that an inclusive socially responsible research agenda can emerge.
- The design of the engagement process needs clarification and conceptual work.
- Engagement should concentrate on applied work.

FOR THE NUCLEI

- Enhance researchers' knowledge of engagement possibilities, especially of more interactive formats.
- To overcome the obstacle of unbalanced stakeholder influence, identify stakeholders with different interests regarding a certain research project or a field of research that is prominent in your institution; pay special attention to non-industry stakeholders.
- Explore the design of an engagement process that is acceptable to scientists, e.g., by conducting a survey or a focus group among researchers.

5.2.3 RRI AS DEFINED BY THE EUROPEAN COMMISSION

Although participants supported conducting research in accordance with societal needs and values, they often focussed on either public engagement or research ethics to achieve this. Awareness of the different features of RRI should be fostered in the scien-

tific community. Also, in order to be useful in practice, the definition of RRI needs to become more concrete and include, for example, details on the engagement process (see above). To shoulder the additional burden created by RRI implementation (administration, communication etc.), respondents strongly emphasised the need for funds, incentives and support. It also became clear that RRI is not a concern in countries where science operates under poor funding opportunities and lacking support.

GENERAL

- Educate the scientific community on the concept of RRI.
- Elaborate and specify what RRI means in practice.
- Keep the additional effort required from scientists for RRI at a minimum.
- Create funding opportunities, career opportunities, incentives and support structures (e.g. for communication) for RRI.
- Be aware of national differences in RRI prioritization.

FOR THE NUCLEI

- Organise an event that aims at informing Leading Researchers and Research Executives about RRI and to familiarize them with the concept and its benefits.
- Identify role models at your institution who already engage in RRI and bring them together with other interested scientists for an exchange about how RRI might be implemented in practice.
- Foster a dialogue among institutions, funding agencies and scientists how RRI can be incentivized, e.g., by organising a debate about how RRI can be acknowledged in calls for proposals or via scholarships.

5.3 OUTLOOK ON THE CONCEPTUAL ANALYSIS

The empirical analysis yielded important insights into the views of Leading Researchers and Research Executives on RRI. In the second phase of the NUCLEUS Project, we will subject those findings to a philosophical analysis which will be combined with case studies. The aim is to determine whether worries of participants identified in the empirical part of our analysis are *justified* and how they might be *alleviated*. Some fruitful points for conceptual analysis have already become apparent.

For example, participants frequently voiced fears to lose scientific autonomy as well as sustainability and creativity of research if agendas are directed by social demands. This calls for an analysis of the different aspects of fundamental and applied re-

search, their differences and relationship. Participants often seem to assume a linear relationship, i.e., fundamental research feeding into applied research feeding into innovations and new technologies. However, this so-called linear model has been criticised for not taking into account the reciprocal relationships between different kinds of research. For example, applied research is able to produce new insights useful for basic research. Also, participants were sceptical of the predictability of research outcomes and their usefulness to society. This raises the conceptual question under which conditions planned research can actually be successful and the normative question whether research exclusively aimed at understanding can be part of RRI.

Another important point of the conceptual analysis is the potential *epistemic* benefits of RRI. As mentioned by one study participant, such benefits might win over scientists for RRI who are concerned about decreasing quality of research through external influence and engagement. Many interviewees were also concerned with how to design public influence, for example, at which stages of the research process it is most effective or whether lay people should be educated beforehand. Clarification and justification of the actual process might decrease worries in the scientific community. The process design is also connected to questions of what can reasonably be expected of individual scientists to implement RRI and what might rather be tasks of institutions or policy makers. The interviews showed that participants fear an additional personal burden and that they wish for incentives and support structures.

The aim of the philosophical analysis is to develop a more detailed and concrete concept of RRI. Participants criticised the vagueness of the EC definition, especially on controversial issues like science directed by societal demand and public engagement. We wish to flesh out the RRI concept, thereby taking into account the intuitions of Leading Researchers and Research Executives as well as philosophical analysis. Relevant items are appropriate designs for including public input effectively and without adverse side-effects, schemes for familiarizing the public with the scientific issues at hand, and potential epistemic benefits of RRI which might win over scientists who are concerned about decreasing research quality through external interference. Our findings will be continually fed into the work carried out in the Embedded and Mobile Nuclei to support successful RRI implementation in the second phase of the NUCLEUS project.

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APPENDIX 1: INTERVIEW FOR LEADING RESEARCHERS

Good Morning/Good Afternoon, Professor/Dr./Mr./Ms. XXX - Thank you very much for your willingness to participate in this interview.

The interview is part of an interdisciplinary study which focuses on a new understanding of Responsible Research and Innovation (RRI) in universities and scientific institutions. The study is embedded in a Horizon 2020-project called 'NUCLEUS'. In this interview, it is our goal to capture and understand your experiences, views, hopes and worries with regard to research performed in the service of society. We want to understand your point of view and what RRI could sensibly mean from where you are sitting.

The data from the interviews will be anonymised and only used for research in the NUCLEUS project.

All in all, this interview will take approximately one hour.
Do you give me the permission to record this interview?
We will send you the transcribed interview for correction of factual mistakes.

Gender (fill in without asking):
□ female
□ male

Age:
Ph.D.: ☐ yes
☐ no
Year:
Years in research after Ph.D.:
Name and country of institution (fill in without asking):
Field of research:

1. **First…**

a. Do you think that the willingness of scientists to cooperate with one another has declined over the last [30] years [or so]? [reword for young participants]

b. Can you provide one piece of anecdotal evidence in support of your answer?

2. This section of the interview is about your experiences and views with regard to RRI.

a. What role do you see for science (or research) in society?

b. Can you describe a positive example of Responsible Research and Innovation?

[Can you think of an example that illustrates what RRI means to you personally?]

[Can you describe an example of where research has led to what you would see as a beneficial application?]

*What makes it a positive example?**

c. Can you describe a negative example?

[When you think of what RRI means to you, can you think of an example of research that lacks an appropriate amount of responsibility?]

[Can you describe an example of where research has led to what you would see as a harmful application?]

*What makes it a negative example?**

d. What is your personal experience with science or research in society? For example, how do you engage people in your research? Or do societal challenges influence the research projects which you have conducted or have sought funding for?

[People = literally anybody: students, colleagues, friends and family, representatives of industry or civil society, policymakers and officials, lay people in general]

3. An important aspect of Responsible Research and Innovation as this term is generally understood is the engagement of stakeholders and lay people. This section is about your general views on stakeholder and lay people engagement.

[Stakeholder = any person or party who has an interest in research, e.g. government, industry, media, or representatives therefrom]

[Lay people = 'people from the street', randomly selected members of the population]

[Engagement = participation in the widest sense; could be that stakeholders and lay people contribute, that they listen, make suggestions, or that researchers have to justify or explain what they are doing to them, or anything of this sort.]

a. What possibilities do you see for engaging stakeholders or lay people in your own research?

b. What possibilities do you see for engaging stakeholders in fields of research other than your own?

c. What hopes and worries do you have?

   [What hopes and worries do you have with regard to the possibilities of engagement you have just described?]

d. What conditions must be fulfilled in order for these possibilities of engagement to be realised?

   [What main things are needed in order to realise the possibilities of engagement you have just described?]

4. **This section is about different mechanisms for shaping research. We are interested in the relative importance of different driving forces that shape research – political agendas, business interests, research-internal factors, or more broader societal influences.**

   [One could also put it like this: There are different kinds of actors who can take the lead in shaping research – for example, political institutions, corporations, researchers themselves, or citizens. In this section, we are asking about your views on, and your experiences with, different mechanisms and actors that can influence the pathways of research.]

   a. How do calls for proposals influence your own research? How do calls for proposals influence research more generally?

      [What do you think about calls for proposals (issued by ministries or other governmental agencies)? What are your experiences?]

   b. How does private sponsorship influence your own research? How does private sponsorship influence research more generally?

      [What do you think about private sponsorship? What are your experiences?]

   c. How do senior researchers (including yourself) influence your own research? How do senior researchers influence research more generally?

      [What do you think about thought leadership of renowned experts (e.g. senior researchers)? What are your experiences?]

d. How do collaborations among all researchers – including junior researchers and students – influence your own research? How do collaborations among all researchers influence research more generally?

[What do you think about collaborations among all researchers (including junior researchers or students)? What are your experiences?]

e. What do you think about 'Citizen Science'- involvement of both researchers and representatives of civil society? What are your experiences?

[How do members of civil society influence your own research? How do members of civil society influence research more generally?]

[Citizen Science = involvement of both researchers and representatives of civil society in research activities]

5. **This section is about your evaluation of the existing institutional context of research and innovation. We are interested in your views on, and experiences with, various aspects of this context.**

[In particular, in the following, we would like to talk about funding structures, career paths, the publication environment, intellectual property rights, existing institutional initiatives, support services and the distribution of power within research organisations.]

a. What is good about current funding structures (in the context of RRI)? What is bad about current funding structures? What are your experiences?

[To what extent do current funding structures enable RRI? To what extent do current funding structures constrain RRI?]

[Do funding structures incentivise positive contributions to society? Are positive societal impacts appropriately considered within the current system of research funding?]

b. What is good about current career paths (in the context of RRI)? What is bad about current career paths? What are your experiences?

[To what extent do current career paths enable RRI? To what extent do current career paths constrain RRI?]

[Are positive contributions to society rewarded career-wise? Does it help researchers' careers to think about questions such as "Is my research beneficial to society?"]

c. What is good about the current publication environment (in the context of RRI)? What is bad about the current publication environment? What are your own experiences?

   [To what extent does the current publication environment enable RRI? To what extent does the current publication environment constrain RRI?]

   [Are positive contributions to society considered within the current publication system? Does thinking about questions such as "Is my research beneficial to society?" help getting published]

d. What is good about the current system of intellectual property rights (in the context of RRI)? What is bad about the current system of intellectual property rights? What are your own experiences?

   [To what extent do intellectual property rights enable RRI? To what extent do intellectual property rights constrain RRI?]

   [Does the current system of intellectual property rights promote socially beneficial applications of research? Does intellectual property help to make the world a better place?]

e. What is good about existing institutional initiatives/agendas (in the context of RRI)? What is bad about existing institutional initiatives/agendas? What are your experiences?

   [Existing institutional initiatives or agendas = institutionally initiated programmes to promote an alignment of research with societal needs and values, including requirements of gender equality or interdisciplinarity. For example, in the UK there is the Athena SWAN initiative to promote equal opportunities for women in science. Also, many universities have on-site incubators which seek to convert research into marketable products.]

   [To what extent do existing institutional initiatives and agendas enable RRI? To what extent do existing institutional initiatives and agendas constrain RRI?]

   [Do existing institutional agendas promote socially beneficial applications of research? Do existing institutional agendas help to make the world a better place?]

f. What is good about current support services (in the context of RRI)? What is bad about current support services? What are your experiences?

[Support services = organisational units such as Human Resources, IT and Web Development, or Controlling, that contribute to the administration of research in line with accepted frameworks of conduct.]

[To what extent do existing support services enable RRI? To what extent do existing institutional initiatives and agendas constrain RRI?]

g. What is good about the distribution of power among researchers (in the context of RRI)? What is bad about the distribution of power? What are your experiences?

[To what extent do existing power structures within research organisations and projects enable RRI? To what extent do existing power structures within research organisations and projects constrain RRI?]

[Who can set research agendas?]

[Do they harm? Are they a hindrance?]

6. This section is about your views on the new definition of RRI adopted by the European Commission.

In the Research Framework HORIZON 2020 the European Commission defines RRI as *"a process in which all societal actors (researchers, citizens, policymakers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to align research and innovation outcomes with the values, needs and expectations of society."*

a. What opportunities and risks does RRI as defined by this definition present for your own work?

b. What opportunities and risks does RRI as defined by this definition present for the future development of science and research more generally?

7. This section is about the assessment of research and innovation outcomes.

a. To what extent is it possible to anticipate research outcomes during the research process?

b. To what extent do you think the societal consequences of technological innovations can be anticipated?

8. This section is about your visions for Responsible Research and Innovation.

a. What are your ideas for the future of Responsible Research and Innovation?

   [To what characteristics and ideals should RRI aspire? What should RRI be like?]

   [What steps would you take? Where do you want to go?]

b. What kind of support (institutional, economic, etc.) do you need in order to realise these possibilities?

   i. Are there differences between your own research and other fields of research?

c. What obstacles do you anticipate?

Is there anything regarding Responsible Research and Innovation that we haven't discussed that you'd like to add?

Thank you for your time and answers. We will send you the transcript of the interview as soon as possible.

APPENDIX 2: INTERVIEW FOR RESEARCH EXECUTIVES

Good Morning/Good Afternoon, Professor/Dr./Mr./Ms. XXX - Thank you very much for your willingness to participate in this interview.

The interview is part of an interdisciplinary study which focuses on a new understanding of Responsible Research and Innovation (RRI) in universities and scientific institutions. The study is embedded in a Horizon 2020-project called 'NUCLEUS'. In this interview, it is our goal to capture and understand your experiences, views, hopes and worries with regard to research performed in the service of society, with a particular focus on your own institution. We want to understand your point of view and what RRI could sensibly mean from where you are sitting.

The structure of the interview is as follows: the first part is about your own personal experiences and the experiences of your current institution, the second part is about the possibilities for institutional change as you perceive them.

The data from the interviews will be anonymised and only used for research in the NUCLEUS project.

All in all, this interview will take approximately 50 to 60 minutes.
Do you give me the permission to record this interview?
We will send you the transcribed interview for correction of factual mistakes.

Gender (fill in without asking):

☐ female

☐ male

Age:
Name and country of institution (fill in without asking):
Current position in institution:
Time in current post:
Professional background:
Number of research staff:
Number of research students:

Part One: Personal Experience and Experience of *Own Institution*

The idea of the first part is to talk about your own personal experience and the governance of *your own institution*. We are interested in your views on 'Responsible Research and Innovation' and the possibilities, opportunities and risks you see as far as 'Responsible Research and Innovation' in *your own institution* is concerned.

1. **The first section is about your experiences and views.**
    a. How would you describe the role of *your institution* in society?
    b. Can you describe a positive example of Responsible Research and Innovation?

    [Can you think of an example that illustrates what RRI means to you personally?]

    [Can you describe an example of where research has led to what you would see as a beneficial application?]

    *What makes it a positive example?**

    c. What is *your institution's* experience with science or research in society? For example, how does *your institution* engage people in research? Or do societal challenges influence the research projects that *your institution* seeks funding for?

    [People = literally anybody: students, colleagues, friends and family, representatives of industry or civil society, policymakers and officials, lay people in general]

    [Can you say a few words about the relationship between your institution and society?]

2. **An important aspect of Responsible Research and Innovation as this term is generally understood is the engagement of stakeholders and lay people. This section is about your general views on stakeholder and lay people engagement.**

    [Stakeholder = any person or party who has an interest in research, e.g. government, industry, media, or representatives therefrom]

    [Lay people = 'people from the street', randomly selected members of the population]

[Engagement = participation in the widest sense; could be that stakeholders and lay people contribute, that they listen, make suggestions, or that researchers have to justify or explain what they are doing to them, or anything of this sort.]

a. What possibilities do you see for engaging stakeholders or lay people in *your own institution*?

b. How do these possibilities of engagement differ between different research areas?

c. What hopes and worries do you have with regard to these possibilities for engagement?

d. What conditions must be fulfilled in order for these possibilities of engagement to be realised in *your institution*?

[What main things are needed in order to realise the possibilities of engagement you have just described?]

3. **This section is about different mechanisms for shaping research. We are interested in the relative importance of different driving forces that shape research - political agendas, business interests, research-internal factors, or more broader societal influences.**

[One could also put it like this: There are different kinds of actors who can take the lead in shaping research – for example, political institutions, corporations, researchers themselves, or citizens. In this section, we are asking about your institution's experiences with different mechanisms and actors that can influence the pathways of research.]

a. How do calls for proposals influence research in your institution?

[What do you think about calls for proposals (issued by ministries or other governmental agencies)? What are your institution's experiences?]

b. How does private sponsorship influence research in your institution?

[What do you think about private sponsorship? What are your institution's experiences?]

c. How do renowned experts (e.g. senior researchers) influence research in your institution?

[What do you think about thought leadership by renowned experts and senior researchers? What are your institution's experiences?]

d. How do collaborations among all researchers – including junior researchers and students – influence research in your own institution?

[What do you think about collaborations among all researchers (including junior researchers or students)? What are your institution's experiences with collaborations among all researchers?]

e. What do you think about 'Citizen Science'? What are your institution's experiences?

[Citizen Science = involvement of both researchers and representatives of civil society in research activities]

[How do members of civil society influence research in your own institution?]

4. This question is about the 'embeddedness' of research performed by *your institution* within the larger institutional setting.

a. How would you characterise the relation between research performed by *your own institution* and industry?

i. What partnerships with industry does *your institution* currently have?

[Can you give us a broad overview of the types of relationships with industry that your institution is currently engaged in?]

ii. How does this differ from the past?

[Can you say a few sentences about how the relationship between your institution and industry has evolved over time?]

iii. How does this differ from other institutions you have worked for?

[How do the relations between your current institution and industry differ from other institutions you have worked for?]

b. How would you characterise the relation between research performed by *your institution* and external partners other than industry?

i. What partnerships other than those with industry does *your institution* currently have?

[Can you give us a broad overview of the types of relationships with partners other than industry that your institution is currently engaged in?]

ii. How does this differ from the past?

[Can you say a few sentences about how the relationship between your institution and non-industry partners has evolved over time?]

iii. How does this differ from other institutions you have worked for?

[How do the relations between your current institution and non-industry partners differ from other institutions you have worked for?]

Part Two: Desirable Changes

The idea of the second part is to explore the potential for institutional change.

5. **This question is about the changes would you make to the current institutional environment of research and innovation.**
    a. What, if any, changes would you make to the following elements of the current institutional environment as faced by *your own institution*?
        i. Funding structures
        ii. Career paths
        iii. Publication environment
        iv. Intellectual property rights
        v. Existing institutional initiatives/agendas

        [Existing institutional initiatives or agendas = institutionally initiated programmes to promote an alignment of research with societal needs and values, including requirements of gender equality or interdisciplinarity. For example, in the UK there is the Athena SWAN initiative to promote equal opportunities for women in science. Also, many universities have on-site incubators which seek to convert research into marketable products.]

        vi. Support services (e.g. HR departments, controlling, IT)

        [Support services = organisational units such as Human Resources, IT and Web Development, or Controlling, that contribute to the administration of research in line with accepted frameworks of conduct.]

        vii. Reporting lines
        viii. Distribution of power within research organisations

6. **This section is about your views on the practical implication of the new definition of RRI adopted by the European Commission.**

    In the Research Framework HORIZON 2020 the European Commission defines RRI as *"a process in which all societal actors (researchers, citizens, policymakers, business, third sector organisations, etc.) work together during the whole research and innova-*

tion process in order to align research and innovation outcomes with the values, needs and expectations of society."

a. What opportunities does RRI as defined by the EC's new definition present for *your own institution*?

b. What risks does RRI as defined by the EC's new definition present for *your own institution*?

7. This question is about your vision for Responsible Research and Innovation.

a. What is your personal vision for Responsible Research and Innovation?

i. How would you characterise the ideal outcome of Responsible Research and Innovation?

ii. How would you characterise the ideal process for achieving this outcome?

8. This question is about what needs to be done.

a. Given the vision for Responsible Research and Innovation you have just described, where do you see *your own institution*?

b. If you had all the resources required, what steps would you take within the next year or two to move *your institution* closer to the envisaged ideal?

Is there anything regarding Responsible Research and Innovation that we haven't discussed that you'd like to add?

Thank you for your time and answers. We will send you the transcript of the interview asap.

APPENDIX 3: NUMBER OF INTERVIEW PARTNERS FROM EACH CONSORTIUM PARTNER

Consortium Partner	Leading Researchers female	Leading Researchers male	Research Executives female	Research Executives male	All Interview Partners	*All invited potential Interview Partners*
Rhine Waal University of Applied Sciences	1	1	1	0	**3**	*5*
Lyon University	0	2	1	0	**3**	*7*
Ruhr University Bochum	1	8*	1	3	**14**	*17*
Science View	0	0	0	1	**1**	*6*
University of Malta	1	4	0	0	**5**	*7*
University of Twente	1	2**	0	2	**5**	*6*
University of Aberdeen	0	2	2	1	**5**	*10*
University of Edinburgh	2	0	1	0	**3**	*17*
Ilia State University	2	3	2	0	**7**	*7*
Bielefeld University	0	0	0	1	**1**	*3*
Science City Hannover	2	2	0	2	**6**	*6*
Psiquadro	0	0	1	0	**1**	*3*
Nottingham Trent University	1	2	1	1	**5**	*8*
Wissenschaft im Dialog	0	0	1	1	**2**	*3*
Dublin City University	0	1	2****	1****	**4**	***
Delft University of Technology	3	5	1**	0	**9**	*16*
Nottingham City Council	1	0	1	1	**3**	*4*
Mathematical Institute of the Serbian Academy of Sciences and Arts	3	4	1	2	**10**	*15*
All	**18**	**36***	**16**	**16**	**86*** *(response rate 61%)*	***146***

State: August 31, 2017

* One additional interview partner is from Canada but we did not analyse the interview.

** One additional interview could not be used because the voice isn't recorded.

***All interviews are conducted by consortium partner.

**** We did not receive one additional interview yet.