Monitoring the Evolution and Benefits of Responsible Research and Innovation (MoRRI)

In-depth case studies on the benefits of RRI across scientific disciplines and industrial sectors

Progress report

Sub-task 6.4, In-depth case studies of the scientific disciplines and industrial sectors, Deliverable D5.2

This report is one of a series of documents produced as part of the European´Commission's service contract RTD-B6-PP-00964-2013, "Monitoring the evolution and benefits of responsible research and innovation". The following deliverables have been produced so far:

- **Citizen engagement and participation of societal actors in research and innovation**, Task 2, Analytical report, Deliverable D2.1, April 2015
- **Science literary and scientific education**, Task 2, Analytical report, Deliverable D2.2, April 2015
- **Gender equality**, Task 2, Analytical report, Deliverable D2.3, April 2015
- **Open access**, Task 2, Analytical report, Deliverable D2.4, April 2015
- **Ethics**, Task 2, Analytical report, Deliverable D2.4.1, April 2015
- **Governance**, Task 2, Analytical report, Deliverable D2.4.2, April 2015
- **Synthesis report on existing indicators across RRI dimensions**, Task 3, Progress report, Deliverable D3.1, May 2015
- **Metrics and indicators of Responsible Research and Innovation**, Task 3, Progress report, Deliverable D3.2, September 2015
- **Update of the literature review & Visioning exercise**, Task 6, Progress report, Deliverable D5.1, January 2016

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Executive Summary

The aim of subtask 6.4 of MoRRI was to carry out in-depth case studies about RRI or certain RRI dimensions in order to analyse their social, democratic and economic benefits. For that, a three-round case study programme was designed to guarantee a profound and synthesising cyclic research process:

1. In the first round, EU-funded projects suggested by the Commission were screened for their viability as case studies. Following a broad screening process, four of them were selected for comprehensive review (GAP2, CIT-PART, WiST, PRIMAS). Existing data and material of these projects was used to conduct the case studies, following a predeveloped formalised template.
2. In the second round, new empirical case studies were designed and carried out, building on the results and conclusions of the first round of case studies and on case suggestion by consortium partners. A new template was developed that allowed a more open and flexible approach towards the case study analysis.
3. In the third round of case studies, the approach of the previous round was continued and extended. Further cases were investigated by consortium partners, filling still existing gaps in the coverage of RRI dimensions, fields of benefits and R&I institutions.

The conclusions drawn within the research process were:

First round of case studies:

- The first round proved to be a feasible approach for developing and testing the case study template as well as getting insights into specific challenges regarding the study of RRI benefits. However, conducting case studies specifically designed for the purposes of MoRRI seemed to be a more expedient approach.
- The cases were mostly concerned with single RRI dimensions but not with RRI in a comprehensive way.
- Certain RRI dimensions and fields of benefit were more strongly represented than others. The four cases covered the dimensions citizen engagement and participation (short: public engagement - PE), science literacy and scientific education (SLSE), gender equality (GE) and RRI governance and ethics (ET). For the dimension open access (OA) and the investigation of economic benefits appropriate data was missing.
- In some cases, the measurement of impacts was not possible because the evaluation took place soon after the implementation of the RRI activities. Evaluation was also not always comprehensive, resulting in data inadequate for the purposes of MoRRI. Furthermore, the existing data was often insufficient to identify benefits.

Second round of case studies:

- The objectives of the second round were to extend knowledge about - and to assess possible benefits of - RRI across different dimensions, areas of impact and RRI performing actors/organisations was.
- The case studies demonstrated very diverse RRI measures that resulted in diverse benefits. Again, mainly democratic and societal benefits could be identified. A

systematic assessment of economic benefits was done only marginally and was not based on quantitative data.
- It proved to be difficult to identify causalities between RRI measures and impacts or benefits for similar reasons as in the first round, namely a lack of available evaluation data, the short implementation span of measures and difficulties directly attributing benefits to RRI activities.

Third round of case studies:

- In the last round of case studies, blank spots were filled and the consortium partners were asked to focus on finding economic benefits of RRI activities as much as possible in their case studies.
- It proved to be difficult to link economic benefits directly to RRI measures quantitatively (numbers, profits, growth of GDP, etc.) as the (economic) effects are too diverse to develop comparable screenings.
- There are indications of positive effects of RRI, but in order to determine causal links and impacts, comprehensive long-term studies would have to be set up.

A comprehensive and substantial analysis of the results and conclusions of the case studies will be conducted in deliverable D 5.3, also considering the questions and objectives of the other subtasks of task 6. However, there are preliminary synthesised findings on possible benefits of RRI activities:

- RRI measures can result in broader inclusion, empowerment and better access for various societal groups, actors and stakeholders on different level of R&I.
- Certain RRI activities raise awareness about RRI-related issues and in turn promote culture change in R&I.
- Organisations and institutions established mechanisms and processes concerning transparency, data handling, or others, that would otherwise not have been dealt with.
- RRI-related measures created higher credibility, integrity and legitimacy of organisations and science as such.
- Taking into account research ethics, stakeholder participation or gender equality can often save costs and efforts in R&I processes (litigation costs, redundant research, scientific misconduct etc.).

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List of Abbreviations

AU	Aarhus University
CS	Case Study
CWTS	Centre for Science and Technology Studies, Leiden University
EC	European Commission
ET	Ethics
FhG-ISI	Fraunhofer Institute for Systems and Innovation Research
FP	Framework Programme
GE	Gender Equality
GOV	R&I Governance
IHS	Institute for Advanced Studies
INGENIO (CSIC-UPV)	Institute of Innovation and Knowledge Management, Spanish National Research Council (CSIC) and Polytechnic University of Valencia (UPV)
MML	Mutual Mobilization and Learning
OA	Open Access
PE	Public Engagement
PTA	Participatory Technology Assessment
RRI	Responsible Research and Innovation
SLSE	Science Literacy and Scientific Education
UA	University of Athens
XTP	Xenotransplantation

Introduction: Case study programme on the impacts of RRI

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The European Commission funded project MoRRI aims at "Monitoring the evolution and benefits of Responsible Research and Innovation". One part of this effort is the organisation and implementation of a comprehensive empirical case study programme on the impacts of Responsible Research and Innovation (RRI) in different scientific disciplines and industrial sectors (MoRRI Task 6, Subtask 6.4). The objective of this Task is to carry out several in-depth case studies to analyse the social, democratic and economic benefits of RRI in general or of certain dimensions of RRI in particular, such as citizen engagement and participation (short: public engagement - PE), science literacy and scientific education (SLSE), gender equality (GE), open access (OA), as well as RRI governance and ethics (ET).

The case study programme was implemented mainly in 2015 and was coordinated by the Institute for Advanced Studies (IHS), Vienna, and designed in agreement with the European Commission and the MoRRI project consortium partners. Besides the IHS, Aarhus University (AU), the Centre for Science and Technology Studies (Leiden University, CWTS), the Fraunhofer Institute for Systems and Innovation Research ISI (FhG-ISI), the Instituto de Gestión de la Innovación y del Conocimiento (INGENIO), Joanneum Research (JR), Technopolis Group, and the University of Athens (UA) conducted empirical case studies; an overview of all case studies can be found in Table 10 on page 28. As a result, the consortium not only produced new empirical case studies, but also screened and analysed existing data and the results of European research projects on RRI or related RRI dimensions.

The case study programme was designed in three rounds. In the first round – following the request of European Commission representatives at the project-kick-off in Brussels –, the aforementioned existing projects were screened to consider their viability to be employed as case studies for MORRI and selected projects were analysed in depth. Building on the results of the first round, in the second round new empirical case studies were conducted by MoRRI consortium partners, trying to empirically identify the democratic, economic and social benefits if RRI activities in various fields. In the third round, further cases were investigated in order to fills gaps in knowledge. Thus, the focus lay on finding economic benefits of RRI activities, since these were still underrepresented.

In the following sections, the organisation and implementation of the MoRRI case study programme will be outlined in more detail. After that, all case studies are presented as separate chapters.

1 First round

Within the European Commissions' framework programmes (FP6, FP7), many projects have been conducted that deal with RRI or certain RRI dimensions. Given the time and resource constraints, a comprehensive in-depth analysis of all existing case studies within EU projects was not possible. The purposes of the projects, their research objectives, and their methodologies varied considerably and did not always fit the demands of MoRRI Task 6. For that reasons, a careful and efficient screening and selection of viable cases was necessary.

The selection of cases for the first round was guided by the purpose of the project as outlined in the tender:

> *The contractors will design, draft, execute and deliver a monitoring system on RRI in order to have a better understanding of its scope, nature and the socio-economic and democratic benefits, so as to provide an evidence-based view of RRI evolution (EC 2013, 16).*

Thus, existing projects or existing case studies within projects were selected as viable for MoRRI if they offered sufficiently documented results and data that provided information about the impact of RRI or its sub-dimensions in different areas (R&I field, economy, democracy, society).

This means they had to include:

- in-depth description of research objectives and methods,
- detailed qualitative and/or quantitative data collection,
- analysis and interpretation of acquired data.
- In addition, they should give empirically grounded evidence of the beneficial and/or negative effects of different RRI measures concerning certain dimensions on society, economy, or democracy.

One main source of information used for case selection was a report on SiS Case Studies compiled by Technopolis Group (2012). This report describes a total of 54 EC FP6 and FP7 funded projects with regards to their design, methodology, research results, links to research or policy groups, outcomes and social impacts. The document provides a brief overview of a large number of projects and supports an efficient first selection procedure.

Further information, especially on newer and ongoing projects, was collected in a desk research and included project deliverables, project webpages, articles and conference papers.

1.1 Screening process

The screening and selection process of existing cases for review and analysis was carried out in two steps:

First, 67 projects funded by the EC Framework Programmes (FP6, FP7) that dealt with RRI in general or certain RRI dimensions in particular were scanned in order to get an overview of the

project landscape and to preselect the most relevant cases in terms of the effects and benefits of RRI.

- Research projects were pre-selected as possible cases if they conducted empirical research and tried to collect, measure, and analyse the positive as well as negative effects of RRI measures on research and innovation itself, on the economy, or on certain societal areas.
- Projects were excluded if they did not rely on empirical evidence in their assessment of impacts or if their results were too descriptive and did not establish reliable links between the RRI measures under consideration and their outcomes.

By following this procedure, a list of selected and excluded cases including a rationale for the respective decision was produced, which can be found in the Annex. A total of 14 projects were selected as possible case studies for further in-depth review of project material and output.

Second, a more in-depth review of the 14 preselected cases was conducted. In this step, output material of the research projects under consideration was collected (including final reports, journal articles, or working papers). These documents were analysed and it was evaluated whether the available data, analysis, and conclusions were comprehensive and persuasive and if they fit the research objective of task 6.

- Projects were selected that easily provided those reports, articles or other documents comprising a comprehensive description of the projects' objectives, methodologies, data basis and results.
- Projects were excluded if the existing documentation could not be obtained because of, e.g., dead links to documents on the internet, offline project webpages, non-responding project co-ordinators, etc.

Seven of the preselected cases were classified as viable for MORRI. The final selection (

Table 1) comprises cases that not only fit the research purpose with regards to their research design and approach, but also provide sufficient information to understand the project (research questions, methodology, design, data, results, limitations, etc.) as well as to elaborate on them as a case for MoRRI, which shows benefits of RRI or certain RRI measures.

Table 1 First round: Selection of viable cases

Title	**Dimension**
CIT-PART - Impact of Citizen Participation on Decision-Making in a Knowledge Intensive Policy Field.	PE
ECB - European Coordinating Body in Maths, Science and Technology Education (ECB)	SLSE
GAP2 - Bridging the gap between science, stakeholders and policy makers. Phase 2: Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment.	PE

PRIMAS - Promoting inquiry in mathematics and science education across Europe	SLSE
Res-AGorA - Responsible Research and Innovation in a Distributed Anticipatory Governance Frame. A Constructive Socio-Normative Approach.	RRI
Responsible-Industry	RRI
WiST - Women in Innovation, Science and Technology working group.	GE

From these seven cases, four were selected that seemed to be most suitable for a first round of case studies in terms of research focus, data availability and data quality:

Table 2 List of first round case studies

First round: screening of existing cases					
Name of case	**Country**	**R&T field**	**RRI Dimension**	**Identified effects**	**MoRRI partner[1]**
Impact of Citizen Participation on Decision-Making in a Knowledge Intensive Policy Field (CIT-PART).	AT, DK, UK, IT, LV, NL, SE, CA, CH, VA, (EC, OECD)	Biotechnology, Xenotransplantation	Citizen Participation, Ethics, Governance	Democracy, Society	IHS
Bridging the gap between science, stakeholders and policy makers. Phase 2: Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment (GAP2).	DK, EE, FR, DE, IT, MT, NL, NO, ES, SE, UK	Fishery	Citizen Participation	Democracy, Society	IHS
Promoting inquiry in mathematics and science education	CY, DK, DE, HU, MT, NL,	Maths and science education	Science Literacy and Science	Economy, Society	IHS

[1] For full names of consortium partners see list of abbrevations p. 8.

across Europe (PRIMAS).	NO, RO, SK, ES, CH, UK		Education		
Women in Innovation, Science and Technology working group (WiST).	International comparison (mainly DE and FR)	R&D in S&T industry	Gender Equality	Economy, Society	IHS

1.2 Illustration of selection process

Generally, the main reasons for excluding existing EU projects from further analysis as cases within Task 6 were:

- lack of analysis or evaluation of the impacts of RRI respectively RRI measures;
- lack of available data;
- inadequate data quality.

Table 3 and Table 4 provide two examples to illustrate the selection criteria and rationale. Although the first example, the EPOCH project, dealt with an RRI dimension, i.e. ethics in the governance of science and technology, and analysed and described relevant governance mechanisms in this area, it did not consider the effects of such governance mechanisms in a comprehensive and empirical way. Therefore, it was decided not to consider the project for further analysis.

Table 3 First round: Example of deselected case

EPOCH: Ethics in Public Policy Making: The Case of Human Enhancement.
The EPOCH project investigated the role of ethics in the governance of science and technology with a focus on human enhancement. Therefore, it looked at discourses in different areas and analysed the institutional landscape of ethical policy advice and how participation, reflection, and scientific expertise play a role in the governance of science and technology. It developed strategic recommendations for dealing with normative issues of technologies and innovation. Though it analysed measures to include ethical considerations into the R&D process (e.g. national ethics advisory bodies) - including their design, role, or inclusiveness - it did not assess the positive or negative impact of such institutional RRI procedures. Thus, it was not a suitable case for Task 6 to demonstrate the effects of RRI.

The second example, in contrast, provided sufficient empirical data that could be used for a Task 6 case study. The GAP 2 project evaluated the impact of its participatory approach of innovation in 13 case studies.

Table 4 First round: Example of preliminarily selected case

GAP2: Bridging the gap between science, stakeholders and policy makers. Phase 2: Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment.
GAP2 set out to promote dialogue between fishermen, scientists and policy makers in order to develop innovations for sustainable fisheries. It tried to make research and innovation more inclusive and open to societal stakeholders and evaluated the impact of this participatory approach. In the project, 13 empirically grounded case studies were conducted on different topics (in the field of fisheries) in different countries. A short summary of each case study and scientific papers on several of them were included in the project material. Although not all of them seemed to be relevant to the topic of RRI, several were dedicated explicitly to innovations and their impacts in the field of fisheries. Therefore, GAP2 could be a possible case or even provide several cases for further analysis.

1.3 Case study analysis template

In order to analyse the selected cases of the first round in a consistent way, a case study analysis template was developed and tested. It aimed to provide an overview of the projects and their results as well as identify the RRI dimensions and benefits that were shown by the different activities undertaken. For that purpose, a formalised and closed template seemed to be most viable in order to make the cases comparable and get a quick overview.

Table 5 First round: case study template

[Acronym]	
Case abstract	[Short abstract including description of case and main results with regards to MoRRI task 6]
Reviewer	[Name, affiliation, email]
Project Information	
Project Name	[Full name]
Project Homepage	[if online]
Final report	[if available; authors, year, title, editors, journal/book, volume, publisher, place, page, source, DOI/ISBN]
Funding programme	[FP6, FP7, Horizon 2020]
Duration	[Month/Year – Month/Year]

<table>
<tr><td>Abstract</td><td colspan="4">[Copy/Paste short abstract of project]</td></tr>
<tr><td>Project description</td><td colspan="4">[Objectives, purpose, Approach/Methods, Involved groups, topic, etc.]</td></tr>
<tr><td>Field of R&I</td><td colspan="4">[techno-scientific domain, field of innovation]</td></tr>
<tr><td>Country</td><td colspan="4">[in which measurements were undertaken]</td></tr>
<tr><td colspan="5">Analysis of RRI dimension and benefits</td></tr>
<tr><td colspan="5">Input</td></tr>
<tr><td rowspan="2">RRI dimension</td><td>RRI/RI
□</td><td>Citizen Participation
□</td><td>Science Education
□</td><td>Gender Equality
□</td></tr>
<tr><td>Open Access
□</td><td>R&I Governance & Ethics
□</td><td>Other
□</td><td></td></tr>
<tr><td>RRI activities</td><td colspan="4">[Type of activity, purpose of activity, approach, methods]</td></tr>
<tr><td rowspan="2">Level of RRI activity</td><td>Global
□</td><td>International
□</td><td>National
□</td><td>Regional
□</td></tr>
<tr><td>Local
□</td><td>Organisation
□</td><td>Programme
□</td><td>Project
□</td></tr>
<tr><td>Involved actors</td><td colspan="4">[Which actors/groups were involved in the implementation of RRI activities?]</td></tr>
<tr><td colspan="5">Output and Outcome</td></tr>
<tr><td>Output of RRI activities</td><td colspan="4">[Which tangible and intangible outputs (products, services, knowledge, etc.) were produced by the activity?]</td></tr>
<tr><td rowspan="7">Impact of RRI activity</td><td colspan="4">Overall assessment</td></tr>
<tr><td colspan="4">[What difference made the output in different areas? Were there unintended (negative/positive) side effects?]</td></tr>
<tr><td colspan="4">Society</td></tr>
<tr><td colspan="4">[Societal impact of RRI activity]</td></tr>
<tr><td colspan="4">Democracy</td></tr>
<tr><td colspan="4">[Impact of RRI activity on democracy]</td></tr>
<tr><td colspan="4">Economy</td></tr>
<tr><td colspan="4">[Economic impact of RRI activity]</td></tr>
<tr><td>Level of RRI impact</td><td>Global
□</td><td>International
□</td><td>National
□</td><td>Regional
□</td></tr>
</table>

	Local □	Organisation □	Programme □	Project □
Affected actors	[Which actors/groups were affected by the implementation of RRI activities?]			
Measurement of impact	[How was the impact measured?]			
Relationship between RRI activity and impact	[How did the benefits of RRI come into being? Is it possible to identify a causality? Did the case itself identify a relationship? Describe the empirical base of the impacts assessment.]			
Discussion				
Methodology and data	[Critical assessment of methodology and data basis: Validity and significance of data, problematic aspects of data collection and analysis, disregarded aspects, etc.]			
Recommendation	[Recommendation for further case study design, data collection and analysis of RRI dimensions and linked benefits]			
Other remarks				
References, documents, sources				
• Ref1 • Ref2 • Ref3				

1.4 Main findings

The scan and analysis of the 67 EU-funded projects showed that there is a large variety of projects and activities dealing with RRI or certain RRI dimensions. However, it became apparent that there is a general lack of assessment of the (long-term) societal, economic and democratic impacts of these RRI activities. This can be ascribed to the temporary nature of these projects - long-term effects cannot be assessed in projects lasting two to three years - but also to various methodological challenges of defining and measuring causalities between activities and outcomes. In the review process, the unavailability or inaccessibility of appropriate documentation (deliverables, reports, journal articles, data, etc.) imposed a further barrier to our analysis.

Nonetheless, seven projects could be identified that fit the purpose of MoRRI and provide an impact assessment as well as sufficient documentation to be used as cases in the first round. Four of them (GAP2, CIT-PART, WiST, PRIMAS) were analysed using a newly developed case study template, which was further refined in the process. Research purposes, methodological approaches and data quality varied considerably. Qualitative as well as quantitative data were collected and analysed in different ways (interviews, policy analysis, surveys, observations, etc.). Whereas some projects conducted activities to promote certain RRI dimensions (e.g.,

GAP2 used a participatory approach to fisheries research), others were traditional research projects analysing societal dynamics and impacts of different RRI measures (e.g., CIT-PART investigated PTA activities) and others lay in between (e.g., WiST wanted to promote cultural change towards GE but also explored the effects of GE on research performance).

The four analysed cases cover the RRI dimensions of PE, SLSE, GE, and to some extent ET but do not deal with the dimension of OA. The measures in the cases were mostly concerned with single RRI dimensions but not with RRI in a more comprehensive way. On the outcome side, especially societal and democratic benefits were identified; the assessment of economic impacts was underrepresented in the existing data. In some cases, measurement of impacts was not possible because too little time had passed since the implementation of RRI activities. Furthermore, evaluation was not always as comprehensive as necessary or planned (e.g., GAP2 only conducted a one- instead of two-time survey).

1.5 Conclusions and considerations for the design of the second round of case studies

The use of existing projects proved to be a feasible approach for developing and testing the case study template and getting initial ideas about challenges regarding the study and analysis of RRI benefits. Furthermore, several projects were identified that could be further analysed in the following rounds of the case study research, conducting additional empirical inquiry on them.

However, given the experiences from the first four analysed cases, the design and conduct of new and more in-depth and tailored case studies seemed to be more expedient. The richness and quality of the empirical data and material provided by the EU projects was very diverse and mostly not in line with the purpose of MoRRI Task 6. In order to obtain a firm assessment of the quality of data and results, time-consuming research and analysis would be needed and this might be used more efficiently in producing new case studies of high quality with an explicit research focus on RRI benefits. The cases should not only cover EU-funded projects - often conducted by universities - but also RRI efforts in private R&D institutions, industry and SMEs.

While the first round of case study research was rather exploratory, the next rounds needed to systematically search for cases that illustrated the benefits of different RRI measures in different dimensions and fields in order to gain a broad and comprehensive picture of the issue and not to produce blind spots.

For the next round of case studies, especially the implementation of RRI (or dimensions of it) either in enterprises or in applied research institutions was of interest, including large companies (e.g. with elaborated CSR guidelines) and public research institutions. This emphasis might provide a better position to elaborate on the economic impacts of RRI, an issue barely covered by the case studies that were screened in the first round.

2 Second round

The scope of the second round of case studies was to extend the knowledge about the benefits of RRI across the different dimensions and areas of impact. Task 1, Task 2 and the first round of case studies showed that there is ample knowledge about a number of dimensions (e.g. gender, public engagement), but little knowledge about others (e.g. ethics, governance, open access). Moreover, there was some knowledge - albeit using rather soft criteria - about certain aspects of impact (democratic, social), but little about economic aspects. The goal of the second round was to cover, as much as possible, all dimensions and all areas of impact with at least one case study in each of those fields (preferably more, preferably with cases that cover more than one dimension).

2.1 Case study selection process

For the second round of case studies, the IHS chose a bottom-up approach and asked the consortium partners and dimension leaders in their role of experts to send at least three suggestions of interesting and suitable possible cases, especially taking into account the distribution across the five RRI dimensions, the three aspects of impact (social, democratic and economic) and the actors that undertake RRI measures (research performing organisations, research funding organisations, industry, etc.).

A proposal had to meet certain criteria to be included as a MoRRI case:

- A case had to have a firm empirical basis, either by drawing on existing data or the collection of primary data;
- a case had to address one or more RRI key dimensions;
- it had to deal with impacts of RRI dimensions in social, democratic or economic terms;
- RRI activities and measures (input) as well as their outputs and outcomes had to be observable (at best measureable);
- there needed to be a clear link between input and output/outcome. This link needed to be well argued and demonstrable.

Consortium partners were asked to provide this specific information about their case proposals in order to be able to carefully select across dimensions and fields of benefit and design the second round of case studies (see Table 6).

Table 6 Second round: Case abstract template

1. RRI dimension(s) addressed in the case	Which RRI dimension(s) is (are) being addressed in the case: Citizen Engagement, Science Literacy and Scientific Education, Gender Equality, Open Access, RRI Governance, Ethics
2. Short case description	What is the case about? Why is it relevant for identifying the impact (benefit) of RRI in various dimensions and aspects?
3. Actors involved	Which actors are involved in the case: industry, research performing organisations, research funding organisations,

	others
4. Technological area	Which technological area is the case situated in?
5. Area of impact	In which area do you expect to identify benefits of RRI: society, democracy, economy?
6. Measurement	How would you identify and measure these benefits? What would be your data basis?
7. Data availability	Is there enough empirical data? How do you assess the overall effort to collect (additional) data, if needed?

Twenty-eight case proposals were given by the consortium partners, which were then revised by IHS. A selection from these suggestions was compiled, considering the RRI fields and dimensions (see Table 7). Seven consortium partners, including Institute for Advanced Studies (IHS), Technopolis Group (Technopolis), Aarhus University (AU), CWTS, INGENIO, Fraunhofer ISI (FhG-ISI) and University of Athens (UA), thus carried out the selected case studies. A feedback process was established where the IHS reviewed the conducted case studies according to content, consistency and results and asked some consortium partners to include this feedback in a revised final version of case studies.

Table 7 List of second round case studies

Second round: new empirical case studies					
Name of case	**Country**	**R&T field**	**RRI Dimension**	**Identified effects**	**MoRRI partner[2]**
European Molecular Biology Organisation (EMBO).	EU (DE)	Molecular biology	Ethics, Open Access	Not specified	INGENIO
Institutional Efforts to Ensure and Enhance Responsible Conduct of Research: Lessons Learned from Aarhus University.	DK	Academic research	Ethics, Governance	Society, Economy	AU
UK Science Media Centre.	UK	Natural and physical sciences, engineering	Citizen Participation, Science Literacy	Society, Economy	Technopolis

[2] For full names of consortium partners see list of abbrevations p. 8.

Research Council of Norway.	NO	Funding Council Promotion of RRI	Ethics, Gender Equality, Governance, Open Access	Society, Democracy	FhG-ISI
Austrian Agency for Research Integrity.	AT	Academic research	Ethics	Society, Economy, Democracy	IHS
Gender and affirmative action: Lessons Learned from the Danish Council for Independent Research (YDUN).	DK	RFO addressing academic institutions	Gender Equality, Governance	Economy, Society, Democracy	AU
Open Air Laboratories (OPAL).	UK	Academic research	Citizen Participation	Society, Economy, Democracy	UA
National Open Access Policy in the Netherlands.	NL	Industry, Publishers, RPO, RFO	Ethics, Governance, Open Access	Economy, Democracy, Society	CWTS
Participatory Action Research (PAR) in Environmental Management.	UK	Environmental and land management	Citizen Participation, Ethics, Governance, Science Literacy	Economy, Democracy, Society	Technopolis

2.2 Case study template

In order to analyse the cases in a consistent and coherent way, a case study analysis template was developed and tested for round one. This template was adapted for the second round - following suggestions by consortium partners - into a more open and narrative format with guiding questions instead of the previous formalised version.

Table 8 Second and third round: Case study template

Analysing the Benefits of RRI: Name of Case

Reviewer: Name, email, affiliation

1 Case Information

Case abstract (max. 250 words)

This section should include a short introduction into the case and consists of:

- A description of the case (what is the case about?)
- Which method did you use to describe and analyse your case?

- Which qualitative and quantitative data did you use and how did you collect it?
- Which RRI impacts/benefits were achieved in the case you analysed?

Case details

Please fill in some detail information about your case.

- Which RRI dimension is being addressed in the case study (multiple choices possible)?
- Which field of technology and/or research is being dealt with in the case?
- In which country/countries is the case situated

RRI dimension	RRI □	Citizen Participation □	Science Literacy □	Gender equality □
	Open Access □	R&I governance □	Ethics ☒	Other □
R&T field				
Country				

2 Introduction

Please introduce your case briefly:

- What is the case about?
- Who are the main actors and stakeholders in the case?
- What is the activity or instrument used in the case to achieve RRI?
- Why is your case relevant for RRI?

3 Methodology and data

- Please describe the methodology of data collection and assessment.
- Describe the data basis.
- How was the impact of the RRI activity measured?
- Describe the validity and significance of data, problematic aspects of data collection and analysis, etc.
- Please include further important points about methodology and data used which are not covered by the questions above.

4 Input level: RRI activity

Please describe the RRI activity in detail:

- Which problem or challenge did the RRI activity address and what was its objective?
- What was the activity and which methods were applied to achieve the goals?
- Which actors or groups were involved in the implementation of the RRI activity?

- On which level was the RRI activity implemented?
    - global, international, national, regional, local
    - organisation, programme, project
- Please include further important issues about the RRI input that are not covered by the questions above if seen necessary.

5 Output and outcome level: impact and benefits

Please provide an overall assessment of the impact:

- Which tangible and intangible outputs (products, services, knowledge, etc.) were produced by the activity?
- Which actors or groups were affected by the RRI activity?
- On which level can an impact of the RRI activity be identified?
- global, international, national, regional, local
- organisation, programme, project
- Please include further important issues about the output and outcome of the RRI activity that are not covered by the questions above if seen necessary.

Please consider in particular the benefits and impact of the described activity in the following areas:

Society

- Which societal impact did the RRI activity have and how did it come into being?
- Which specific benefits on a societal level can you assess?
- Which specific negative effects on a societal level can you assess?

Democracy

- Which impact did the RRI activity have in terms of democracy and how did it come into being?
- Which specific benefits on a democratic level can you assess?
- Which specific negative effects on a democratic level can you assess?

Economy

- Which economic impacts did the RRI activity have and how did it come into being?
- Which specific economic benefits can you assess?
- Which specific economic costs can you assess?

6 Discussion

Please discuss the methodology, data and results of your case study:

- How would you assess the quality of the data used?
- Is it possible to identify a causal link between the described RRI activity and the

identified outcome?

- Please include further important issues that are not covered by the questions above if you consider it necessary.
- What are your recommendations for further case study design and content in the third round?

7 References

Please include references, documents and sources.

2.3 Main findings and conclusions for the design of the third round of case studies

The case studies of the second round showed very diverse measures and activities spread across Europe that relate to the RRI dimensions. These activities resulted in a range of benefits. Mainly democratic and societal benefits were identified:

- RRI measures can result in broader inclusion, empowerment and better access for various groups, actors and stakeholders on different level of R&I.
- Certain RRI activities raise awareness about RRI-related issues and in turn promote a culture change in R&I.
- Organisations and institutions established mechanisms and processes concerning transparency, data handling, or others that would otherwise not have been dealt with.
- RRI-related measures created higher credibility, integrity and legitimacy of organisations and science as such through taking into account research ethics, stakeholder participation or gender equality can often save costs and efforts in R&I processes (litigation costs, redundant research, scientific misconduct, etc.).

These benefits were recognised on a qualitative level, but the identification of direct causalities between RRI measures and impacts/benefits proved to be difficult for several reasons:

- A lack of baseline and evaluation data available for tracking developments and effects of RRI measures.
- The short implementation span of measures prevents the investigation of long-term impacts and benefits.
- There is a general attribution problem of benefits to input measures.

A systematic assessment of economic benefits on the other hand was done only marginally in some of the second round of case studies. The identification of economic benefits was not based on quantitative data, but on a qualitative assessment by involved relevant actors.

The bottom-up approach of finding case studies brought about a diverse set of investigated cases and a coverage of all RRI dimensions, but showed the difficulties of identifying hard economic benefits. This will be a task for the third round of case studies.

3 Third round

The second round of case studies revealed challenges regarding methodology and data availability. The identification of clear causality between certain RRI measures and changes attributed to those measures was often unclear due to a lack of baseline data, and external influencing factors, etc. Another hindering point was the fact that many of the investigated activities did not exist for a long time, so it was too early to measure impacts and benefits on empirical grounds. Furthermore, predominantly societal and democratic benefits were identified but only preliminary economic benefits of doing RRI.

In the third round of case study research, MoRRI consortium partners conducted further empirical case studies in order to expand the knowledge about possible RRI benefits. The objective was to fill gaps in knowledge in the coverage of RRI dimensions, fields of benefits or R&I sectors. The focus was therefore put on finding economic benefits that can be supported by numbers and conducting industry case studies, where numbers can be assumed to exist; however, this proved to be challenging as can be seen in the discussions of the single case studies.

3.1 Case study selection process

The IHS engaged in bilateral discussions with the consortium partners designated for conducting case studies in order to determine a final set of case studies for the third round. Some cases were drawn from the proposals for the second round; others were newly suggested by partners, especially considering the task of filling gaps in the third round.

The criteria for the cases remained similar to the criteria for the second round:

- A case had to have an empirical basis, either by drawing on existing qualitative or quantitative data or collecting new primary data;
- a case had to address one or more RRI key dimensions;
- it had to deal with impacts of RRI dimension in *economic* terms;
- RRI activities and measures (input) as well as their outputs and outcomes had to be observable;
- there should be a clear link between input and output/outcome. This link should be well argued and demonstrable.

After the consortium members had reached agreement on the list of third-round cases, the partners responsible carried out their case studies using the developed template of the second round. The IHS then reviewed the conducted case studies, gave feedback to the consortium partners and asked for further clarifications if necessary.

Table 9 List of third round case studies

Third round: new empirical case studies					
Name of case	**Country**	**R&T field**	**RRI Dimension**	**Identified effects**	**MoRRI partner[3]**
Nanotechnology RRI in the Netherlands	NL	Nanotechnology	Citizen Participation, Ethics, Governance	Economy, Society	Technopolis
AVL List	AT	Industry (Powertrain Systems)	Ethics, Gender Equality, Open Access	Economy	Joanneum
Infineon	AT	Industry (Semiconductor and system solutions)	Ethics, Gender Equality, Open Access	Economy	Joanneum
ETH Zürich	CH	Academic research	Citizen Participation, Science Literacy	Democracy, Society	UA
FemPower Bonus for Female Project Leaders.	AT	ICT, Life Sciences	Gender Equality	Economy, Democracy, Society	IHS
Gender Criteria in the Austrian Science Fund (FWF).	AT	Basic research	Gender Equality	Democracy, Society	IHS
Institute of Gender in Medicine at the Charité University Medicine Berlin.	DE	Medicine, Health	Gender Equality	Economy, Democracy, Society	FhG-ISI
The European Bioinformatics Institute (EMBL-EBI).	EU (DE, FR, IT, UK)	Molecular biology	Open Access	Economy	INGENIO

3

3.2 Main findings and conclusions

The industry case studies proved especially viable for finding (some) economic benefits of certain RRI dimensions. Still, the benefits were hard to link directly to RRI measures in monetary terms, profits or growth in GDP. Indications of positive economic effects of RRI can be found, but in order to determine causal links and impacts, comprehensive long-term studies would have to be set up, where RRI activities are being tracked. This has to start with the collection of baseline data before the measures are implemented and compared with later on. Several points of data collection have to be set after the implementation of the RRI activity to determine short- and long-term effects and impacts.

A further and more comprehensive analysis of the third round of case studies in connection with the previous rounds will be done in progress report D 5.3, where the other subtasks of task 6 will also be elaborated on.

4 Overview of case study programme

Table 10 Full list of case studies

First round: screening of existing cases						
No	**Name of case**	**Country**	**R&T field**	**RRI Dimension**	**Identified effects**	**MoRRI partner[4]**
01	Bridging the gap between science, stakeholders and policy makers. Phase 2: Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment (GAP2).	DK, EE, FR, DE, IT, MT, NL, NO, ES, SE, UK	Fishery	Citizen Participation	Democracy, Society	IHS
02	Impact of Citizen Participation on Decision-Making in a Knowledge Intensive Policy Field (CIT-PART).	AT, DK, GB, IT, LV, NL, SE, CA, CH, VA, (EC, OECD)	Biotechnology, Xenotransplantation	Citizen Participation, Ethics, Governance	Democracy, Society	IHS
03	Women in Innovation, Science and Technology working group (WiST).	mainly DE and FR	R&D in S&T industry	Gender Equality	Economy, Society	IHS
04	Promoting inquiry in mathematics	CY, DK, DE, HU, MT, NL,	Maths and science education	Science Literacy	Economy, Society	IHS

[4] For full names of consortium partners see list of abbrevations p. 8.

	and science education across Europe (PRIMAS).	NO, RO, SK, ES, CH, UK				
Second round: new empirical case studies						
05	Institutional Efforts to Ensure and Enhance Responsible Conduct of Research: Lessons Learned from Aarhus University.	DK	Academic research	Ethics, Governance	Society, Economy	AU
06	Gender and affirmative action: Lessons Learned from the Danish Council for Independent Research (YDUN).	DK	RFO addressing academic institutions	Gender Equality, Governance	Economy, Society, Democracy	AU
07	Research Council of Norway.	NO	Funding Council Promotion of RRI	Ethics, Gender Equality, Governance, Open Access	Society, Democracy	FhG-ISI
08	Austrian Agency for Research Integrity.	AT	Academic research	Ethics	Society, Economy, Democracy	IHS
09	European Molecular Biology Organisation (EMBO).	EU (DE)	Molecular biology	Ethics, Open Access	Not specified	INGENIO
10	UK Science Media Centre.	UK	Natural and physical sciences, engineering	Citizen Participation, Science Literacy	Society, Economy	Technopolis
11	Open Air Laboratories (OPAL).	UK	Academic research	Citizen Participation	Society, Economy, Democracy	UA
12	National Open Access Policy in the	NL	Industry, Publishers, RPO, RFO	Ethics, Governance, Open Access	Economy, Democracy, Society	CWTS

	Netherlands.					
13	Participatory Action Research (PAR) in Environmental Management.	UK	Environmental and land management	Citizen Participation, Ethics, Governance, Science Literacy	Economy, Democracy, Society	Technopolis
Third round: new empirical case studies						
14	Nanotechnology RRI in the Netherlands	NL	Nanotechnology	Citizen Participation, Ethics, Governance	Economy, Society	Technopolis
15	Infineon Technologies Austria AG	AT	Industry (Semiconductor and system solutions)	Ethics, Gender Equality, Open Access	Economy	Joanneum
16	AVL List	AT	Industry (Powertrain Systems)	Ethics, Gender Equality, Open Access	Economy	Joanneum
17	FemPower Bonus for Female Project Leaders.	AT	ICT, Life Sciences	Gender Equality	Economy, Democracy, Society	IHS
18	Gender Criteria in the Austrian Science Fund (FWF).	AT	Basic research	Gender Equality	Democracy, Society	IHS
19	Institute of Gender in Medicine at the Charité University Medicine Berlin.	DE	Medicine, Health	Gender Equality	Economy, Democracy, Society	FhG-ISI
20	The European Bioinformatics Institute (EMBL-EBI).	EU (DE, FR, IT, UK)	Molecular biology	Open Access	Economy	INGENIO
21	ETH Zürich	CH	Academic research	Citizen Participation, Science Literacy	Democracy, Society	UA

Table 11: Case study overview by RRI dimension

RRI Dimension	Case Study
ET	02 CIT-PART 05 Institutional Efforts to Ensure and Enhance Responsible Conduct of Research: Lessons Learned from Aarhus University 07 Research Council of Norway 08 Austrian Agency for Research Integrity (OeAWI) – Research Integrity Workshops 09 European Molecular Biology Organisation (EMBO) 14 Nanotechnology RRI in the Netherlands 15 Infineon Technologies Austria AG 16 AVL List GmbH 21 Promoting Citizen Science at the ETH Zurich
GE	03 WiST 06 Gender and affirmative action: Lessons Learned from the Danish Council for Independent Research 07 Research Council of Norway 15 Infineon Technologies Austria AG 17 FemPower Bonus for Female Project Leaders 18 Gender Criteria in the Austrian Science Fund (FWF) 19 Institute of Gender in Medicine at the Charité, University Medicine Berlin 21 Promoting Citizen Science at the ETH Zurich
GOV	05 Institutional Efforts to Ensure and Enhance Responsible Conduct of Research: Lessons Learned from Aarhus University 06 Gender and affirmative action: Lessons Learned from the Danish Council for Independent Research. 07 Research Council of Norway 08 Austrian Agency for Research Integrity (OeAWI) – Research Integrity Workshops 12 National Open Access Policy in the Netherlands 14 Nanotechnology RRI in the Netherlands
OA	07 Research Council of Norway 09 European Molecular Biology Organisation (EMBO) 12 National Open Access Policy in the Netherlands 20 The European Bioinformatics Institute (EMBL-EBI)
PE	01 GAP2 02 CIT-PART 10 UK Science Media Centre

	11 Open Air Laboratories (OPAL) 13 Participatory action research (PAR) in environmental management 14 Nanotechnology RRI in the Netherlands 15 Infineon Technologies Austria AG 16 AVL List GmbH 21 Promoting Citizen Science at the ETH Zurich
SLSE	04 PRIMAS 10 UK Science Media Centre 11 Open Air Laboratories (OPAL) 13 Participatory action research (PAR) in environmental management

Table 12: Methods applied in case studies

No	Name of case	MoRRI partner[5]	Methods
01	Bridging the gap between science, stakeholders and policy makers. Phase 2: Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment (GAP2).	IHS	Desk research of project material
02	Impact of Citizen Participation on Decision-Making in a Knowledge Intensive Policy Field (CIT-PART).	IHS	Desk research of project material
03	Women in Innovation, Science and Technology working group (WiST).	IHS	Desk research of project material
04	Promoting inquiry in mathematics and science education across Europe (PRIMAS).	IHS	Desk research of project material

[5] For full names of consortium partners see list of abbrevations p. 8.

05	Institutional Efforts to Ensure and Enhance Responsible Conduct of Research: Lessons Learned from Aarhus University.	AU	Desk research of all publicly available policy documents, meeting minutes and organisational memorandums offering information on RCR related activities Three semi-structured qualitative interviews with core RCR policy-makers at the university
06	Gender and affirmative action: Lessons Learned from the Danish Council for Independent Research (YDUN).	AU	Secondary data originally gathered by the consultancy group DAMVAD ANALYTICS (2015) on behalf of DFF in 2015: • register information on all candidates applying for research funding programmes similar to YDUN in the period 2009 to 2015 • survey questionnaire conducted one year after the YDUN application round
07	Research Council of Norway.	FhG-ISI	Desk research of primary sources from the RCN (policy and strategy documents) Interviews with people involved in RRI in Norwegian research (representatives of the council as well as of external institutes with close connections, e.g. institutions receiving council grants)
08	Austrian Agency for Research Integrity.	IHS	Desk research of OeAWI material Six qualitative interviews with two representatives from the OeAWI and four interview partners from a biomedical research campus in Vienna List of lectures, workshops and seminars about research integrity held by the OeAWI plus approximate number of participants provided by the workshop facilitator
09	European Molecular Biology Organisation (EMBO).	INGENIO	Primary publicly available data resource: annual Facts and Figures report (trend line statistics) Telephone interviews with the head of the Science Policy programme
10	UK Science Media Centre.	Technopo	Desk research covering several document

		lis	sources, i.e. both, external as well as internal SMC documents: • Explorations into a German SMC • Strategic Review Report by the SMC Three semi-structured interviews which were conducted in the context of another project were used for the preparation of this case
11	Open Air Laboratories (OPAL).	UA	Desk research on the internet, study of hard-copy reports Five semi-structured telephone and face-to-face interviews
12	National Open Access Policy in the Netherlands.	CWTS	Quantitative: direct linking of DOAJ listed journals and comparison of relative output and relative impact among three European countries of similar size and scientific production: the Netherlands (NL), Denmark (DK), and Switzerland (CH) Qualitative: document analysis Semi-structured interviews with stakeholders from the Ministry of Education, Culture and Science (OCW), the Association of Universities in the Netherlands (VSNU), and journal publishing
13	Participatory Action Research (PAR) in Environmental Management.	Technopo lis	Desk research of evaluation report: The process was evaluated through group discussions and in-depth interviews with each participant conducted separately by one of the academic researchers.
14	Nanotechnology RRI in the Netherlands	Technopo lis	Desk research: several sources of which the majority was provided by Nanopodium and NanoNextNL Two semi-structured interviews with a company director who participated in Nanopodium and with the RATA programme officer of NanoNextNL
15	Infineon Technologies Austria AG	Joanneu m	One semi-structured interview

			Information made available by the company
16	AVL List	Joanneum	Desk research of publicly available information One semi-structured interview and informal information by the environmental manager
17	FemPower Bonus for Female Project Leaders.	IHS	Evaluation report of FemPower (Thaler/Hofstätter 2012) Complemented by comprehensive desk research (documents, homepages)
18	Gender Criteria in the Austrian Science Fund (FWF).	IHS	Desk research using several sources provided by the FWF (annual reports, funding statistics, programme guidelines and principles of the FWF decision-making procedure) Analysis of the decision-making procedures
19	Institute of Gender in Medicine at the Charité University Medicine Berlin.	FhG-ISI	Desk research of studies respectively literature on (benefits of) gender aspects in medicine Personal interview with the head of the institute based on an interview guideline developed by FhG-ISI.
20	The European Bioinformatics Institute (EMBL-EBI).	INGENIO	Desk research: • online documentation and publications hosted at the websites of EMBL and EMBL-EBI • EBI Annual Scientific Report series (most recent edition 2014) • consultant report produced by Charles Beagrie Ltd 'The Value and Impact of the European Bioinformatics Institute', January 2016 (Beagrie and Houghton 2016) • case study of EMBL-EBI compiled as part of the EvaRIO project
21	ETH Zürich	UA	Desk research: internet research, policy documents Extensive interview with the Vice Rector, Prof.

			Günther

First round case studies: Screening and analysis of existing cases on the impacts of RRI

GAP2

Alexander Lang
Institute for Advanced Studies Vienna

GAP2	
Case Abstract	The GAP2 project implemented participatory activities in research in the field of fisheries. GAP2 conducted 13 case studies in 11 countries involving different stakeholder groups and especially fishers into the research process. It showed that participation of stakeholder in research (in the area of fisheries) has several positive impacts: • It promotes communication, exchange of knowledge and trust building between different societal groups, which might lead to easier and socially more accepted decision-making processes (societal benefit). • It raises awareness of certain crucial issues (sustainability) on behalf of relevant stakeholder and imparts competences and knowledge that enables better practices and personal empowerment. • It enables informed bottom up decision-making and thus might also strengthen the own political power and persuasiveness.
Project Information	
Project Name	Bridging the gap between science, stakeholders and policy makers. Phase 2: Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment.
Project Homepage	http://gap2.eu/; accessed 23 April 2015.
Final report/most relevant publication	• Hadjimichael, Maria; Holm, Petter; Ramirez-Monsalve; Paulina; Tveiterås (2015): Framing participatory research. Analysis of fit between collaborative research and management. GAP2, Deliverable 4.3.2. http://gap2.eu/gap2wordpress/wp-content/uploads/2015/03/D4.3.2-Analysis-of-fit-between-collaborative-research-and-management.pdf; accessed 23 April 2015. • Holm, Petter; Dubois, Mark (2015): Analysis of how participants' attitudes change through collaborative research. GAP2, Deliverable 4.2.2. http://gap2.eu/gap2wordpress/wp-content/uploads/2015/03/D4.2.2-Analysis-of-how-participants-attitudes-change-through-collaborative-research.pdf; accessed 23 April 2015.
Funding	FP7 (Capacities)

programme	
Duration	04/2011 - 04/2015
Abstract	"GAP2 is about making a difference to an issue of significance to the whole of society; the wellbeing of the marine environment and the sustainability of fisheries upon which society depends for food. It builds on the relationships, processes and plans arising from GAP1 by enabling Mobilisation and Mutual Learning (MML) actions that promote stakeholder participation in the debate on and development of research knowledge and structures relevant to emerging policy on fisheries and the marine environment. A broad range of stakeholders will participate, including actors from civil society organisations, research institutions, universities, national and regional ministries and media organisations. Their work will involve participatory research actions that integrate the knowledge of stakeholders and scientists and render it useful for management and policy development, critical evaluation of the participatory processes and incorporation of the lessons learned into systems of research and decision-making. Global networks will be developed to enable trans- and international cooperation on comparing and establishing good practice. The actions of the participants and the outcomes from GAP2 will provide a concrete realisation of specific Science in Society objectives for engaging the public in research, enabling effective two-way communication between scientists and other stakeholders, and helping to make policy based on scientific evidence and research knowledge. It will contribute to the aim of the Science in Society programme to enhance democratic debate with a more engaged and informed public, by providing better conditions for collective choices on scientific issues relating to sustainable management, conservation of ecosystem integrity and biodiversity of the marine environment." (http://cordis.europa.eu/project/rcn/99712_en.html; accessed 23 April 2015)
Project description	See abstract above
Field of R&I	Fisheries
Countries	Denmark, Estonia, France, Germany, Italy, Malta, the Netherlands, Norway, Spain, Sweden, the UK.
Analysis of RRI dimension and benefits	

<table>
<tr><td colspan="5">Input</td></tr>
<tr><td rowspan="2">RRI dimension</td><td>RRI/RI
x</td><td>Citizen participation
x</td><td>Science Literacy
□</td><td>Gender equality
□</td></tr>
<tr><td>Open Access
□</td><td>R&I governance & ethics
□</td><td>Other
□</td><td></td></tr>
<tr><td>RRI activities</td><td colspan="4">The project implemented participatory actions in research. They conducted 13 case studies in 11 countries involving different stakeholder groups and especially fishers into the research process.

The way of involvement differs from case to case. Participation activities range from research planning, to data collection, co-production and discussion of research results. They include various mutual mobilization and learning (MML) activities, stakeholder workshops and debates, focus groups, networking events, cognitive map, joint field observations, participatory sampling, surveys, and other research activities.[6]

On the one hand, fishers should be empowered and informed through their involvement in research on issues relevant to their work. On the other hand, research should profit from the knowledge and insights of the involved actors. Furthermore, activities also aimed to inform political decision and governance making processes (e.g. best practice models) regarding the management of fisheries activities, thus giving fishers a voice in these processes.</td></tr>
<tr><td rowspan="2">Level of RRI activity</td><td>Global
□</td><td>International
□</td><td>National
x</td><td>Regional
x</td></tr>
<tr><td>Local
x</td><td>Organisation
□</td><td>Programme
□</td><td>Project
x</td></tr>
<tr><td>Involved actors</td><td colspan="4">• Scientists/researchers.
• Fishers.
• Different societal stakeholder groups depending on the specific case, including advisory councils, public authorities, NGOS, intergovernmental organisations, associations, policy makers, etc.</td></tr>
</table>

[6] An overview of methods used in the different case studies can be found in Raicevich et al. (2013).

<table>
<tr><td colspan="2">Output and Outcome</td></tr>
<tr><td>Output of RRI activities</td><td>13 case studies (CS) in 11 different European countries were co-produced by researchers, fishers and other stakeholder groups.

These case studies generated different innovations, data and knowledge in the area of fisheries:

• CS1: Individual based model of crab population and related fishery.
• CS2: Methodology for collaborative management in fisheries.
• CS3: Species inventory of rare and migrant species for the Wadden Sea.
• CS4: Management rule informed by modelling of herring stock dynamics.
• CS5: Fisheries based model for the Norwegian Coastal Cod.
• CS6: Alternative fishing methods and recommendations to public authorities.
• CS7: Best practice for using Fish Aggregating Devices.
• CS8: Data on ecology and fish stocks in the Northern Adriatic.
• CS9: Data on demersal resources of Maltese Fishery Management zone.
• CS10: Long Term Management Plan for Mediterranean red shrimp fisheries.
• CS11: Involvement of local small-scale fishers in Marine Spatial Planning process by knowledge mapping and multi-stakeholder events.
• CS12: Model and rationale for self-sampling in fisheries data collection.
• CS13: Software tool for supporting identification and evaluation of management options in fisheries.</td></tr>
<tr><td rowspan="4">Impact of RRI activity</td><td>Overall assessment</td></tr>
<tr><td>Several of the outputs described above will probably have long-term future effects (benefits), e.g. regarding sustainability of fisheries or the preservation of the natural environment. However, it is hard to assess to what extent the development and implementation of certain measures (e.g. best practices or long term management plans) would have been possible without “doing RRI” (here: stakeholder engagement).

Nonetheless, the individual case studies give evidence for the successful realization of participatory research and innovation processes that, besides the direct output, brought forth positive effects on certain societal groups and social relationships.</td></tr>
<tr><td>Society</td></tr>
<tr><td>The GAP2 objective of bridging societal gaps between science, stakeholders and policy makers in the field of fisheries already contains a societal benefit of RRI: to</td></tr>
</table>

	enable and facilitate societal interaction on a level playing field. Different case studies (CS1, CS3, CS4, CS6, CS7, CS8, CS10, CS12) speak of *trust-building and the facilitation of communication between different actor groups* (scientists, policy makers, fishers) through research and MML activities. Beyond the case studies, certain mechanisms of inclusions and discussion and participatory forms of decision-making have been institutionalised, e.g., communication platforms (CS4), or existing institutions strengthened (CS6). This is a benefit of doing RRI (resp. participatory research) that should not be underestimated although it is hard to measure and collect hard data on its actual wider impact. In CS10 the concrete benefit of good communication basis and processes is described in the following way: "When a clear final objective is shared and agreed amongst all actors, everyday activity becomes easier and the path to success more feasible." Through the participatory approach, case studies could raise awareness on sustainability issues in fisheries on behalf of the involved fishers and policy makers (e.g., CS3). Case study work also had an effect on competence building regarding scientific methods and practices (e.g., CS5, CS6, CS12) that increased quality of monitoring and data regarding fish stocks. In this regard, Holm and Dubois (GAP2 Del. 4.2.2) conclude: "Collaborative research, we gradually discovered, is not so much about bridging the gap through providing a melting pot for collecting and integrating the knowledge fishers are already in possession of with that of science, but rather, to engage fishers as active agents in the knowledge production process." (Holm and Dubois 2015: 4) Furthermore, there are examples of change of fishing practices and regulatory governance through research and MML activities. For example, in CS10 local fishers of Palamós decided to implement a closure of deep-sea shrimp fisheries during winter season in order to promote sustainability of shrimp stock. This decision was taken after the jointly implemented case study, in which the fishers provided daily data of red shrimp catches including the crucial catch of juvenile red shrimp that effected in a reduced shrimp-population. After a two-year negotiation phase, the Spanish Government approved the Long Term Management Plan developed by the project. The project *cautiously* links this result to the participatory approach: "Perhaps a factor influencing management of finally accepting the LTMP was that this was a process initiated by fishermen themselves, and that at the end, fishers made a significant economic sacrifice" (Hadjimichael et al. 2015: 15). Besides this example, several other case studies also report that the collected data and project results informed and influenced decision-making and management processes (CS4, CS9, C11).

<table>
<tr><td></td><td colspan="4">Democracy</td></tr>
<tr><td></td><td colspan="4">Besides development of relationships and communication structures, the empowerment of fishers as a key stakeholder group is highlighted by several case studies (e.g., CS 2, CS3, CS8, CS11). First, in some cases new policymaking processes have been implemented that include fisher in decision-making. Second, through participation in research activities and the inclusion in decision-making processes, fisher not only got included in relevant networks but also acquired new competencies (e.g., regarding data collection methods) that probably empower their position in negotiations on fisheries management issues.

Furthermore, through the participatory approach fishers not only got involved in collecting new data, but also their own traditional knowledge could be taken into account in evaluation processes that inform fisheries management and decision making (e.g., CS8, CS10, CS11).</td></tr>
<tr><td></td><td colspan="4">Economy</td></tr>
<tr><td></td><td colspan="4">Besides one remark on the (short-term) negative economic effects of a ban on shrimp fishery in winter (CS10), case studies do not deal or describe the impact of the project in this regard. However, these short-term negative economic effect could have a positive impact in the long run, because it could secure the future fish stock for sustainable fish production. Additional research on this matter is necessary.</td></tr>
<tr><td rowspan="2">Level of RRI impact</td><td>Global
☐</td><td>International
☐</td><td>National
x</td><td>Regional
x</td></tr>
<tr><td>Local
x</td><td>Organisation
x</td><td>Programme
☐</td><td>Project
☐</td></tr>
<tr><td>Affected actors</td><td colspan="4">• Researchers
• Fishers
• Policy maker / decision maker (public authorities, associations, etc.)</td></tr>
<tr><td>Measurement of impact</td><td colspan="4">WP4 of GAP2 was concerned with evaluating the participatory research approach and its impacts. From all 13 case studies, six were selected for in-depth evaluation.

Information and data for the evaluation was collected through

• qualitative interviews with key participants in the projects;
• documentary research;
• attendance of GAP2 meetings and conversations with other project</td></tr>
</table>

	members; • GAP2 Case documentation. Furthermore, perception and attitude of participants in the six case studies were collected through a survey and a Q-sort analysis conducted. Within the individual case studies, case workers themselves described and assessed the impacts of the implemented activities, drawing on interviews, experiences and their own observations and interpretation of the events and processes. Several of the impacts described above rely on this sort of information and therefore should be assessed with care.
Relationship between RRI activity and impact	The impacts of the diverse participatory measures are diverse and sometimes hard to grasp. The same holds true for identifying the relationship between a certain RRI activity and its impact. In general, the relationship between RRI activity and its impact corresponds with the impact logic of the activity itself. Through inclusion of the actors into the activity, the latter could yield an effect. • Awareness raising, e.g. for sustainability aspects of fishery, came into being through information and participation in workshops, discussions and cooperative research activities. • Inclusion in decision-making processes on fishery regulation and management was established through targeted dissemination activity, networking events, direct involvement of decision maker in case study work. Overall, it is hard to assess whether or not the same outcome could have been reached by different means respectively without conducting participatory research actions. However, the accounts in the case studies suggest a close relationship between the conduct of the measures and the positive outcome described above.
Discussion	
Methodology and data	Regarding methodology and data collection there are several aspects: • In a positively transparent way, the researchers give a statement about a possible bias deriving from one aspect in data collection: "We acknowledge that the interview situation is biased as we ask scientists to evaluate the participation of fishers. Ideally both parties would have been interviewed however this was not possible due to lack of time." (Hadjimichael 2015: 5). • The evidence base of different claims in the case studies is not always clear (e.g., change in perception, competence building, etc.). • The second wave of a two-times survey on fishers' perception and

	attitudes at the beginning and end of the project was not conducted because underlying assumptions turned out to be false and because of its time consuming implementation: "While we cannot address how collaborative research changes participant attitudes, the work undertaken in WP4 strongly indicates that the attitudes of the participants now in general reflects strong support for collaborative approaches." (Holm and Dubois 2015: 7) • In many cases, it is still too early to evaluate the impact of measures in different areas. In some cases, processes have not finished yet and in others, impacts will unfold in the long run.
Recommendation	The case study report at hand analyses a project that comprises 13 individual case studies in the area of fisheries and fishery management. It draws lessons on an (more or less) aggregated level. Thus, it might be possible to identify some key cases and take a closer look at them in order to deepen the understanding of the respective RRI activities and benefits. Furthermore, the analysis uses existing materials (short case study reports and some central deliverables) produced by the GAP2 project; these materials are more or less comprehensive and embody the interpretation of the scientists involved in the project. Thus, it might be possible to select the most relevant cases, conduct further data collection (e.g., through interviews with participants, scientists etc.) and analysis to deepen and validate the insights regarding the benefits of RRI. The evaluation of the impacts of some cases should be done further down the road since the activities have just recently come to an end.
Other remarks	
References, documents, sources	
• Hadjimichael, Maria; Holm, Petter; Ramirez-Monsalve; Paulina; Tveiterås (2015): Framing participatory research. Analysis of fit between collaborative research and management. GAP2, Deliverable 4.3.2. http://gap2.eu/gap2wordpress/wp-content/uploads/2015/03/D4.3.2-Analysis-of-fit-between-collaborative-research-and-management.pdf; accessed 23 April 2015. • Holm, Petter; Dubois, Mark (2015): Analysis of how participants' attitudes change through collaborative research. GAP2, Deliverable 4.2.2. http://gap2.eu/gap2wordpress/wp-content/uploads/2015/03/D4.2.2-Analysis-of-how-participants-attitudes-change-through-collaborative-research.pdf; accessed 23 April 2015. • Raicevich, S.; Pastoors, M.; Holm, P.; Pita Orduna, P.; Mackinson, S. (2013): Case studies experience in producing and integrating stakeholders and scientific knowledge. GAP2, Deliverable 2.2.2. • Report of interviews and documentary research on development of collaborative research. GAP2, Deliverable 4.1	

- Single case studies (summaries) on GAP2 website (http://gap2.eu).

CIT-PART

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CIT-PART	
Case Abstract	CIT-PART provides three case studies on Participatory Technology Assessment (PTA) in three different countries (Canada, Switzerland, The Netherlands) on the issue of xenotransplantation. The cases show what impacts PTA activities have apart directly influencing formal decision-making processes. The analysed PTAs • initiated or promoted public debate, • supported the formation of new actor coalitions, • and are sometimes linked to institutional learning towards openness and transparency in decision-making process.
Project Information	
Project Name	Impact of Citizen Participation on Decision Making in a Knowledge Intensive Policy Field.
Project Homepage	http://www.cit-part.at (accessed 20 April 2015).
Final report/most relevant publication	• Griessler, E., Biegelbauer, P., Hansen, J., & Loeber, A. (2012). Citizen Participation in Decision-Making on Complex and Sensitive Issues? Experiences with xenotransplantation. Report of the Project "Impact of Citizen Participation on Decision-Making in a Knowledge Intensive Policy Field". Retrieved from http://www.cit-part.at/CIT%20PART%202.Edition.pdf. • Loeber, A., Griessler, E., & Versteeg, W. (2011). Stop looking up the ladder: analysing the impact of participatory technology assessment from a process perspective. Science and Public Policy 38(8), 599-608. http://dx.doi.org/10.3152/030234211X13111546663296.
Funding programme	FP7 (CP-FP)
Duration	2009-2012

Abstract	"Citizens, policy makers and social scientists often call for citizen participation for reasons of democratic legitimacy and effectiveness. An important field in which this has been claimed vigorously is science and technology policy. Thus, many countries witnessed the introduction of Participatory Technology Assessment (PTA). The ""litmus test"" of PTA, and of citizen participation, is their impact on policy-making. However, can PTA keep its promises and increase the influence of citizens' voices on decision-making? What actual fact is the impact of PTA on decision-making? How can we increase it? In order to answer these questions the project ""Impact of Citizen Participation on Decision Making in a Knowledge Intensive Policy Field"" (CIT-PART) will study comparatively the impact of PTA and TA on policy-making in 7 member- and a non-member countries, the Commission, the OECD and the Holy See. From that, we will draw conclusions about the potential impact of institutionalised citizen participation on EU level. We will exemplify our questions through the reactions of various political systems to the challenge of xenotransplantation (XTP), which stands for the transplantation of animal organs, tissues or cells into humans. XTP is highly controversial: Its advocates perceive it as promising since it could help to remedy the shortage of human transplants. Its opponents insist that it involves too many risks - most prominently infection risks - and ethical questions. Adopting a theoretical approach of "social practices", we assume that the impact of citizen participation on decision-making is not only dependent on the quality of the PTA process itself but on practices of policy makers in which PTA is embedded in. Following from our theoretical approach, we will apply qualitative methods of empirical research. The team involves researchers from anthropology, communication studies, political science, public law, social psychology and sociology." (http://cordis.europa.eu/project/rcn/89948_en.html)			
Project description	see abstract			
Field of R&I	Biotechnology, xenotransplantation			
Countries	Austria, Denmark, Great Britain, Italy, Latvia, The Netherlands, Sweden, Canada, Switzerland, The Holy See, (European Commission, OECD).			
Analysis of RRI dimension and benefits				
Input				
RRI dimension	RRI/RI ☐	Citizen Participation x	Science Literacy ☐	Gender equality ☐

<table>
<tr><td></td><td>Open Access
</td><td>R&I governance & ethics
x</td><td>Other
</td><td></td></tr>
<tr><td>RRI activities</td><td colspan="4">The CIT-PART project focused on the instruments of Participatory Technology Assessment (PTA) and on Expert Based Technology Assessment (TA) as means to deal with the issue of xenotransplantation, but also looked for other means of involving the public into decision-making processes or dealing with wider ethical aspects of xenotransplantation (opinion surveys, ethic committees).

In three of the investigated cases, PTAs were conducted. The paper at hand will consider the results of these three cases:

• Canada: Health Canada drafted and implemented a Public Involvement Plan that included information and outreach activities, planning workshops, a Public Advisory Groups (which conducted citizen forums, telephone surveys, mail surveys, and informal feedback), dialogue and awareness activities, and a public consultation.
• Switzerland: TA Swiss initiated a consensus conference (“PubliForum”) on xenotransplantation.
• The Netherlands: The Ministry of Health initiated a campaign that in the end consisted of information activities, public debate, a survey, a website, discussions and a theatre play.</td></tr>
<tr><td rowspan="2">Level of RRI activity</td><td>Global
</td><td>International
</td><td>National
x</td><td>Regional
</td></tr>
<tr><td>Local
</td><td>Organisation
</td><td>Programme
</td><td>Project
</td></tr>
<tr><td>Involved actors</td><td colspan="4">• Advisory organisations (e.g. TA Swiss).
• Researchers.
• General public.
• Government and public authorities.</td></tr>
<tr><td colspan="5">Output and Outcome</td></tr>
</table>

Output of RRI activities	Canada: • Dissemination: website, mailings, national media coverage. • Public discussion events. • Final report. Switzerland: • Final report on the TA of xenotransplantation. • Recommendation from the PubliForum. The Netherlands: • Dissemination: website, free cards, national media coverage. • Theatre play on discussions around xenotransplantation. • Public discussion events. • Final report.
Impact of RRI activity	Overall assessment
	The three PTAs had limited impact on the formal political decision-making process regarding xenotransplantation ("first generation impact criteria" - see measurement of impacts) because decisions had been made before the PTAs finished[7]. However, applying a different set of assessment criteria ("second generation of impact criteria") researchers in CIT-PART identified several societal impacts.
	Society

[7] "Indeed, when judged in these terms ["access to political power and participants' influence vis-à-vis formal political institutions"], none of the three PTAs under scrutiny in the CIT-PART project has been influential." (Griessler et al 2012: 51).

	All case studies identify a stimulation and intensification of public debate in the respective country. The topic of xenotransplantation and related issues became more visible and better known to a wider audience. In the various public debates, different interest groups and civil society organisations could participate, raise their voice and disseminate their opinion and position. And even though no direct influence of the PTA on political decision making processes could be identified, the PTA promoted reflection in parliament and government about the role of politics vis a vis other actor groups. In the case of Canada, two evaluations of the impact on participants' perception of xenotransplantation were conducted. These show that participants not only got better informed on the topic but also that their perception of the issue changed. They also highlighted the public's capability to understand complex issues such as xenotransplantation. In some cases, new cooperation between different actor groups emerged. In the Netherlands, an animal welfare organisation cooperated with the pharmaceutical industry to - at least - reduce the number of laboratory animals. Furthermore, the animal welfare organisation got in contact with a xenotransplantation critical patients' organisation and then "encouraged their members to become organ donors" (Versteeg & Loeber 2011, 66). In Switzerland, the PTA provided an opportunity for exchange between different actor groups.
	Democracy

<table>
<tr><td></td><td colspan="4">As mentioned above, the PTA activities had limited influence on the formal political decision making processes. Versteeg & Loeber (2011, 52) describe this for the Dutch case as follows: "The comprehensiveness in policies did not increase as a result of the debate, nor were the policies actively evaluated through it. There was no new initiative to further scrutinize the problem at stake, nor was a new orientation in politics established. No new ways of governance were introduced."

In the case of Switzerland, the PTA "played a role in the emergence of shared meanings between those involved in the PTA and the civil servants regulating XTP" (Loeber et al. 2011, 604). However, not direct impact on policymaking could be identified; it rather legitimised already made decisions. However, the results of PTA were recognised within the parliamentary decision making process.

Also in the case of Canada, the impact of the PTA could not be definitively assessed, because there had not been a subsequent change in policy and government took a wait-and-see approach. However, the Canada case study identifies institutional learning as an impact of the PTA process: "the complexity of the issue combined with the timing of its appearance on the policy landscape made it an essential element of the process of policy learning in health governance." (Einsiedel et al. 2011, 43) Health Canada created and adopted new means to promote transparency and openness in its work.</td></tr>
<tr><td></td><td colspan="4">Economy</td></tr>
<tr><td></td><td colspan="4">-</td></tr>
<tr><td rowspan="2">Level of RRI impact</td><td>Global
□</td><td>International
□</td><td>National
x</td><td>Regional
□</td></tr>
<tr><td>Local
x</td><td>Organisation
x</td><td>Programme
□</td><td>Project
□</td></tr>
<tr><td>Affected actors</td><td colspan="4">• General public.
• Civil society organisations.
• Public administration.
• (Politics, government).</td></tr>
</table>

Measurement of impact	In CIT-PART, in-depth qualitative case studies dealing with PTA exercises and their outcome in different countries were conducted. The researchers used qualitative interviews and desk research on policy documents as well as media coverage to collect data that was analysed per case and in a cross-case comparison using a common template. Thus, information was also categorised and transferred into a more standardised form. CIT-PART distinguishes "two generation of impact assessment" with regards to PTA (Loeber et al. 2011, 600). It is possible to evaluate (1) the impact of a PTA on the governments' political decision-making process or (2) the wider impact on the development of societal relationships, identity (co-)construction, as well as decision-making and judgement processes in a variety of societal arenas. The project focused on both of them, giving four categories to measure the second one: 1. Diffusion: opportunity to spread information on the issue to a broader audience. 2. Brokerage: contribution to the formation of new actor groups and coalitions. 3. Category formation: creation or activation of (new) boundaries between existing categories or identities. 4. (De)certification: legitimization or de-legitimization of actor positions.
Relationship between RRI activity and impact	• Diffusion of information and conduct of discussion events led to public debate on issues related to xenotransplantation. • In the Dutch case, the coalition between an animal welfare and a patients' organisation was formed in the process of public debate because they united out of different reasons against xenotransplantation and because of strategic considerations: "the animal welfare organisation […] could not afford to look self-centred, caring for animals rather than assisting humans dying for lack of donor organs. Thus, animal welfare organisations found themselves encouraging their members to become human donors." (Versteeg & Loeber 2011, 54). • Institutional learning in Canada happened in the course of and subsequent to the PTA activities, because of the experiences public administration made in the overall process. However, a clear relationship cannot be established due to the nature of the issue and a lack of reliable data.
Discussion	

Methodology and data	The results of the case studies resort to (1) qualitative data from interviews with different actors involved in or (potentially) affected by the PTA processes and (2) analysis of policy documents. Certain impact assessments (e.g. on public debate) are based on the interpretation of the case workers, do not resort to "hard" data and do not quantify the extent of media coverage or debate.
Recommendation	Due to their characteristics, PTA activities could be further considered as cases for MoRRI. They are relatively confined instrument of public involvement, their output is (usually) clearly mediated and they are sometimes already evaluated (in terms of impact). However, data collection and assessments of their mid- and long-term impacts might be difficult.
Other remarks	

References, documents, sources

- Griessler, E., Biegelbauer, P., Hansen, J., & Loeber, A. (2012). Citizen Participation in Decision-Making on Complex and Sensitive Issues? Experiences with xenotransplantation. Report of the Project "Impact of Citizen Participation on Decision-Making in a Knowledge Intensive Policy Field". Retrieved from http://www.cit-part.at/CIT%20PART%202.Edition.pdf.
- Loeber, A., Griessler, E., & Versteeg, W. (2011). Stop looking up the ladder: analysing the impact of participatory technology assessment from a process perspective. Science and Public Policy 38(8), 599-608. http://dx.doi.org/10.3152/030234211X13111546663296.
- Einsiedel, E., Jones, M., & Brierley, M. (2011): CIT-PART: Report Case Study Canada. Research Report. Retrieved from http://www.cit-part.at/CIT-PART%20Deliverable%206_7.pdf.
- Griessler, E. (2011). Xenotransplantation Policy and Participatory Technology Assessment in Switzerland. Sociological Series 95. Retrieved from http://www.cit-part.at/XTP_%20Policy_%20Switzerland.pdf.
- Versteeg, W., & Loeber, A. (2011). CIT-PART: Report Case Study Netherlands. Retrieved from http://www.cit-part.at/CIT-PART%20Deliverable%2010_11.pdf.

WiST

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WiST	
Case abstract	The WiST project wanted to promote a cultural change towards more gender equality in science and technology companies. The participating enterprises and experts formulated four points of action that would have to be implemented in order to promote this cultural change on a corporate level. The application of the Gender Dax showed differences among the companies with a women's percentage between 15% and 32%. Most companies used active strategies in order to support women, like coaching, networking and mentoring programmes, or took measures to improve the work-life balance with part-time work, flexible working hours and less often with the provision of childcare. To which extent these points were implemented or which impacts they had on gender diversity was not being assessed. The impact of gender diversity on performance was being assessed though in one of the five projects conducted by the researchers: Laure Turner (2006/2009) found that gender diversity has a positive impact on individual performance and an increase of 10% in female team members would increase the probability to achieve the highest level of individual performance by 2,6%. Gender diversity also has a positive impact on performance measured in terms of research bonuses. The measurement of the effect of gender diversity on group performance did mostly not deliver statistically significant results (see section "Methodology and Data"). The trend shows, however, that gender diversity has a positive effect on collective performance as well. It must be considered here that women are over-represented in projects that do not directly contribute to the R&D performance. Turner acknowledges the limitations of her study being the short time and the lack of appropriate data. She suggests implementing protocols for data collection that can be done by the companies themselves in order to be able to share and aggregate this data in future studies. A greater variety of performance indicators and explanatory variables should be developed for this data collection.
Project Information	
Project Name	Women in Science and Technology – The Business Perspective

Project Homepage	no homepage available
Final report	Brouns, Margo et. al. (2006): *Women in science and Technology. The Business Perspective.* EC DG for Research: Science and Society: Women and Science. EUR 22065 EN.
Funding programme	FP6 - Society
Duration	2005
Abstract	"This paper aims to empirically assess the impact of gender diversity on innovative performance, specifically research and development (R&D) in companies, in exploring the business case for gender diversity. The study's originality lies in isolating the specific effect of gender diversity on innovative performance from the effects of other forms of diversity, particularly in terms of age, nationality, status and seniority. The results show that the innovative performance of both individuals and teams would be increased by more gender balance at the team level. Another finding is that women are over-represented in some domains and on projects that are not designed to be major contributors to the performance of the activity under study, which has a measurable cost in terms of performance. Two factors of success for businesses and science are allowing more women to take an active part in core R&D and developing appropriate diversity management strategies within research teams." (Turner 2006: 69)
Project description	Significantly fewer women enter education in science and engineering, and this gender gap even increases the higher the position in the field. The WiST working group, consisting of representatives from 18 companies and 5 experts in different sectors, aimed at promoting a cultural change in the field of science and technology that will endorse more gender diversity in attracting, developing and employing men and women equally. Necessary measures were studied and discussed, experiences and knowledge were exchanged in the group. Apart from this exchange, five projects were conducted by the experts: (1) identifying crucial milestones on a typical woman engineer's career in order to understand the mechanisms of the "leaky pipeline" in Europe; (2) investigating work-life-balance issues, especially focusing on dual career couples; (3) emphasizing complexities in managing diversity and cultural change and discussing possibilities of quality and process management and the application of social auditing (gender dax) for gender diversity; (4) identifying instruments for organisational change; (5) and

<table>
<tr><td></td><td colspan="4">measuring diversity effects on individual and collective performance in order to “prove” the economic value of gender diversity and make a business case out of it. The latter has been done in cooperation with four of the participating companies and this project paper is the main source of the case study (see Turner 2006/2009).</td></tr>
<tr><td>Field of R&I</td><td colspan="4">Industry (S&T)</td></tr>
<tr><td>Countries</td><td colspan="4">Internationally active companies headquartered mainly in France and Germany.</td></tr>
<tr><td colspan="5">Analysis of RRI dimension and benefits</td></tr>
<tr><td colspan="5">Input</td></tr>
<tr><td rowspan="2">RRI dimension</td><td>RRI/RI
□</td><td>Citizen Participation
□</td><td>Science Literacy
□</td><td>Gender equality
x</td></tr>
<tr><td>Open Access
□</td><td>R&I governance & ethics
□</td><td>Other
□</td><td></td></tr>
<tr><td>RRI activities</td><td colspan="4">Different steps were taken in order to promote gender diversity amongst companies in the science and technology sector. The results of the five projects of the experts were presented and discussed with the participating companies and recommendations for specific actions were given.

The most relevant activity for this case study is the measurement and proof of the positive effect of gender diversity on individual and group performance in research and development. Furthermore, a Gender Dax was applied to the companies as an example of quality management in gender diversity that screened them on the current state of gender equality and gender equality schemes and activities. Difficulties and limitations, as well as motivating factors, of women’s careers in engineering and science were identified in order to understand the dropout rate on the career path; the same applies to understanding the difficulties and needs of dual career couples in order to keep both partners in the work force.</td></tr>
<tr><td rowspan="2">Level of RRI activity</td><td>Global
□</td><td>International
□</td><td>National
□</td><td>Regional
□</td></tr>
<tr><td>Local
□</td><td>Organisation
x</td><td>Programme
□</td><td>Project
□</td></tr>
<tr><td>Involved actors</td><td colspan="4">Researchers and representatives of the participating companies.</td></tr>
<tr><td colspan="5">Output and Outcome</td></tr>
</table>

Output of RRI activities	Five reports on the mentioned expert projects and company profiles regarding their gender diversity were produced. The positive effect of gender diversity on individual and collective performance in research and development in different participating science and technology companies was proven. The project also produced knowledge about the various difficulties women and dual career couples face in engineering, science or technology careers and how those can be tackled. Knowledge was also produced about effectively managing diversity. Recommendations for specific actions towards more gender diversity in these fields were given which had yet to be implemented.
Impact of RRI activity	Overall assessment
	The impact of gender diversity on team and individual performances has been empirically measured by Laure Turner (2006/2009). She was able to show that gender diversity has a positive effect on individual performance in research and development and an increase of the percentage of women raises the performance level. The effect on collective performance could only be assessed very superficially due to a lack of appropriate data, but an idea was gained that a positive affect happens here as well. Further research would have to be done in order to formulate stronger base of evidence. If consequently applied, the proposed actions would probably contribute to the stipulated change of culture in the field of science, technology and engineering to be more open for female careers. Here as well further research would be necessary and could be done in the participating companies as a follow-up project.
	Society
	A change towards more gender equality in science and technology companies contributes to a general equality between men and women in society. More women might choose to seek education and employment in these former male-dominated fields that are also linked to higher income and status. The impact of this is difficult to assess though.
	Democracy
	Economy
	As Laure Turner showed in her study, a higher rate of women in research and development teams contribute to the individual and collective performance and

<table>
<tr><td></td><td colspan="4">thus to the performance of the company, which can be translated into economic performance as well.</td></tr>
<tr><td rowspan="2">Level of RRI impact</td><td>Global
☐</td><td>International
☐</td><td>National
☐</td><td>Regional
☐</td></tr>
<tr><td>Local
☐</td><td>Organisation
x</td><td>Programme
☐</td><td>Project
☐</td></tr>
<tr><td>Affected actors</td><td colspan="4">Individuals and groups in the respective companies.</td></tr>
<tr><td>Measurement of impact</td><td colspan="4">The impact of gender diversity was measured by econometric modelling in a controlled setting, thus clearing the effect of other parameters such as age, seniority in the company or nationality (see “Methodology and data”).</td></tr>
<tr><td>Relationship between RRI activity and impact</td><td colspan="4">It was not shown in this project how the activities to promote women directly influenced the percentage of women working in the S&T sector, but the impact of gender diversity is measured in terms of their effect on individual and collective R&D performance.</td></tr>
<tr><td colspan="5">Conclusion and discussion</td></tr>
<tr><td>Methodology and data</td><td colspan="4">In her measurement of the impact of gender diversity on performance, Laure Turner (2006/2009) focused on one specific aspect, namely the research and development performance, for several reasons: (1) it provides clear performance indicators like patents, publications, bonuses etc; (2) there is a strong link between input (researchers, resources) and performance; (3) the assessment of performances in R&D is quite homogenous amongst the participating companies and the data can therefore be merged into a sufficient sample size.

The measurement had to take place in a controlled setting in order to isolate the impact of gender from other diversity factors. The method of econometric modelling was chosen for that and the indicators were operationalized.

The data was provided by four participating companies for the year 2004. The sample consisted of 1506 persons of which 26% were women. They worked on 272 projects, some of them in several projects. Additionally, data was provided on gender, age, seniority in the company, nationality, and position or grade in the company. The latter as well as the performance on an individual and team level were grouped into 3 ranks.

Performance was measured on an individual level in terms of bonuses for successful research achievements or regarding to annual objectives, and on a team level in terms of success of the R&D projects which was done by the</td></tr>
</table>

	companies by ranking either projects or teams. It was not possible to gain statistically significant data for the effect of gender diversity on group performance for three companies due to a lack of teams/projects available for the three level classifications. It was possible to build an econometric model for the fourth company relying on two indicators of performance, namely the ratio of anticipated to actual project costs and the delivery before or behind schedule.
Recommendation	A follow-up investigation of the participating companies regarding their gender equality level could probably be done quite easily, since the same data would be necessary for that. If the companies regularly collected this data is a crucial point to that.
Other remarks	
References, documents, sources	

- Brouns, Margo et. al. (2006): Women in science and Technology. The Business Perspective. EC DG for Research: Science and Society: Women and Science. EUR 22065 EN.
- Turner, Laure (2006): Gender Diversity and Performance. in Women in science and Technology. The Business Perspective. EC DG for Research: Science and Society: Women and Science. EUR 22065 EN, pp. 69-80.
- Turner, Laure (2009): Gender Diversity and Innovative Performance. International Journal Innovation and Sustainable Development, Vol. 4, Nos. 2/3, pp. 123-134.

PRIMAS

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PRIMAS	
Case abstract	The objective of the PRIMAS project was to promote the implementation of inquiry-based learning (IBL) in mathematics and science at schools in its participating countries in order to interest more students in these subjects. Promoting and hindering factors were investigated, professional development courses for teachers were designed and offered, the different countries observed and recommendations formulated, especially focusing on shifts in school structures and curriculums. Changes on a policy level have been slow and hard to make though due to the logics of the political systems.´ In two evaluation reports, the changes amongst teachers and students were investigated and it was shown that in general mathematics and science education could be improved. A meta-study examined the benefits of IBL in mathematics lessons, which despite some limitations in comparability and generalisability, showed that there are certain benefits considering motivation, interest and understanding of the subject. Combining these two findings, PRIMAS contributed significantly to the science literacy dimension of RRI in furthering the qualified use of IBL at European schools.
Project Information	
Project Name	Promoting inquiry in mathematics and science education across Europe
Project Homepage	http://www.primas-project.eu/en/index.do
Final report/most relevant publication	Maaß, Katja, Karen Reitz-Koncebovski (eds.) (2013). Inquiry-based learning in maths and science classes. What it is and how it works – examples – experiences. University of Education Freiburg, Germany. ISBN: 978-3-00-043851-6
Funding programme	FP7 (Science and Society)
Duration	01/2010-12/2013

<table>
<tr><td>Abstract</td><td colspan="4">PRIMAS stands for ‘Promoting inquiry-based learning (IBL) in mathematics and science across Europe’. IBL has the potential to raise students’ intrinsic interest in mathematics and science and it supports the attainment of important competences, such as problem-solving skills, self-directed learning and exploring new knowledge areas.

Teachers are the key players in implementing IBL pedagogies in mathematics and science classrooms and in transforming the potential benefits of IBL into real effects. This is why PRIMAS predominately aims to support them by providing teaching materials along with professional development courses and a continuous support system within ‘communities of IBL-practice’. (Maaß, Reitz- Koncebovski 2013)</td></tr>
<tr><td>Project description</td><td colspan="4">Apart from the above mentioned, PRIMAS was working on a policy level to promote change towards a more IBL-based teaching system. It also investigated the supporting and hindering factors for successfully implementing IBL in schools and set support actions on different systemic levels in order to further the dissemination of IBL.

The ultimate goal would be to bring a greater number of students to continue higher education in mathematics and science subjects by sparking their interest already in school.</td></tr>
<tr><td>Field of R&I</td><td colspan="4">Maths and science education</td></tr>
<tr><td>Countries</td><td colspan="4">Cyprus, Denmark, Germany, Hungary, Malta, Netherlands, Norway, Romania, Slovakia, Spain, Switzerland and the UK</td></tr>
<tr><td colspan="5">Analysis of RRI dimension and benefits</td></tr>
<tr><td colspan="5">Input</td></tr>
<tr><td rowspan="2">RRI dimension</td><td>RRI/RI
□</td><td>Citizen Participation
□</td><td>Science Literacy
x</td><td>Gender equality
□</td></tr>
<tr><td>Open Access
□</td><td>R&I governance & ethics
□</td><td>Other
□</td><td></td></tr>
<tr><td>RRI activities</td><td colspan="4">Training of multipliers that in turn trained teachers in IBL teaching methods. Support actions on systemic levels in order to promote and disseminate IBL (publications, conference presentations, congress and symposium participation). Development of guidelines and teaching material to use in classrooms.</td></tr>
</table>

Level of RRI activity	Global □	International □	National x	Regional □
	Local □	Organisation □	Programme □	Project □
Involved actors	Researchers of the project and teachers of math and science classes.			
Output and Outcome				
Output of RRI activities	Publication for teachers about and how to use IBL in their classrooms, training lessons for teachers, a professional development system for teachers wanting to use IBL. Policy recommendations in order to further the change of school systems and curriculums towards a more IBL-based teaching approach. A special issue on the Implementation of Inquiry-Based Learning in Day-to-Day Teaching of ZDM Mathematics Education (Volume 45, Issue 6, November 2013) was published.			
Impact of RRI activity	Overall assessment			
	The project had an impact in the way of promoting and contributing to an implementation of a teaching method (IBL) at schools that showed positive results on achievement, motivation, understanding and interest of students for math and science topics, as well as finding supporting and hindering factors in this process. The teachers noticed an impact on cognitive and affective developments amongst their students and that this approach includes all students, the high as well as the low ability students. This observation was backed by the student questionnaires that showed an improvement of almost all students in all investigated aspects towards more confidence in exploring the posed questions, talking to teachers or discussing their ideas in the group. The same is true for the teachers: they gained more confidence in the training courses in how to implement IBL in their classes and did it more regularly; they started to independently and creatively plan their lessons and shared ideas and experiences with their colleagues. In another evaluation, the project found that through the implementation of IBL and the support of the teachers in offering professional development courses, the teaching practices in mathematics and science classes changed significantly and education improved. A meta-study examined the benefits of IBL in mathematics lessons, which despite			

<table>
<tr><td></td><td colspan="4">some limitations in comparability and generalisability, showed that benefits in motivation, better understanding of mathematics and a development of beliefs of relevance of mathematics for life and society. It was furthermore shown, that a so called guided inquiry, were the students are softly guided in their inquiry of posed questions, showed the best results in the achievement of the students.</td></tr>
<tr><td></td><td colspan="4">Society</td></tr>
<tr><td></td><td colspan="4">The promotion and motivation of students for science and mathematics subjects might continue in an increased number of students taking up studies and furthermore careers in these fields. Since a decreasing number of beginners in these subjects was diagnosed, the application and promotion of IBL as a teaching method is of crucial importance.

In addition, evidence shows that both low and high ability students benefited from this teaching method, which contributes to a more equal society in terms of chances of education.</td></tr>
<tr><td></td><td colspan="4">Democracy</td></tr>
<tr><td></td><td colspan="4"></td></tr>
<tr><td></td><td colspan="4">Economy</td></tr>
<tr><td></td><td colspan="4">A better educated and broader number of people deciding on an education and career in mathematics and science might bring direct economic benefits for a society in terms of productivity and innovation.</td></tr>
<tr><td rowspan="2">Level of RRI impact</td><td>Global
☐</td><td>International
☐</td><td>National
x</td><td>Regional
☐</td></tr>
<tr><td>Local
☐</td><td>Organisation
☐</td><td>Programme
☐</td><td>Project
☐</td></tr>
<tr><td>Affected actors</td><td colspan="4">Teachers and students in math and science classes.</td></tr>
<tr><td>Measurement of impact</td><td colspan="4">In order to measure the overall impact of the project, different questionnaires were developed for different target groups (teachers, teaching students, pupils, parents, other stakeholders like school authority or industry). Additionally, case studies were conducted that followed single teachers in the process of the project in which they were interviewed, classrooms and teachers' trainings were observed and formative questionnaires were given that could individually be applied according to the evaluation traditions of the respective countries - being more quantitative or</td></tr>
</table>

	qualitative oriented. A framework was developed for the analysis of these data. The internal evaluation looked into the benefits, expectations and interests of involved actors in the project. The questionnaires for the students were administered twice, first before implementing IBL methods in the classroom and second after the project finished with its activities at the schools. In an IBL implementation report, questionnaires with comparable sections on the teaching practice were given again to teachers and students prior and after the implementation of the teaching method. Additionally, the teachers' views on IBL were asked. In the meta-study on the benefits of IBL, 16 very diverse studies were analysed and compared as far as possible. Naturally, these studies were very different in their scale, methods and reach, which makes a generalisation difficult.
Relationship between RRI activity and impact	The benefits of the teaching method IBL were shown in the meta-study. Also the evaluation of the project showed an improvement on teachers' and students' abilities and attitude towards IBL. By continuous and intense teachers' training and guidance they were qualified to implement IBL in their classroom. By this approach, students' understanding, achievement, motivation and abilities towards science and mathematics were improved, as was shown in the evaluation.
Conclusion and discussion	
Methodology and data	There are two evaluation reports, one internal evaluation of the impact of the project and one specifically about the implementation of IBL. Empirical data was generated with different methods: both evaluations used questionnaires for teachers and students, one as well for other stakeholders. Additionally, case studies were conducted in the overall assessment, using interviews, observations and questionnaires. A special issue of the magazine ZDM Mathematics Education (Volume 45, Issue 6, November 2013) was published on Implementation of Inquiry-Based Learning in Day-to-Day Teaching. In one of the articles evidence of benefits of IBL as teaching method were being investigated in a meta-study of the state of knowledge of existing empirical studies on the topic. The studies naturally were diverse in their approaches and designs and therefore hardly generalizable. Still, evidence-based trends could be shown.
Recommendation	A follow-up assessment of the impacts of IBL at the participating schools and a tracking of the educational and professional paths of the students would show the

	long-term benefits of this teaching method and of the goal of the project to interest more students in science and mathematics.
Other remarks	
References, documents, sources	

- Wake, Geoff et al (2013). The PRIMAS project: Promoting inquiry-based learning (IBL) in mathematics and science education across Europe. Final policy report.
- Maaß, Katja et al (2013). The PRIMAS project: Promoting inquiry-based learning (IBL) in mathematics and science education across Europe. PRIMAS report on the results of the internal evaluation.
- Engeln, Katrin et al (2013). The PRIMAS project: Promoting inquiry-based learning (IBL) in mathematics and science education across Europe. IBL implementation survey report.
- Bruder, Regina, Anne Prescott (2013). Research evidence on the benefits of IBL. ZDM Mathematics Education 45: 811–822. DOI 10.1007/s11858-013-0542-2

Second round case studies: Investigation and conduction of new empirical case studies

Institutional efforts to ensure and enhance responsible conduct of research: Lessons learned from Aarhus University

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1 Case abstract

This study represents a first attempt to open the black box of 'ethical governance' in university settings. Drawing on organisational memorandums and expert-interviews with policy-makers at Aarhus University in Denmark[8], it provides new insights deepening our understanding of how institutional codes of responsible conduct of research (henceforth RCR) are implemented, how they function, and which tangible and intangible organisational and extra-organisational outcomes they may foster. It highlights the various exogenous and endogenous drivers triggering institutional commitment to RCR and provides examples of the different types of obstacles and challenges encountered in the policy-making process. Finally, it illuminates and discusses the immediate and expected outputs and outcomes of such initiatives. In doing so, it illustrates how well developed RCR strategies can be instrumental in raising awareness of academic honesty and integrity among scientific staff and in establishing more transparent and efficient mechanisms for "whistle-blowing" and judicial systems for handling suspected incidents of scientific misconduct. Moreover, such strategies may, in the long run, operate to ensure and sustain the university's legitimacy among its external constituencies and foster more valid, reflective and credible research outcomes

Table 13 Case study 05: Case details

RRI dimension	RRI X	Citizen Participation □	Science Literacy □	Gender equality □
	Open Access □	R&I governance X	Ethics X	Other □
R&T field	Academic research			
Country	Denmark			

[8] For transparency, it should be noted that the authors are themselves from Aarhus University. They have, however, not been involved in the organisational processes leading to a strategy for rresponsible conduct of research at the university.

2 Introduction

With the growing public support for science as a key driver in overcoming the 'grand societal challenges' of our time (EC, 2012), concerns about how academic research is conducted have increasingly come to the fore of both the public and political agenda (Steneck, 2007). This places new demands on research performing organisations (henceforth RPO's), which in order to preserve and maintain legitimacy among their constituencies are expected to account for technical activities in new and more transparent ways. Concurrently, new modes of research governance aimed at rendering scientific institutions more productive and efficient in their day-to-day activities have spawned competitive pressures on the researchers to produce better and more relevant research at an increasingly higher pace (Whitley & Gläser, 2008). As asserted by several scholars (see. e.g. Bornmann, 2010; Lui, 2006; Skandalakis & Mirilas, 2004; Vasconcelos et al., 2009; Qiu, 2010), this pressure – combined with the proliferation of new technological tools for detecting scientific misconduct – may serve as a plausible explanation to the increasing levels of intellectual rashness, plagiarism and fraud identified in the literature (see e.g. Errami & Garner, 2008; Steen, 2010; Steen et al., 2013).

In his theory of anomie, Merton (1938, p. 675) contextualises the basis for this type of deviating behaviour with a metaphorical example derived from competitive athletics:

> *…when the aim of victory is shorn of its institutional trappings and success in contests becomes construed as "winning the game" rather than "winning through circumscribed modes of activity," a premium is implicitly set upon the use of illegitimate but technically efficient means.*

Put differently, a disproportionate emphasis on success-goals (e.g. extensive publication outputs in high impact journals) may, when separated from coordinated institutional emphasis, lead demoralised competitors to neglect the rules of the game (e.g. responsible conduct of research) and adopt illegitimate means (e.g. ethical misconduct) to their ends (Bornmann, 2010, p. 174).

One of the strategies that RPOs (and countries) can adopt to actively prevent this type of "the-end justifies-the-means" behaviour from gaining ground among its faculty, is to prepare specified codes of conduct on appropriate and ethical research behaviour. By drawing up clear distinctions between permissible and impermissible organisational practices, such policy documents can help to maintain (or restore) the university's legitimacy among its constituencies and provide guiding principles which, over time, may also serve as reference for the construction of professional identity (Rezaee et al., 2001, p. 172). Contrarily, codes of conduct, if not sufficiently implemented, risk becoming "a panacea for problems that they cannot solve", which may ultimately intensify distrust and cynicism in the organisation (Dobel, 1993; cf. Rezaee et al., 2001).

Despite their increasing importance, no studies have so far investigated how institutional codes of conduct on research ethics and integrity are implemented, how they function, and which

organisational and extra-organisational outcomes they may foster.[9] Drawing on organisational memorandums and expert-interviews with central policy-makers involved in the process of developing and implementing a new RCR strategy at Aarhus University in Denmark, this case study attempts to open the black box of ethical governance in university settings. [10] In line with the general ambition of the MoRRI project's Task 6, the main objective will be to provide qualitative insights deepening our understanding of the immediate and expected outputs and outcomes of AU's new policy-initiative.

With more than 40,000 students and approximately 4,000 full-time research employees (including 1500 PhDs) distributed on four mega-faculties[11], AU is the second-largest public institution of higher education and research in Denmark. The university accounts for approximately 23% of the Danish universities' overall research output and around 32% of the research output of the Danish university hospitals (Piro & Schneider, 2011). 60% of AU's funding is state-financed (Pinheiro & Stensaker, 2010).

3 Methods and data

As mentioned above, we employ a single-case study approach focusing on AU's recent policy efforts to preserve and promote RCR. In our investigations of AU's institutional efforts to preserve and enhance RCR, we draw on two types of qualitative data. The first step in the data collection process has been to systematically harvest all publicly available policy documents, meeting minutes and organisational memorandums offering information on RCR related activities. Besides providing insights on the different steps of the policy-making process and the content of the actual strategy, these documents have prepared the ground for three semi-structured qualitative interviews with core RCR policy-makers at the university. More specifically, we interviewed the Dean and the Pro-dean of talent at the faculty of Health (henceforth Health) and the Pro-dean of talent at the faculty of Science & Technology (henceforth S&T). All three interviews were conducted face to face and on average lasted around 30 minutes. To ensure readability, some of the interview quotes presented in the following sections have been edited slightly without compromising the meaning of the text.

Aarhus University's RCR policy is still quite new (the final document was put into force on the 25th of March, 2015), which makes it difficult to measure (or predict) the more far-reaching and

[9] It is worthwhile mentioning that the 2016-17 SWAFS programme under H2020 will support studies within this area.

[10] As noted by Brom et al. (2015, p. 15) ethical governance is about "institutionalising ethics debate in terms of the implementation of standards in research ethics in science, technology and innovation policies".

[11] I.e. Arts, The School of Business and Social Sciences (BSS), Science and Technology (S&T), and Health.

long-term outcomes and benefits of the initiative. We have therefore decided to limit the scope of the interview study to cover the following themes:

- The policy-making process (from first step to current status)
- The relevance and necessity of the policy (pan-university level? Faculty-level?)
- Expected benefits at Aarhus University (will the policy make a difference and in which ways?)
- Expected benefits in larger society (the relation between the university and larger society)
- Strategy for ensuring commitment at lower organisational levels
- Experiences of resistance and scepticism in the policy-making process
- Implications of the policy on how the university/faculty organises its activities.

4 Input level: RRI activity

In the following, we will account for the policy-making process leading to the implementation of AU's new pan-university strategy for RCR. The section will be structured as follows: First, we provide a brief introduction to the policy context by highlighting the most notable RCR-related national incidents preceding AU's engagement in the issue. Moreover, this part outlines the central arguments for promoting RCR identified by the three interviewees. Secondly, we draw-up the central steps in the policy-making process – from the initial agenda setting by the faculty of Health in the beginning of 2011, to the final implementation of the pan-university RCR strategy plan in March 2015. Finally, we present and discuss the actual content and scope of the plan and account for the current status of the implementation process.

4.1 The policy context

In 2003, the Ministry of Science put forth the proposal that Danish universities should take on new precautionary measures against scientific misconduct by developing specific policy documents including professional rules and specified mechanisms for "whistle-blowing". These recommendations were, however, left unnoticed by universities until 2010, when a severe incident of scientific misconduct at the University of Copenhagen[12] (henceforth KU) brought the issue of RCR to the forefront of the public and political agenda (ESNA, 2011). The so-called "Penkowa scandal" not only cast doubt on KU's management for ignoring "alleged misdeeds for the better part of a decade" (Callaway, 2011). In addition, Penkowa's co-workers came under fire for not sufficiently voicing their concerns over suspicious and unusual behaviour both inside

[12] During the period 2010 through 2012, Milena Penkowa, a high-profile neuroscientist and former professor at Copenhagen University's Panum Institute, was convicted of both embezzlement of research funds (2010) and severe data falsification and fabrication (2012) (https://en.wikipedia.org/wiki/Milena_Penkowa).

and outside the laboratory (ESNA, 2011; Zieler & Baggersgaard, 2015). As observed by the Dean of Health, these incidents became the backdrop for AU's and particularly Health's decision to initiate the process of developing a new RCR strategy.

> *I became the Dean of Health at the end of 2010, when the Penkowa case was at its highest. And I thought to myself: "The question is not whether, but WHEN we will experience a similar case at Aarhus University". (Dean, Health)*

> *The handling of the Penkowa-case was a "lesson how not to do it"… Too dilatory and too much shirking of responsibility. Four to five years passed by, where you could have said "this is totally wrong", but where no-one did anything. (Dean, Health)*

Reflecting on the relevance and necessity of the new RCR strategy, the Pro-dean of S&T, which entered the policy-making process at a later point, similarly notes:

> *RCR is something we discuss all the time, but when a new national or international case arises… Well, then you look yourself in the mirror and ask "could such a case happen here?" …Would we have discovered a Penkowa-case? (Pro-dean, S&T)*

AU's engagement in RCR did, however, not merely arise as an institutional response to the Penkowa case. Research funding requirements also played an important role. As the Pro-dean of Health highlights, large funding organisations such as the American National Science Foundation already require applicant institutions to have clear RCR policies in place, and it seems plausible that similar requirements will soon be adopted by the European Research Council. Moreover, the Pro-dean points to the increasing performance pressures on research faculty as an exogenous factor influencing AU's engagement in this policy-issue:

> *Time is becoming more and more constrained, and many researchers are now competing for the same funding. Then a question arises of whether one starts to cut corners regarding research quality. (Pro-dean, Health)*

> *There is an increasing pressure. And we do this to remind people that quality is crucial and that the research should be conducted in the best possible manner. And in my work activities, I've experienced that people cut corners once in a while. This cannot be considered misconduct per se, but where you think "hmm, this could have been done better". (Pro-dean, Health)*

To briefly sum up, AU's engagement in RCR appears to have been triggered by both *exogenous stimuli* in the form of "danger signals" (i.e. the Penkowa case and similar international incidents), increasing performance demands and financial incentives, and *endogenous stimuli* in the form of local agenda setting initiated by a few dedicated "institutional entrepreneurs" (DiMaggio, 1988) at the university's faculty of Health (more on this below). With these perspectives in mind, we will now proceed to account for the different steps of the RCR policy-making process – from the initial agenda setting to the finalizing of the pan-university strategy.

4.2 The policy-making process

As mentioned, AU's efforts to develop a pan-university strategy for RCR originally grew out of a policy initiative launched by the management of Health, who in 2011 invited a number of local and national experts to draw up a faculty-specific RCR code. As part of this process, the faculty conducted a survey among its research employees revealing that formalised specifications on how to handle illegitimate or suspicious research behaviour among fellow scientists were requested by the researchers. Moreover, the Health faculty in 2013, on behalf of AU, organised a symposium under the title "Research integrity & responsible conduct of research – new challenges in a turbulent world", with keynote presentations from leading international experts on RCR.

In the wake of these activities, AU's Committee for Talent Development[13] (henceforth CTD), at the instigation of the Pro-Dean of Health, decided to expand the RCR policy initiative to cover all faculties at the university. The first initiative taken by the CTD was to write up a joint discussion paper based on international principles for research integrity and responsible research practice, which could serve as the preliminary draft for the new RCR strategy. On this background the committee members agreed on preliminary policy document comprising the following elements: 1) a clear code of practice on research integrity, 2) precise discipline-specific standards for RCR, 3) mandatory training and education in RCR, 4) a transparent and professional committee consisting of researchers from each faculty, in charge of handling cases of suspected breach of academic honesty and RCR, 5) an advisory organ consisting of experienced researchers from each faculty providing confidential and professional guidance for scientific staff on RCR related issues and 6) an Office of Research Integrity facilitating and supporting the work of the RCR committee and the advisory organ (Aarhus University, 2013).

In September 2013, the preliminary draft was passed for consultation at the four faculties and in various councils and forums to allow employees to provide feedback on the proposal. Generally, the proposal was met with broad support in the local environments (Aarhus University, 2014a). During the spring of 2014, a revised policy draft was passed for a second round of consultation in the local environments and as in the first round the employee-responses were generally positive (Aarhus University, 2014b). The final proposal was approved by the senior management team in March 2015 (Aarhus University 2015d). In the meantime, the Danish Ministry of Higher Education and the stakeholder organisation *Universities of*

[13] The Committee for Talent Development consisted of the Dean of BSS and the Pro-deans of Talent from each of the four university faculties.

Denmark[14] announced a national code of RCR (The Danish Ministry of Science, 2014)[15], and as observed by the Dean of Health (AU), the early agenda-setting efforts made by his own faculty may have served to prepare the ground for this national initiative.

4.3 Obstacles and disagreements: when the devil is in the detail

Whereas the overall policy process, as illustrated above, passed relatively smoothly, the decision making of the Committee for Talent Development did not take place without complications. As observed by the Pro-dean of S&T, the committee work "was characterised by continuous misgivings and doubts concerning what was the legitimate procedure, who ought to be involved - and when - and what should be passed for consultation". This resulted in a quite lengthy process, which was further delayed by organisational restructurings[16], and the cropping up of a national code of RCR along the way. These delays, according to the Pro-dean, may "have led to some confusion among the employees about what was actually going on" thus potentially weakening the local commitment to the initiative.

Moreover, disciplinary variations in authorship practices triggered some discussion among the stakeholders. As the S&T Pro-dean describes it:

> *The devil is often in the detail…minor variations in the formulations of a policy can have crucial implications for the day-to-day practices of many people. (Pro-dean, S&T)*

What he is referring to here is a discussion between the faculties of whether all researchers, irrespective of discipline and position in the author hierarchy, should be subject to the Vancouver rules for authorship, which among others state that scientific authors and co-authors should be held "accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved".[17] According to the Pro-dean, this principle, while being relevant and applicable in some scientific fields, does not always correspond with how authorship cultures work in the Natural sciences, where thousands of researchers are sometimes included in the byline (see e.g. Aad et al.,

[14] *Universities of Denmark* operates to ensure and maintain the collaborative ties between the eight Danish universities.

[15] This code was developed by a working group consisting of representatives from the eight Danish universities, the Sector Research Institutes of Denmark, The Danish Council of Independent Research and the Danish Council for Strategic Research.

[16] In a comprehensive reorganization exercise process in 2010, AU reduced nine faculties into four main scientific areas 55 research units into 27 new departments. Moreover this restructuration involved a centralization of the faculty administrations into one unified all-encompassing administrative organ (Nielsen, 2015).

[17] For further specifications see: www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html

2015). This, according to him, makes it meaningless to render each contributor accountable for every step in the research process. The Dean of Health adds to this discussion with the following comment:

> *When we had to finalise AU's joint strategy, we experienced a challenge regarding Science and Technology, because some disciplines have a tradition for including hundreds of authors on the same paper (…). I am not sure that this is the right way to do it, but that's how they do it. And ok, then we'll have to take that into account in the strategy. But in health we use the Vancouver rules right…and we sometimes see studies involving more authors than patients, because someone participated in taking a blood test twenty years ago. Is that ok? Personally, I don't think so. But that is a discussion we'll have to take in the future. (Dean, Health)*

As illustrated by the quote, the discussion on authorship rules does not merely adhere to the principle of ensuring accuracy and integrity in the research findings per se. It also points to the issue of "honorary authorships" (i.e. to credit researchers in the byline that made little or no contributions to a study (see e.g. Bonekamp et al., 2012; Eisenberg, 2011; Wislar, 2011)), and the question of legitimate and illegitimate labour divisions in academia. The Dean and Pro-dean of Health elaborate on this matter thus:

> *We often hear PhD fellows saying "Listen, my supervisor is asking me to credit this person on the paper, but do you know what? The person merely walked through our laboratory. What shall we do?" (Pro-dean, Health)*

> *The biggest problem within Health is that some people are not contributing sufficiently to be listed as co-authors. Being a co-author without contributing is becoming more common. Some might say, "I am a senior member of staff in this department, so I should be listed in the byline". This is not good enough. (Dean, Health)*

The Pro-dean of S&T likewise raises concerns about honorary credentials for two reasons:

> *The first reason is that it is unfair. It is too easy to be credited as a co-author merely by obtaining funding and doing nothing else. It doesn't make any sense. Secondly, I feel sorry for the young researchers. Some (…) apparently talented young scholars have senior names written all over their work. We need to avoid that… but I think it will be difficult to change. (Pro-dean, S&T).*

What we can imply from these examples is that institutional efforts to develop a joint set of rules and shared guidelines covering the university as a whole, may be impeded and delayed by cultural variations in authorships practices, scientific values and the nature of the research conducted across the university faculties. As the Pro-dean of Health observes, cultural and professional differences have been quite explicit in the policy-making process, and the main challenge for the Committee for Talen Development has been to establish common ground for a strategy that accounts for these differences in the best possible way. The down-side of

establishing "common-ground", however, may be that the actual policy stipulations charting the course of the research employees sometimes end up being more "elastic and easier to evade" than first planned (Pro-dean, S&T). This point is best illustrated by the aforementioned formulation on authorship rules, which in the original discussion paper adhered directly to the four principles of the Vancouver statement,[18] but in the final policy was loosened by including the following addendum:

> *However, the responsibility of each author should be assessed in relation to their individual role in the research and in relation to their area of expertise, experience, seniority, supervisory role and other relevant factors. Thus, in some cases an author may have a greater responsibility than others for ensuring the integrity of the article or parts of the article. (Aarhus University, 2015a)*

However, as the Pro-dean of S&T concludes on this matter, the elasticity of some policy formulations in the document may not necessarily have been of any crucial importance in this regard:

> *At the end of the day, the main purpose has been to remind people of proper and honest behaviour rather than to formulate specific stipulations, and I think all of the faculties face challenges in communicating that message to the senior research staff. (Pro-dean, S&T)*

This quote points to another challenge related to the work on a new RCR strategy, i.e. to ensure commitment to its realization by binding the researchers to a course of action of relevance to its objectives (Meyer & Herscovitch, 2001, p. 301). Supported by a similar formulation by the Pro-dean of Health, the Dean of Health describes it thus:

> *Universities are conservative institutions, and some people interpret this as if we intend to control their research activities – "big brother" and so on. It has nothing to do with that. But I think – and this is well substantiated – that when you raise the discussion and enable people to contribute in an informed manner, then people become excited and realise that "this is actually important". There is always resistance, and it would be easier without rules, but this is crucial. However, we haven't experienced much noise – only natural scepticism. But that scepticism is thawed like snow in the summer sun, when people realise what this is actually about. (Dean, Health)*

[18] I.e. 1) Substantial contributions to the conception or design of the work, or the acquisition, analysis or interpretation of data, and 2) Drafting the work or revising it critically for important intellectual content; and 3) Final approval of the version to be published; and 4) Agreement to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved (Aarhus University, 2015).

4.4 Scope and Content of the RCR strategy

Table 14 (see below) provides an overview of the different elements included in AU's Pan-university RCR strategy. The strategy, as observed by the Dean of Health, has two main functions. The first is to develop mechanisms that a) makes it legitimate and uncomplicated to turn to a neutral, knowledgeable and competent authority for professional advice in cases of a suspected breach of academic honesty (i.e. the establishment of an advisory organ with representatives from each faculty); and b) ensures efficiency and transparency in the judicial handling of allegations of scientific misconduct (i.e. the establishment of a Committee for Responsible Conduct of Research with representatives from each faculty). The second is to develop clearer structures for prevention, and this, according to the Dean, will be the most important and difficult task.

> *When we talk about students, PhD fellows, semi-old researchers and old researchers – all the way through people have to reflect on "what is our ethical codex?" (…) You won't really internalise these issues if you are not confronted with them at the early stages of your education, i.e. bachelor and master level and through your PhD training. If you're a young person in an environment with a bad culture, you will be annexed by this culture "this is what we've always done". (Dean, Health)*

Continuous training and guidance of both students and research staff, in other words, constitutes a core activity in AU's RCR strategy, which as noted by the Dean will be "a long and arduous task". In addition, a code of practice, among others, provides formalised procedures for data management, rules for authorship practices and specifications on responsible research behaviour.

During the policy-making process, several of the faculties have pointed to the necessity of developing a complementary set of faculty-specific guidelines to more adequately account for field-specific scientific cultures and practices. Health has already developed such guidelines and S&T and ARTS are currently in the process formulating similar documents. The school of Business and Social Science, however, has not found it necessary to further specify the pan-university rules and guidelines. So far, Health is the only faculty that has appointed a representative for the RCR advisory organ (Aarhus University, 2015e).

Table 14 Case study 05: Input level: RRI activity

	Local	**Institutional**
Policy stipulations	- Developing specified rules for authorship practice	- Developing specified rules for authorship practice - Developing formalised procedures for data-management - Developing a pan-university Code of Practice

Policy guidelines (Principles/standards)	- Developing faculty specific principles and standards for RCR	- Developing a Pan-university Policy on RCR
Preventive initiatives	- Providing educational training in RCR addressing both students, PhD-fellows and research faculty	
Advisory initiatives	- Establishing an advisory organ (faculty experts)	- Establishing an advisory organ
Restorative initiatives	- Establishing a Committee for Responsible Conduct of Research (local representatives)	- Establishing a Committee for Responsible Conduct of Research
Coordinating initiatives		- Establishing an Office of Research Integrity facilitating and supporting the work of the RCR committee and the advisory organ

5 Output and outcome level: impact and benefits

In this section, we illuminate and discuss the tangible and intangible outputs and outcomes fostered by AU's efforts to implement a new RCR strategy. More specifically, we rely on a conceptual distinction derived from the MoRRI project, defining **outputs** as the immediate or direct results of RCR related activities, and **outcomes** as the more long-term societal, economic and democratic benefits and achievements (MoRRI Proposal, 2014). Moreover, to account for the 'newness' of the policy-initiative, we operate with a distinction between the *immediate* and *expected* outputs. Finally, we distinguish between outputs at four levels of aggregation: *the individual level* (i.e. the individual researcher), *the local level* (i.e. the four university faculties), *the institutional level* (i.e. Aarhus University) and *the societal level* (i.e. the extra-organisational level). Table 15 (see page 81) provides an overview of the various forms of immediate and expected outputs/outcomes generated by AU's RCR strategy. In the following, we will account for each of the identified outputs/outcomes separately.

5.1 Awareness raising

As mentioned in the preceding section, all of the interviewees highlight 'awareness raising' as an immediate benefit of AU's RCR strategy. Two interviewees describe it thus:

> *As many have been pointing out from the beginning of this process, the discussion may be more important than the actual outcome… To raise awareness of the importance of dealing with such questions, if someone should've forgotten. And someone did forget, cf. Penkowa and other things. This, in itself, has been useful. (Pro-dean, S&T).*

> *The most important thing has actually been the process, rather than the final document. That we have sought to initiate a discussion of these issues in the research environments and at group meetings. That people address the topic and say: "Well, maybe we should repeat the experiment", right? (Pro-dean, Health).*

As illustrated by these quotes, the immediate outputs of the policy-making process, may far exceed the stipulations of the actual policy documents, by increasing the day-to-day discussions on RCR and hereby potentially improving the ethical climate and restoring demoralised competitors' adherence to 'the rules of the game' (i.e. the expected output). The strong policy-emphasis on establishing RCR-related training and education-programmes can be viewed as another immediate policy-output related to 'awareness-raising'. If successfully implemented, such programmes, as argued by the Dean of Health (see second quote p. 11), may come to serve as a reference for the construction of professional identity, by charting (and in the long run consolidating) an ethical course for new generations of academics both inside and outside the university (i.e. the expected output).

5.2 Clarification on practical issues

Another immediate output highlighted by the interviewees concerns the establishment of clearer and more systematised procedures for data handling and data storage, which as noted by the Dean of Health is of particular importance in the health-related fields:

> *In the health sciences there are many issues involving ethical aspects (…). The code of conduct will have implications for how we come to think about these issues in the future. Especially with respect to research that ensures the personal integrity of the patient. This is very, very important. (Dean, Health)*

As illustrated by the quote, formalised specifications on data-handling and data-storage not only serve as a mechanism for ensuring scientific transparency and accountability. They may at the same time bear crucial societal implications as to the question of maintaining the integrity and confidentiality of personal information in all aspects of 'human subject research' (i.e. the expected output).

5.3 Advisory bodies

A third RCR-related output concerns the appointment of an advisory organ consisting of four faculty experts providing confidential and professional guidance in cases of suspected breach of academic honesty (i.e. the immediate output). According to the interviewees, this organisational arrangement will when fully implemented make it easier for researchers to raise questions and concerns about RCR-related matters hereby becoming more actively involved in detecting and preventing scientific misconduct (i.e. the expected output).

5.4 Committee for responsible conduct of research

A fourth output highlighted by the interviewees relates to the establishment of a Committee for responsible conduct of research (i.e. immediate output) ensuring faster and more transparent procedures for handling allegations of scientific misconduct (i.e. the expected output). As described by both the Pro-dean and the Dean of Health, the combination of an advisory organ and an overseeing committee has created a fine-meshed net, which makes it easier to detect the few potential "fraudsters" of the organisation before things escalate (i.e. expected output).

5.5 Sustaining legitimacy and producing more

Finally, the interviewees highlight a few examples of the more long-term RCR related benefits and achievements (i.e. the outcomes). The first of these benefits concerns the university's legitimacy among its external constituencies. Two of the interviewees note:

> *I think that having an active policy (…) will heighten the university's integrity among citizens. Nothing is worse than taxpayers becoming suspicious of our activities and saying: "Hmm, they are fraudsters". We have to be cleaner than clean. That's just how it is. (Dean, Health)*

> *If the university makes an effort to clearly signal that "we have a policy" and also says "at Aarhus University we want to make sure that our contributions to society are based on honesty, credibility and transparency", we can win the trust of the people and make them think that it's a good idea to pay taxes for research and education. (Pro-dean, Health).*

Another expected outcome concerns the actual content and nature of the research conducted at the university. Referring to the aforementioned discussion on the increasing performance pressures on research staff (see p. 6), the Pro-dean of Health elaborates:

> *I mean... it is important that Danish citizens, who are supporting the universities with their taxes, are getting credible and valid research in return. At the same time… When your research is used by politicians, as is often the case within Health, then they'll need certainty that their prioritizations hold water (…). (Pro-dean, Health)*

Later in the interview, she further asserts:

> *It may be difficult to measure the direct impact on the research activities, other than increasing levels of discussion on the quality of our work, and that the quality of what actually comes out is heightened and that the results are more credible and if quantitative can be replicated.*

As illustrated by these quotes, the university's legitimacy (and to some extent also economic latitude in the form of tax money), seems contingent on the quality and credibility of its products (i.e. research and education). However, the underlying logic, here appears to be that not only the legitimacy of the university, but also its commitment and contribution to the

greater good, in the form of better education and research, will be slightly strengthened by making RCR a clear-cut institutional priority.[19]

Table 15 Case study 05: Output and outcome level: impact and benefits

	Individual	**Local**	**Institutional**	**Societal**
Immediate outputs	- Raising awareness / agenda setting via open discussion	- Raising awareness / agenda setting via open discussion - RCR education (pre- and postgraduate) - Clarification on practical issues (e.g. data-handling) - Specified mechanisms for "whistle-blowing" - Specified procedures for how to deal with cases of suspected breach of honesty	- Raising awareness / agenda setting via open discussion - RCR education (pre- and postgraduate) - Clarification on practical issues (e.g. data-handling) - Specified mechanisms for "whistle-blowing" - Specified procedures for how to deal with cases of suspected breach of honesty	- Raising awareness / agenda setting via open discussion
Expected outputs	- Improving the ethical environment -Change of attitudes as regards authorship practices and research integrity - Increased integrity in data-management/storage - Active	- Improving the ethical environment - Change of attitudes as regards authorship practices and research integrity - Increased integrity in data-management/storage - Detecting	- Improving the ethical environment - Change of attitudes as regards authorship practices and research integrity - Increased integrity in data-management/storage - Detecting	- Change of attitudes as regards authorship practices and research integrity - Increased integrity in data-management/storage

[19] We have not identified any tangible or intangible outcomes democratic and economic relevance of this RRI activity.

	participation in detecting and preventing misconduct	'fraudsters' before things escalate - Faster and more transparent case handling in cases of suspected breach of honesty	'fraudsters' before things escalate -Faster and more transparent case handling in cases of suspected breach of honesty	
Outcomes				- Sustaining legitimacy among constituencies (e.g. citizens and politicians) - More valid, reflective, qualified and credible research

6 Discussion

We have adopted a qualitative case-study approach drawing on expert-interviews with RCR policy-makers and a document analysis of RCR related policy statements, meeting minutes and organisational memorandums. Whereas critics have deemed the qualitative case-study inappropriate for impact assessments due to its lack of external validity and failure to yield formally generalizable results, proponents on the other hand argue that the key benefits of such an approach lies in its "ability to engage with complexity (…) and the detailed, in-depth understandings gained about events or initiatives over which the research has little or no control (Bell et al., 2011, p. 228; cf. Bornmann, 2011). In line with this argument, we consider the main contribution of this study to lie in its in-depth analysis of how institutional codes of responsible conduct of research (henceforth RCR) are implemented, how they function, and the tangible and intangible outputs and outcomes they may foster in one particular case, i.e. Aarhus University. This does, however, not mean that our findings may not be of relevance to other universities. As observed by Flyvbjerg (2011, p. 305), "knowledge may be transferable even where it is not formally generalizable."

Aarhus University's RCR policy, as mentioned in Section 1, is still quite new, which has made it difficult to directly measure (or predict) the more far-reaching and long-term outputs and outcomes of the initiative. A follow up study in a year or two, therefore represents a clear-cut opportunity to further investigate both the implementation success and the organisational and extra-organisational benefits and achievements fostered by AU's RCR strategy.

7 References

Literature

Aad, G., Abbott, B., Abdallah, J., Abdinov, O., Aben, R., Abolins, M., ... & Piqueras, D. Á. (2015). Combined Measurement of the Higgs Boson Mass in p p Collisions at s= 7 and 8 TeV with the ATLAS and CMS Experiments. *Physical Review Letters*, *114*(19), 191803.

Bell, S., Shaw, B., & Boaz, A. (2011). Real-world approaches to assessing the impact of environmental research on policy. *Research evaluation*, *20*(3), 227-237.

Bonekamp, S., Halappa, V. G., Corona-Villalobos, C. P., Mensa, M., Eng, J., Lewin, J. S., &

Kamel, I. R. (2012). Prevalence of honorary coauthorship in the American Journal of Roentgenology. *American journal of roentgenology*, *198*(6), 1247-1255.

Bell, S., Shaw, B., & Boaz, A. (2011). Real-world approaches to assessing the impact of environmental research on policy. *Research evaluation*, *20*(3), 227-237.

Bornmann, L. (2010). Mimicry in science? *Scientometrics*, *86*(1), 173-177.

Bornmann, L. (2012). Measuring the societal impact of research. *EMBO reports*, *13*(8), 673-676.

Brom, F. W., Chaturvedi, S., Ladikas, M., & Zhang, W. (2015). Institutionalizing Ethical Debates in Science, Technology and Innovation Policy: A Comparison of Europe, India and China. In *Science and Technology Governance and Ethics* (pp. 9-23). Springer International Publishing.

Callaway, E. (2011). Fraud investigation rocks Danish university. *Nature news. Publ Online doi*, *1038*.

Danish Ministry of Science (2014) *Danish code of conduct for research integrity.* Copenhagen: Danish Ministry of Science.

DiMaggio, P. J. (1988). Interest and agency in institutional theory. *Institutional patterns and organisations: Culture and environment*, *1*, 3-22.

Dobel, J. P. (1993). The Realpolitik of Ethics Codes: An Implementation Approach to Public Ethics, in H. George Frederickson (ed.), *Ethics and Public Administration* (pp. 158–171). M.E. Sharpe, New York.

EC (European Commission) (2012). *The Grand Challenge. The design and societal impact of Horizon 2020*. Luxembourg: Publications Office of the European Union.

Eisenberg, R. L., Ngo, L., Boiselle, P. M., & Bankier, A. A. (2011). Honorary authorship in radiologic research articles: assessment of frequency and associated factors. *Radiology*, *259*(2), 479-486.

Errami, M., & Garner, H. (2008). A tale of two citations. *Nature*, *451*(7177), 397-399.

Flyvbjerg, B. (2011). Case study. In N. K. Denzin, & Y. S. Licoln (Eds.), The Sage handbook of qualitative research, 4th Edition (pp. 301-316). Thousand Oaks, CA: Sage.

Nielsen, M. W. (2015). New and persistent gender equality challenges in academia. PhD dissertation, Aarhus University: Politica.

Martinson, B. C., Anderson, M. S., Crain, A. L., & de Vries, R. (2006). Scientists' perceptions of organisational justice and self-reported misbehaviors. *Journal of Empirical Research on Human Research Ethics*, 1(1), 51–66.

Merton, R. K. (1938). Social structure and anomie. *American sociological review*, *3*(5), 672-682

Meyer, J.P. and Herscovitch, L. 2001. 'Commitment in the workplace: towards a general model'. Human Resources Management Review, 11:3, 299–327.

Nielsen, M. W. (2015). New and persistent gender equality challenges in academia. PhD dissertation, Aarhus University: Politica.

Qiu, J. (2010). Publish or perish in China. The pressure to rack up publications in high-impact journals could encourage misconduct, some say. *Nature*, 463, 142–143.

Rezaee, Z., Elmore, R. C., & Szendi, J. Z. (2001). Ethical behavior in higher educational institutions: The role of the code of conduct. *Journal of business ethics*, *30*(2), 171-183.

Skandalakis JE, Mirilas P (2004) Plagiarism. *Arch Surg,* 139**,** 1022–1024

Steneck, N. H. (2007). *ORI: Introduction to the responsible conduct of research*. Government Printing Office.

Steen, R. G. (2010). Retractions in the scientific literature: is the incidence of research fraud increasing?. *Journal of medical ethics*, jme-2010.

Steen, R. G., Casadevall, A., & Fang, F. C. (2013). Why has the number of scientific retractions increased. *PloS one*, *8*(7), e68397.

Vasconcelos, S., Leta, J., Costa, L., Pinto, A., & Sorenson, M. M. (2009). Discussing plagiarism in Latin American science. *EMBO reports*, *10*(7), 677-682.

Whitley, R., & Gläser, J. (Eds.). (2008). *The changing governance of the sciences: The advent of research evaluation systems* (Vol. 26). Springer Science & Business Media.

Wislar, J. S., Flanagin, A., Fontanarosa, P. B., & DeAngelis, C. D. (2011). Honorary and ghost authorship in high impact biomedical journals: a cross sectional survey. *Bmj*, *343*.

Zieler, S., & Baggersgaad, C. (2015). Timeline: The Bente Klarlund Pedersen Case. *University Post.* Accessed 19 August 2015 http://universitypost.dk/article/timeline-bente-klarlund-pedersen-case

ESNA (2011) Bulletin N°101/102. Accessed 19 August 2015 http://www.esna-office.net/esna-bulletin_101_etn.pdf

Policy documents

Aarhus University (2015a) Responsible Research Practice at Aarhus University. http://www.au.dk/fileadmin/www.au.dk/forskning/Ansvarlig_forskningspraksis/Responsible_research_practice_at_Aarhus_Universitet_25_marts__2015_-_english.pdf

Aarhus University (2015b) Aarhus University's code of practice to ensure scientific integrity and responsible conduct of research at Aarhus University.
http://www.au.dk/fileadmin/www.au.dk/forskning/Ansvarlig_forskningspraksis/Aarhus_University_s_code_of_practice__25_marts_2015_english.pdf

Aarhus University (2015c) Standards for responsible conduct of research at Health.
http://www.au.dk/fileadmin/www.au.dk/forskning/Ansvarlig_forskningspraksis/Standarder_for_Ansvarlig_Forskningspraksis_ved_Health._Engelsk.pdf

Meeting minutes

Aarhus University (2013) Diskussionspapir [Discussion paper], October 2013.
http://www.au.dk/fileadmin/www.au.dk/forskning/Talentbaandets_Debatoplaeg_12-10-13_engelsk.pdf

Aarhus University (2014a) Diskussionspapir, høringssvar fra fakulteter og forums [Discussion paper, consultancy responses from the faculties and forums], February 2014 (pp. 1-43).
http://medarbejdere.au.dk/fileadmin/www.medarbejdere.au.dk/Strategi_og_ledelse/Talentbaandet/2014/Baand_Talent_materiale_200214.pdf

Aarhus University (2014b) Udkast til policy papir, høringssvar fra fakulteter og forums [Policy draft, consultancy responses from the faculties and forums], June 2014 (pp. 27-58).
http://medarbejdere.au.dk/fileadmin/www.medarbejdere.au.dk/Strategi_og_ledelse/Talentbaandet/2014/Baand_Talent_Materiale_1706141_01.pdf

Aarhus University (2014c) Forslag til procedure og rådgiverfunktion *(enhed for forskningsintegritet)* [Proposal for procedure and advisory function (Office of Research Integrity)].
http://www.au.dk/fileadmin/www.health.au.dk/Medarbejdere.health.au.dk/Ansvarlig_forskningspraksis/Bilag_2__Forslag_til_procedure_og_raadgiverfunktion_.pdf

Aarhus University (2015d). Universitetsledelsen, vedtagelse af fælles retningslinjer for forskningspraksis [The senior management team, decision of implementing the responsible research policy].
http://www.au.dk/fileadmin/www.au.dk/Moeder_i_Universitetsledelsen_2015/Konklusionsnoter_2015/Konklusionsnoter_fra_4._marts_2015.pdf

Aarhus University (2015e). BSS akademisk råd, fravalg af supplerende retningslinjer [BSS, Academic Council BSS, deselection of additional guidelines].
http://bss.au.dk/fileadmin/BSS/Profil/Akademisk_Raad_-_Referater/BSS_AR_godkendt_referat_150420_150422.pdf

Gender and affirmative action: Lessons Learned from the Danish Council for Independent Research

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1 Case abstract

This case study investigates the indirect benefits and potential spillover effects related to the use of moderate affirmative action instruments in the allocation of grants in research funding organisations. More specifically, it focuses on YDUN, which is a temporary funding programme implemented by the Danish Council for Independent Research (henceforth DFF) in 2014 to counter the persistent gender inequalities in the Danish research system. The programme allocated DKK 110 million (i.e. 10 percent of DFF's total funding budget for 2014) and privileged female applicants in cases where two or more research proposals were considered equally qualified for a research grant. To investigate the indirect benefits and potential spillovers of YDUN, we draw on a secondary dataset consisting of database information on DFF applicants and a survey questionnaire conducted one year after the YDUN application round. On the basis of a thorough assessment of the data, this paper finds that YDUN, at least to some extent, has generated indirect benefits and spillover effects by: **a)** encouraging a previously "untapped" pool of younger female researcher to formulate their own project proposals for the first time, and **b)** spurring increased shares of female scholars among the applicants competing for ordinary grants in DFF's subsequent funding period. On this background, we conclude that moderate AA-programmes may be instrumental in strengthening the research system's capacity "to harness talent and ideas wherever they exist" (European Commission 2013, p. 4).

Table 16 Case study 06: Case details

RRI dimension	RRI □	Citizen Participation □	Science Literacy □	Gender equality X
	Open Access □	R&I governance X	Ethics ≤	Other □
R&T field	Research funding organisation addressing academic institutions			
Country	Denmark			

2 Introduction

In 2014, the Danish Council for Independent Research (henceforth DFF) allocated DKK 110 million (10% of its total budget for 2014) for a moderate affirmative action (henceforth AA) programme under the acronym YDUN (Young Women Devoted to a University Career). The

programme, which aimed to counter the persistent gender inequalities in Danish academia, was based on the criteria that female applicants would be preferred in cases where two or more research proposals were deemed equally qualified for a research grant. In line with earlier AA programmes initiated by DFF, YDUN attracted far more female applicants than what is usually the case for the council's funding programmes. The main objective of this case-study is to investigate the indirect benefits and potential 'spillover effects' of YDUN with respect to **a)** encouraging new groups of female researchers to write-up their own project proposals for the first time and **b)** increasing the female share of applicants for grants under DFF's subsequent funding period. As elaborated in the following, it seems reasonable to expect that some of the "unsuccessful" proposals under the YDUN programme have since been revised and redirected towards DFF's ordinary programmes. Potentially, this may result in an increased representation of women among both applicants and grant-receivers in the subsequent DFF funding programmes (Nielsen 2014). By scrutinising these indirect "YDUN-effects", this case study deepens our understanding of the potential intangible-benefits of using AA tools in academic settings; benefits which have so far been omitted in the scholarship on AA and preferential treatment in academic settings.

3 Methodology and data

This case study draws on secondary data originally gathered by the consultancy group DAMVAD ANALYTICS (2015) on behalf of DFF in 2015 to illuminate the indirect benefits and potential spillover effects of adopting moderate affirmative action instruments in RFOs. The data-pool consists of register information on all candidates applying for research funding programmes similar to YDUN in the period 2009 to 2015 (the unique ID-numbers attached to each applicant has enabled an assessment of the applicants' application history prior to and after YDUN), and a survey questionnaire conducted one year after the YDUN application round, and in the wake of the programme's allocation of grants. 74 percent of the YDUN applicants completed the survey questionnaire.

The applicant data have been used to investigate the immediate outcomes of YDUN and whether the programme has triggered indirect benefits and spill-over effects in terms of new female applicant groups and a total increase in the share of female applicants under the ordinary DFF funding programmes allocated in June 2015. The survey-questionnaire supplements the applicant data by illuminating the short-term impacts and effects of the YDUN programme on applicant behaviour and motivation.

A methodological reservation related to the use of the DAMVAD ANALYTICS data concerns the registration of first-time applicants for the DFF funds. The baseline for indexing first-time applicants in the applicant database has been set to 2009. This implies that researchers applying for a DFF programme prior to this year are registered as first-time applicants irrespective of their past application record. This may potentially result in a systematic

overestimation of the group of first-time applicants, since applicants from 2010 can only be tracked one year back and so forth. DAMVAD ANALYTICS has attempted to overcome this source of error by only comparing with the years from 2012 and onwards, when illuminating patterns related to first-time applicants.

4 Input level: RRI activity

As stated in DFF's call for YDUN, the funding scheme has been "designed to strengthen talent utilization in Danish research by promoting a more equal gender composition of research in Denmark" (DFF 2013). The programme is prompted by an organisational phenomenon often referred to as the "leaky pipeline" in Danish academia. This phenomenon denominates the fact that a disproportionate share of early-career female researchers are "dropping out" of Danish universities before reaching the highest academic ranks. In 2013, the total share of female researchers in positions equivalent to associate and full professorships amounted to 31 percent and 19 percent; and this is despite the fact that women have accounted for the majority of the Danish Master degree recipients since the late 1990s (Nielsen, 2015, pp. 142-43; Staahle, 2013, p. 7). This, according to the former Minister of Higher Education and Science and the Head of DFF, implies that a considerable pool of academic talent remains underutilised, and YDUN has been framed as an instrument for tapping into this neglected potential (Christiansen & Nielsen 2014).

DFF is a national research council located under the Danish Ministry of Higher Education and Science, which "funds specific research activities within all scientific areas that are based on the researchers' own initiatives and that improve the quality and internationalisation of Danish research."[20] Based on a judicial dispensation from the Danish Equality Act, and with broad parliamentary support, the council in 2014 implemented the YDUN programme. This programme invited both male and female scholars in positions equivalent to postdoc and associate professor level to apply for research funding for managing their own project. The programme was based on the principle of moderate affirmative action, meaning that female candidates were preferred in cases where two or more applicants were considered equally qualified for a research grant. The maximum funding per project was DKK 4.5 million, and the maximum project period extended to four years.

The YDUN programme's immediate implementation success rests on its ability to encourage a larger share of women to take part in the competition for DFF grants, which may potentially also

[20] http://ufm.dk/en/research-and-innovation/councils-and-commissions/the-danish-council-for-independent-research

reflect in the female share of grant recipients. Moreover, a less tangible outcome of the programme concerns its indirect benefits and potential spillover effects in the form of **a)** new groups of early-career female researchers with no previous application history formulating their own DFF project proposals (i.e. the indirect benefit), and **b)** more female applicants applying for DFF's ordinary programmes in the subsequent funding period (i.e. the spillover effect). In this regard, it is also relevant to account for the potential adverse effects resulting from the low success rates of the YDUN programme. In the following section, we assess and discuss each of these issues separately.

5 Output and outcome level: impact and benefits

5.1 Immediate implementation success

As mentioned above, YDUN's primary tangible output concerns its immediate impact on the gender compositions of applicants and grant-receivers. From a total of 542 YDUN applicants, 516 (95 percent) were female and 26 (5 percent) were male. Of the 542 applicants, 17 received grants, equalling an overall a success rate of 3 percent. In comparison, the average success rate for research leaders applying under DFF's ordinary funding programmes in 2013 was 19%. All of the 17 grant recipients are women.

5.2 First-time applicants (indirect benefits)

Another relevant query for assessment concerns whether the YDUN programme has encouraged a relatively larger share of first-time female applicants to apply for DFF grants than what is usually the case under DFF's ordinary funding programmes. DAMVAD ANALYTICS finds that the female share of first-time applicants under the YDUN programme amounts to 57 percent of the overall applicant-pool. In comparison, this group of applicants comprises merely 42, 40, and 36 percent of the PI's directing proposals at comparable funding programmes in the period 2012 to 2014, before YDUN. This amounts to a relative increase of 46 percent compared to the average share for the preceding years (2012-2014), indicating that YDUN has been successful in encouraging an "untapped" pool of early-career researchers to formulate their own project proposals for the first time. This presumption is further supported by the finding that 21 percent of the Principal Investigators (henceforth PI) applying for YDUN grants have no preceding DFF application history, neither as PI's nor co-applicants. Likewise, the DAMVAD ANALYTICS data reveals that the average age of the female applicants under the YDUN programme was 4.6 years lower than the average age for female applicants under DFF's ordinary programmes in the period 2009-2014.

5.3 Female share of applicants for the subsequent funding period (spillover benefits)

The third query for assessment concerns the extent to which YDUN has affected the gender composition of applicants for comparable funds in the subsequent round of DFF programmes, i.e. funds allocated during the spring/summer 2015. According to DAMVAD ANALYTICS, the share of female applicants for this period considerably exceeds the average share of women applying for comparable grants in the period 2009 to 2014. More specifically, the overall share of female applicants for the five comparable funding programmes has increased by 6 percentage points from an average of 24 in the period 2009-2014 to 30 percent in 2015 after YDUN, equalling a relative increase of 25 percent. Similar (although slightly smaller) fluctuations have, however, been evident prior to the YDUN programme. From 2012 to 2013, the share of female applicants increased from 22 to 26 percent, i.e. a relative increase of 18 percent. Thus, assessing the actual impact of YDUN on the basis of these data is neither clear-cut nor simple. It is, however, clear that a rise to 26 percent in 2013 only marginally exceeds the past seven years' average of 24 percent, whereas a rise to a total of 30 percent in 2015 appears more striking.

5.4 Motivation and demotivation of non-recipients

The final query for assessment concerns the motivational side effects of the YDUN programme. When asked about their motivations for applying for YDUN, 75 percent of the respondents, according to DAMVAD ANALYTICS's survey analysis, declare that they were attracted by the brand and the nature of the programme, i.e. programme's purpose of giving younger female researchers "a head start". Likewise, 64 percent expressed that the programme's prioritization of women in cases of two or more equally qualified proposals affected their motivation. These results, combined with the enormous interest in YDUN (i.e. the extensive pool of applicants), further substantiates the programme's success in motivating a larger share of female researchers to engage in the competition for research grants. In this sense, the YDUN-case constitutes an interesting empirical example lending support to the experimental work by Niederle et al. (2009) and Balafoutas & Sutter (2010) showing that moderate AA instruments incentivise a larger pool of female candidates to engage in competition with their male competitors than what would otherwise be the case. However, contrary to the findings of these studies[21], very few male scholars applied for grants under YDUN, which may be explained by the

[21] According to the experimental work by Balafoutas & Sutter (2010), the use of moderate AA-tools does not affect male competitors' willingness to take part in the competition.

initial framing of the programme as an instrument aimed at strengthening the "talent utilization in Danish research by promoting a more equal gender composition".

As regards negative motivational side effects, 24 percent of the unsuccessful applicants declare that their motivation for pursuing a research career has been lowered by the programme. Moreover, 61 percent of the non-recipients also to some extent disagree with the statement that YDUN has encouraged them to apply for DFF's ordinary grants and other private or public research funds/councils. These adverse motivational effects should be interpreted in light of the distinctively low success rates of the programme and the comprehensive efforts involved in preparing the proposals, which can be highlighted as the main downside of the programme.

Against the backdrop of these findings it seems reasonable to assume that YDUN, in addition to its immediate impact on the career opportunities of the 17 women researchers receiving grants, at least to some extent has generated indirect benefits and spillover effects by: **a)** encouraging a previously "untapped" pool of younger female researchers to formulate their own project proposals for the first time, and **b)** spurring increased shares of female scholars among the applicants competing for grants under DFF's ordinary programmes. As stated in the introduction of Horizon 2020's work programme (2014-2015), the "strength of the European science and technology system depends on its capacity to harness talent and ideas from wherever they exist", and AA-driven instruments such as YDUN, may as illustrated by this study be instrumental in building such a capacity. This may not only help to increase the female representation at the upper ranks of the academic profession. It may at the same time lead to a more diverse and gender-responsible scientific knowledge production that is better suited for dealing with the grand societal challenges of our time (EU 2013).

6 Discussion

Drawing on secondary data originally gathered by the consulting group DAMVAD ANALYTICS, this study has provided insights on the immediate and potential spillover effects of the moderate AA funding instrument YDUN. As mentioned earlier, an important caveat of the DAMVAD ANALYTICS data concerns the selection of 2009 as the baseline for indexing first-time applicants in the applicant database, which may have resulted in a systematic overestimation of the group of first-time applicants in the database. In practice, this means that the actual difference between the group of first-time applicants under YDUN and the preceding years' ordinary funding programmes may exceed the relative increase of 46 percent identified by DAMVAD ANALYTICS. Moreover, annual fluctuations in the applicant pool make it difficult to draw any clear-cut conclusion on the strength of the presumed causal link between YDUN and the increased share of female applicants for DFF's ordinary research programmes in 2015. Irrespective of these caveats, the DAMVAD ANALYTICS study makes a quite convincing case for the indirect and potential spillover benefits resulting from the use of AA instruments in competitive research funding. An ideal next step would be to illuminate the potential impact of

YDUN on the actual share of female grant recipients for the spring/summer period in 2015 compared to earlier funding periods. Likewise, a bibliometric study illuminating the "added-value" of the programme in terms of increasing the cognitive diversity (i.e. increased variation in the approaches that researchers employ and the span of areas in which they work) in the applicant pool, seems highly relevant.

7 References

Christiansen, P. M., and Nielsen, S. C. (2014). Der er for få kvinder i toppen af dansk forskning [There are too few women in the top of Danish research]. *Information* [Danish newspaper], April 22, 2014. Accessed August 28, 2015. http://www.information.dk/494923

DAMVAD ANALYTICS (2015). Undersøgelse af YDUN-programmes kortsigtede effekter og betydning [Exploration of the short-term impact and consequences of the YDUN programme] (01/12/2015). Published by the Danish Council for Independent Research, Danish Agency for Science, Technology and Innovation, ISBN: 978-87-93151-82-6NB.

DFF [The Danish council for Independent Research] (2013). *Call for proposals: Autumn 2013* and Spring 2014 + YDUN. Accessed August 28, 2015. http://ufm.dk/en/research-and-innovation/funding-programmes-for-research-and-innovation/calls/2013/dff-call-for-proposals-a2013-adn-s2014

European Commission (2013). Horizon 2020*: Work Programme 2014-2015 - 16. Science with and for society*. Accessed August 28, 2015. https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-swfs_en.pdf

Nielsen, M. W. (2014). YDUN-programmet: Kønsdiskrimination eller frigørelse af forskningspotentiale? [The YDUN programme: Gender discrimination or utilizing the research potential?],Videnskab.dk, October 11, 2014. Accessed February 3, 2015: http://videnskab.dk/kultur-samfund/ydun-programmet-godhjertetdiskrimination-eller-frigorelse-af-forsknings-potentialet

Nielsen, M. W. (2015). *New and persistent gender equality challenges in academia.* PhD dissertation, the Danish Centre for Studies in Research and Research Policy, Department of Political Science, Aarhus University: Politica.

Ståhle, B. (2014). *Videnskabeligt personale på universiteterne 2013* [Scientific staff at the Danish Universities]. Copenhagen, Denmark: Styrelsen for Videregående Uddannelser. Accessed February 18, 2015: http://ufm.dk/forskning-og-innovation/statistik-og-analyser/forskereved-universiteterne/videnskabeligt-personale-pa-universiteterne-2013-statistiknotat-1.pdf

Research Council of Norway

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1 Case abstract

This case focuses on the RRI activities of the Research Council of Norway (RCN). The RCN is a national strategic and funding agency for research activities, and a chief source of advice on and input into research policy for the Norwegian government, the central government administration and the overall research community.

The case relied on two approaches to data collection. First, desk research was done. In particular, documentation made available by the RCN itself was scrutinised. In particular, policy and strategy documents proved useful. Second, interviews were conducted with those involved in RRI in Norwegian research. Interviewees included a range of stakeholders – RCN employees as well as those tied to the RCN as grant recipients.

In the MoRRI project's understanding of RRI as defined by the EU (5 keys), the RCN was very active. RCN approaches to gender perspectives, ethics and to open access are particularly extensive. However, in the opinion of employees of the Council itself, the project's definition of RRI – which applies the EC DG RTD's understanding of RRI – is limiting the potential of RRI. There is considerable Norwegian experience and expertise in many of these areas. For example, there is a long-standing tradition of research ethics in Norway, including well-established national research ethics committees (e.g., the National Committee for Medical and Health Research Ethics (NEM) and the National Committee for Research Ethics in Science and Technology (NENT) which serve as important locations for oversight. Moreover, there is also a small but internationally well-connected and experienced ELSA[22] community, which has been supported through the RCN's ELSA programmes since 2002. In addition, Norway has long-standing experience in technology assessment, stakeholder engagement and associated specific methodologies at the Norwegian Board of Technology.

For the interviewed, RRI essentially represents an embedded approach, and as such a broader, more inclusive discussion concerning future impacts, implications and interactions in society under conditions of uncertainty and ambiguity. In essence, RRI in the RCN's understanding is about changing scientific cultures.

[22] Acronym for research addressing and anticipating the Ethical, Legal, and Social Aspects of emerging science and technology.

Relating to the outcome of 'traditional' RRI activity, data was sparse. Data did not appear to have been made publicly available. In relation to the outcome of RRI activity designed to change the culture of science, data was equally sparse. However, anecdotal evidence suggests the Council's RRI activities have had an impact on specific scientific culture.

Table 17 Case study 07: Case details

RRI dimension	RRI X	Citizen Participation □	Science Literacy □	Gender equality X
	Open Access X	R&I governance X	Ethics X	Other X
R&T field	Funding Council Promotion of RRI			
Country	Norway			

2 Introduction

This case revolves around activities of the Research Council of Norway (RCN) related to RRI. The RCN is a national strategic and funding agency for research activities, and a chief source of advice on and input into research policy for the Norwegian Government, the central government administration and the overall research community. An important objective is to ensure that Norway adequately invests in research and innovation (R&I) activities.

Its primary responsibilities are awarding grants for and promoting scientific research in all disciplines and innovation activities. The RCN has a supplemental role in advising the Norwegian government on matters relating to scientific R&I activities.[23]

The main object of analysis in this case study is the RCN. However, as the main function of the Council is to distribute research money among researchers, organisations applying for grants, as well as those already involved in projects receiving grants, might be regarded as additional sources of information about the RCN and its RRI activities. In terms of the results of funded research, the Norwegian government, as well as Norwegian society as a whole also should be regarded as important stakeholders.

[23] See http://www.forskningsradet.no/en/Vision__mandate/1138785841810 (last consulted 25.08.2016).

The case focuses on the RCN as an institution engaged in shaping and directing R&I activities. Accordingly, rather than focusing on one specific activity or instrument used to achieve RRI, the case looks at the spectrum of RRI-related activities undertaken by the Council.

Looking at RCN is particularly relevant in relation to RRI in Europe. Norway has traditionally been a frontrunner in questions of technology assessment, ELSA research and the societal dimensions of R&I. The RRI initiatives in Norway are building on those efforts. The RCN, being the main institution responsible for awarding public research grants and promoting scientific research and innovation in Norway, thus plays a central role in integrating RRI into Norwegian science and innovation activities.

3 Methodology and data

The methodology of data collection in this case study was dual. Initially, desk research was done. Primary sources from the RCN itself – such as policy and strategy documents – were heavily relied upon. Second, interviews were conducted with those involved in RRI in Norwegian research. Interviewees included representatives of the council itself as well as representatives of external institutes with close connections to the council – for example institutions receiving council grants.

Measuring the impact of RRI activity proved to be particularly difficult in this case. In the first instance, there appear to be very few resources available documenting and quantifying RRI output. In turn, as will be explained later, conceptions of RRI followed by the RCN differed from the European Commission's current understanding. The definition employed by the Commission was regarded as overly narrow and procedural. One interviewee suggested that the definition was even somewhat artificial as opposed to being in line with state-of-the-art scholarly understandings of RRI. This novel concept of RRI is not easily reduced to a specific set of factors, which can be measured in a given instance, as was stated frequently by interviewees. This is also reflected in the report by the EU in the expert group report "Indicators for promoting and monitoring RRI" (Expert Group on Policy Indicators for Responsible Research and Innovation 2014). In 2014, this expert group was set up to design and select possible indicators for RRI as well as evaluating existing RRI-like indicators. The report recommends a network approach to indicators. Roger Strand, chair of the expert group, stated that "[i]f RRI is to be assessed by a standard "package" of numerical indicators, it is likely to lose its transformative potential and degrade into bureaucratic rituals. Instead, the choice of evaluation scheme, including the choice of indicators, of any given RRI policy or practice should in itself be a process of good governance that includes the relevant stakeholders in lively and real discussion." (Strand 2015).

Whilst we have no reason to doubt the validity of the data, it should be observed that using the approach laid out in the case study template was difficult to follow. The template design was rooted in the general set-up of the MoRRI project, which is in turn strongly influenced by a

specific understanding of RRI. Given that interviewees differed from the project's understanding in their interpretation of RRI, many questioned the validity and approach of the template in evaluating their activities. This was particularly true in relation to the output of RRI activity.

4 RRI activity and input

The RCN has an excellent track record in relation to each of the six keys around which the European Commission's definition of RRI revolves.[24] Thus, attempting to provide a concise overview and a balanced account of all these activities, would reach beyond the possibilities of this case study. Instead, the main focus of the case lies on the council's well-developed understanding of RRI related to research in the field of enabling technologies - ICT, biotechnology and nanotechnology. The RCN views RRI as a process of cultural change, defined by promoting anticipation, reflexion, inclusion and responding accordingly, and, where possible, on identifying related impacts.

4.1 Specific understanding of RRI in the Norwegian context

The interviewees observed that, despite the progressive and extensive approach Norway had taken, and the care and attention, which had been paid to setting up an institutional landscape in which ethics and the societal dimensions of science are taken into account in research – including the above activities – they perceived there still to be shortfalls. First, interviewees observed that the practical impact of traditional ethical and societal dimension activities could often be minimal. For example, the early – 2000-2005 – ELSA programmes were criticised for funding ELSA work, which was too remote from scientific practice. The link between ELSA researchers and natural scientists was seen to be far too limited.

Second, interviewees observed that procedures and rules put in place have, by and large, failed to address fundamental issues related to the culture of research and the approach of researchers. This is particularly true in dealing with technological advance, and the increasing complexity of the grand societal challenges scientific research attempts to address. This is also true as researchers and scientists have hitherto not seen themselves as integral in the problems they are researching – the research complex itself is implicated in grand societal challenges. The citizen scientist perspective is thus back in focus. "As science becomes more socially important

[24] For evidence of this see, for example, Research Council internal policy documents such as: Research for Innovation and Sustainability: Strategy for the Research Council of Norway 2015–2020 (2015); Gender balance and gender perspectives in research and innovation: Policy for the Research Council of Norway 2013-2017 (2013); Access to Research Data: Policy for the Research Council of Norway (2014a); Work Programme 2013-2017: Gender balance in senior positions and research management (2014b); The Research Council's Principles for Open Access to Scientific Publications (2014c).

and asks bigger questions of policy, politics and society, we must find ways to connect it with civil society. As part of building what some have called a 'new social contract for science', we need to ask how scientists can be empowered to act as citizens." (Stilgoe 2004: 15)

Accordingly, the RCN – in particular the Division of Innovation – have been looking for alternative approaches to operationalise societal responsibility in research. As opposed to a procedural and goal based approach – for example setting up mechanisms to achieve gender equality in science – RRI, in the understanding of the interviewees, must go further.[25] To them, RRI relates to a need to look much more closely at who is involved in science and scientific research, which research questions are asked and asking what science and technology can bring to the world. The interviewees considered RRI as a break with the mechanisms and institutions, which have hitherto been relied on. In the understanding of the interviewees, RRI focuses on changing the culture and approach of research from bottom-up – through education and an alteration in the process of science. One of the external interviewees observed that this understanding and approach to RRI is much closer to state-of-the-art RRI scholarship than other, more procedural understandings of RRI.

Following discussions, both internally and in collaboration with other institutions – particularly with the UK EPSRC – the council have come up with four key concepts on which their understanding of RRI sits: Anticipation; Reflexivity, Inclusion and Responsiveness.

RRI thus represents an embedded approach, and as such a broader, more inclusive discussion concerning future impacts, implications and interactions in society under conditions of uncertainty and ambiguity.

Anticipatory – describing and analysing those intended and potentially unintended impacts that might arise, be they economic, social, environmental or otherwise. Supported by methodologies that include those of foresight, technology assessment and scenario development, these not only serve to articulate promissory narratives of expectation but to explore other pathways to other impacts, to prompt scientists and innovators to ask 'what if?' and 'what else might it do?' questions.

[25]One interviewee succinctly expressed this - and indeed a divergence between the Commission's and the Research Council's understanding of RRI - as follows: 'The RRI-storyline as presented by the Commission in the transition from FP7 to Horizon 2020, is a contested one. The evidence base or arguments for claiming that taken together the so-called 5-6 RRI-keys or themes will produce RRI, has been questioned. The underlying diagnostics and the implicit assumptions concerning the relationship between science, technology, innovation and society, have not been made explicit and opened up for discussion.

In our RRI-engagement we acknowledge (as a starting point) that co-evolutionary or integrated models may be more adequate for an increasingly larger proportion of research and innovation activities.

We find that researchers and their institutions are not adequately prepared to enter into partnerships with other societal actors. Outreach activities thus have to be supplemented with an equally strong focus on "inreach" in order to enhance the research community's capacities to invite and sustain more productive interactions with other societal actors.'

Reflective – reflecting on underlying purposes, motivations and potential impacts, what is known (including those areas of regulation, ethical review or other forms of governance that may exist) and what is not known; associated uncertainties, risks, areas of ignorance, assumptions, questions and dilemmas.

Deliberative – inclusively *opening up* visions, purposes, questions and dilemmas to broad, collective deliberation through processes of dialogue, engagement and debate, inviting and listening to wider perspectives from publics and diverse stakeholders. This allows the introduction of a broad range of perspectives to reframe issues and the identification of areas of potential contestation.

Responsive – using this collective process of reflexivity to both set the direction and influence the subsequent trajectory and pace of innovation, through effective mechanisms of participatory and anticipatory governance. This should be an iterative, inclusive and open process of adaptive learning, with dynamic capability.

In this regard, the interviewees referred particularly to an entrenched culture in science of a silo mentality. Scientists are used to perceive themselves as experts in a given field and as a result, can be dismissive of the significance of external perspectives. RRI is an attempt to break this mode of thinking, to move scientists and researchers from their comfort zones, to make them understand other perspectives and how they need these perspectives to understand and address the societal challenges they work on. The interviewees observed that more established researchers found it harder to immerse themselves in an RRI culture, PhD students and early stage researchers found this much easier.

In practice, therefore, RRI accompanies research from beginning to end and constitutes the culture and mindset of research – as opposed to achieving one or the other concrete goal. It demands anticipation, reflection and inclusion both in the process of finding research questions, in developing a research project and in the final process of doing research.

5 Output and outcome level: impact and benefits

In relation to the output and outcome levels of RRI activities mentioned in section 3, our research produced relatively little tangible information. The RCN have specifically stated in policy documents that RRI activities would be monitored and reported upon. For example, the 'Gender balance and gender perspectives in research and innovation: Policy for the Research Council of Norway 2013-2017' position paper states the Council will 'include analysis of gender perspectives in the Research Council's annual reports (Research Council of Norway 2013, p. 11). In turn, one would presume that information on other RRI activities – for example, the number of open access articles published as a result of Council funding – would have been collected.

However, this information is not readily available in accessible Council documentation. While there are many evaluation reports available on the Council's website, these do not seem to

contain RRI specific information. On the one hand, there are a number of discipline-specific evaluations, whose focus is not the RRI activity – although RRI activity constitutes a part of the research in question.[26] On the other hand, the annual reports are available in English only up to 2008.[27] Reports from the council's executive board are available up to 2012.[28] However, their focus on RRI activities is very limited. For example, in the 2012 report, only one paragraph is devoted to gender perspectives and includes no quantitative information such as data about gender equality in senior positions (Research Council of Norway 2012, p. 9).

In relation to the RRI activities mentioned in section 3, a similar lack of quantified information pertains, but for different reasons.

First, the interviewees were very clear that a cultural change – such as they understood being the aim of RRI – is very difficult to proceduralise and eventually quantify. It is not the case that there is simply a checklist that can be filled out in order to ensure that the goals of RRI are met. Nor is it the case that an approach to RRI in one project, will transfer across to other projects. The interviewees observed that RRI action must be situated and contextualised. It must be operationalised differently in relation to different calls and in relation to different technology programmes. Without being able to specify constant mechanisms, products or goals related to this type of RRI, it is currently difficult to quantify its output.

Second, from the perspective of the Council this conceptualization of, and approach to, RRI is novel. With the novelty of the approach, information on concrete outcomes is not yet available.

However, interviewees did offer certain anecdotal evidence related to the impact of RRI – both positive and negative.

On the one hand, it was observed that the impact of RRI activity has been somewhat diluted by a lack of precision related to defining RRI principles and goals. This was attributed to the different understandings of RRI across programmes. Factors contributing to this fractured understanding were the differing loyalties, connections and disciplinary backgrounds of those implementing RRI.

On the other hand, however, interviewees observed a series of positive impacts as a result of RRI activity to date. First, they suggested that RRI activities had been effectual in changing the scientific culture. Two reasons were offered for this. 1. RRI thinking has been integrated into some of the larger funding calls (bio- and nanotechnology calls related to the Division of

[26] See http://www.forskningsradet.no/en/Page/1233557971734 (last consulted 25.08.2016).

[27] See http://www.forskningsradet.no/en/Annual_reports/1138785841818 (last consulted 25.08.2016).

[28] See http://www.forskningsradet.no/en/Annual_reports/1138785841818 (last consulted 25.08.2016).

Innovation, for example.) As a result of these big calls, many of the top Norwegian scientists have become acquainted with an RRI oriented working approach. 2. As adhering to RRI principles has, in a number of cases, become a prerequisite to successful grant applications, researchers have begun to learn and adapt their approach to RRI. This in turn has had an effect on how scientific projects are conducted. Anecdotal experience from the NORZYMED project[29] was offered as an example of the above. The use of biodiversity in Norway to isolate enzymes, which might help in waste management, raised a number of legal aspects related to access and benefit sharing. The integrated approach of the project demanded that those working on the legal aspects interfaced with the natural scientists working on enzyme development. The interviewee involved in the project observed a change in the culture of project meetings as a result of this integrated approach. They also observed that, as a result of RRI, each set of stakeholders had a different approach to their lines of questioning and to research and that each set of stakeholders found the interaction highly useful.

Second, they suggested that, as a result of RRI activities to date, RRI thinking was becoming ever more prominent as a feature of the Norwegian research landscape. On the one hand, strong signs for the prominence of RRI can be seen in new policy documents related to the traditionally RRI-strong fields of bio- and nanotechnology. For example, the 'Digital Life – Convergence for Innovation' strategic initiative insists on RRI as a foundational building block for all activity (Research Council of Norway 2014d).[30] On the other hand, whilst much previous discussion of RRI had focussed on the Division of Innovation's biotech and nanotech activities, interviewees observed that RRI has also begun to 'infect' other calls and activities. Current and future ICT calls will now also be run on RRI principles. In turn, the new SAMANSVAR programme[31] aims to engage a broad range of other programmes with RRI ideas and activities. The SAMANSVAR initiative is interesting as, as opposed to embedding RRI activity within a project, it sets up a programme through which RRI thinking can be integrated into external projects and initiatives.

6 Discussion

We have no reason to doubt the validity of the data gathered in this case. The interviewees are close to the institution and the subject matter and all other sources came from the council itself.

[29] See https://norzymed.nmbu.no/ (last consulted 09.09.2016)

[30] Digital Life is used in the document as a synonym for synthetic biology.

[31] See http://www.forskningsradet.no/prognett-samansvar/Home_page/1254002580879 (last consulted 09.09.2016

However, there was a great deal of difficulty in finding quantified information about results and impacts of the different RRI-related activities the RCN has initiated. Public information in English from the council was limited – this is not to say it is not internally available. Other more novel RRI approaches were hard to quantify. Both as a result of type of activity and novelty of activity. Of course, given both the characteristics of the complex transformations aimed at (such as a culture change in the way research is conducted) and the time needed until such changes become institutionalised, this is not surprising.

As a result, it was difficult to identify clear causal links between RRI activities and outcomes. Nevertheless, the anecdotal evidence provided by interviewees draws a compelling picture that RRI activities were having the intended positive effect – particularly in terms of changing the culture of science.

Based on the experiences made with this case study, in terms of future case study design in the MoRRI project, we recommend increasing the sensitivity towards the contexts of the selected cases. It cannot be taken for granted that the specific notion of RRI as it is currently promoted by DG RTD is broadly shared. Without being open and responsive to the dynamic and diverse development of de facto RRI across Europe, the MoRRI project runs the risk of overlooking relevant developments and informative insights into benefits and possible drawbacks of practicing RRI. With regard to potential cases for the third round, it might be worthwhile to collect examples of anecdotal, tentative evidence for RRI impact and commission a set of cases revisiting the second round cases, thereby putting a focus on validating and/or falsifying the initial anecdotal findings.

7 References

Interviewees

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Elisabeth Gulbrandsen, Research Council of Norway

Tobias Bade Strøm, Research Council of Norway

Roger Strand, University of Bergen

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References

Expert Group on Policy Indicators for Responsible Research and Innovation (2015): Indicators for promoting and monitoring Responsible Research and Innovation. European Commission, DG RTD, Brussels. Available at: http://ec.europa.eu/research/swafs/pdf/pub_rri/rri_indicators_final_version.pdf

Research Council of Norway (2012), Report of the Executive Board for 2012. Available at: http://www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3D%22ADMHS-beretning2012engCBE20130909.pdf%22&blobkey=id&blobtable=MungoBlobs&blobwhere=1274505376618&ssbinary=true

Research Council of Norway (2013), Gender balance and gender perspectives in research and innovation: Policy for the Research Council of Norway 2013-2017. Available at: http://www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3D%229788212033030%2C0.pdf%22&blobkey=id&blobtable=MungoBlobs&blobwhere=1274505375883&ssbinary=true

Research Council of Norway (2014a), Open Access to Research Data: Policy for the Research Council of Norway. Available at: http://www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3D%22RCNPolicyOpenDataENGv2.pdf%22&blobkey=id&blobtable=MungoBlobs&blobwhere=1274506615740&ssbinary=true

Research Council of Norway (2014b), Work Programme 2013-2017: Gender balance in senior positions and research management. Available at: http://www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3D%22BALANSEProgrammeplanengelsk.pdf%22&blobkey=id&blobtable=MungoBlobs&blobwhere=1274505441500&ssbinary=true

Research Council of Norway (2014c), The Research Council's Principles for Open Access to Scientific Publications. Available at: http://www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3D%22RCNpolicyOpenAccess.pdf%22&blobkey=id&blobtable=MungoBlobs&blobwhere=1274506495121&ssbinary=true

Research Council of Norway (2014c), Strategic Initiative: Digital Life – Convergence for Innovation. Available at: http://www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3D%22DigitalLife-astrategicinitiativeinBIOTEK2021.pdf%22&blobkey=id&blobtable=MungoBlobs&blobwhere=1274505535983&ssbinary=true

Research Council of Norway (2015), Research for Innovation and Sustainability: Strategy for the Research Council of Norway 2015–2020. Available at: http://www.forskningsradet.no/servlet/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition%3A&blobheadervalue1=+attachment%3B+filename%3D%22FRhovedstrategiwebengelsk%2C0.pdf%22&blobkey=id&blobtable=MungoBlobs&blobwhere=1274506843175&ssbinary=true

Stilgoe, Jack (2004), Citizen scientist. Reconnecting science with civil society, Demos. Available at: http://www.demos.co.uk/files/Citizen_Scientists_-_web.pdf

Strand, Roger (2015): Indicators for promoting and monitoring RRI, University of Bergen, 01.07.2015. Available at http://www.uib.no/en/svt/89949/indicators-promoting-and-monitoring-rri

Austrian Agency for Research Integrity (OeAWI) – Research Integrity Workshops

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1 Case abstract

The *Austrian Agency for Research Integrity (OeAWI)* is a cross-institutional organisation dealing with research integrity and scientific misconduct in Austria. It offers several services: preventive consultation about RI and mediation between conflicting parties, preventive RI workshops or other events at member institutions, and an independent RI commission that investigates alleged cases of scientific misconduct. The focus of this case study lies on the RI workshops.

In order to get information and insight from several actor groups involved in or affected by the workshops, six qualitative interviews were conducted with two representatives from the OeAWI and four interview partners (programme coordinator, research group leader, PhD students) from a joint PhD programme at a biomedical research campus, which includes mandatory research integrity workshops. Additionally, the OeAWI provided a list of RI events held in a teaching context (lectures, workshops, seminars) including an approximate number of participants.

Positive effects of the OeAWI and the RI workshops can be seen on several levels: a high demand of the workshops being held at member institutions; the OeAWI in general and the RI workshops in particular as model for other European states; a very positive evaluation of the RI workshops by a PhD programme coordinator, a research group leader and by participating PhD students; a general evaluation of RI being an important topic by all interview partners.

In order to systematically identify the impacts and benefits of the RI workshops in different areas, an accompanying evaluation, including a comprehensive collection of data (baseline, after workshops) and consideration of a longer time horizon is necessary.

Table 18 Case study 08: Case details

RRI dimension	RRI ☐	Citizen Participation ☐	Science Literacy ☐	Gender equality ☐
	Open Access ☐	R&I governance x	Ethics x	Other ☐
R&T field	Science and research			
Country	Austria			

2 Introduction

The Austrian Agency for Research Integrity (OeAWI - Österreichische Agentur für wissenschaftliche Integrität) is a non-governmental organisation dealing with good scientific practice and scientific misconduct. It investigates cases of alleged misconduct, holds preventive workshops or lectures and offers advice and consultation concerning this topic.

The OeAWI was founded in late 2008 and is organised as a registered association of currently 38 member institutions, comprising Austrian public and private universities and research organisations (RPO: i.a. AIT, IST Austria, IMP, Joanneum Research) as well as various funding institutions (RFO: ÖAW, WWTF, FWF, FFG, CDG). It is member of the European Network of Research Integrity Offices (ENRIO), which has 23 European members and connects the several national organisations.[32]

The foundation of a cross-national research integrity (RI) institution was initiated by several actors at current member organisations. Following growing media attention and public discussion of prominent cases of scientific misconduct, the need for an independent organisation dealing with alleged cases of scientific misconduct was perceived. Universities had established their own research integrity boards, but the wish for an independent entity above and across university level, also including other institutions, led to the establishment of the OeAWI (Interview 1: 19ff). In order to keep its independence, the agency is entirely funded by membership fees and does not get any funding from other sources, like ministries (Interview 2: 946ff, Interview 1: 63ff). Austria takes a pioneering role in this respect and is a popular model for other countries, as the interviewees point out (Interview 1:106ff, 2: 996ff).

Cases of alleged scientific misconduct can be reported by any member organisation or by any person – member or not – affected by scientific misconduct in Austria. An independent commission of six researchers who are not based in Austria and who represent six key scientific areas (humanities, social sciences, life sciences, medicine, natural sciences/technology and law) decides whether to investigate a case further and, if applicable, evaluates the gravity of the violation. The OeAWI then suggests consequential measures to the affected institutions, which are not legally binding; however, they offer a neutral and factual investigation of the accusations (OeAWI 2014a).

Apart from the work of the commission, preventive measures and information about research integrity became an important aspect in the activities of the OeAWI. Unbureaucratic consultation and advice about questions revolving around the topic are offered in order to clarify

[32] Information derives – if not otherwise stated – from the OeAWI homepage (http://www.oeawi.at/).

uncertainties and prevent scientific misconduct from happening. For example, researchers do call when it comes to uncertainties in their own work or if they feel mistreated in their professional environment. Often, the OeAWI tries to mediate between conflicting parties and find a solution outside an official investigation by the commission (Interview 2: 71ff).

The focus of this case study lies on the third stream of work offered by the OeAWI to its member organisations, which is also a preventive measure: workshops and lectures on good scientific practice. These are held, in order to raise awareness and prevent research misconduct. The workshops are free of charge and high in demand. Mostly, they are aimed at PhD students and take place as part of PhD programmes and education at different institutions. RI workshops are however also held for other groups of professionals or students.

The case study portrays the OeAWI RI workshops in detail and then investigates their impacts and benefits in societal, democratic, and economic terms. It then discusses the limitations of the available data and identifies starting points for further empirical investigation. The case study understands the RI workshops as an example for an RRI activity. Research integrity is closely linked to the ethics and governance dimensions. It is especially important to educate future generations of researchers at an early stage in their career so they can incorporate it into their work. That way, research integrity can be naturally applied as a part of their research and not be seen as an extra burden, and this can eventually lead to a culture change and greater awareness and sensitivity regarding RI.

3 Methodology and data

Desk research and interviews were conducted for this case study, in order to provide qualitative empirical data. OeAWI material was analysed to gather background information, which comprised the OeAWI homepage, the rules of procedure and statements of the RI commission (OeAWI 2014a), annual reports from 2010 to 2014 (OeAWI 2010, 2011b, 2012, 2013, 2014b, 2015b), as well as the OeAWI guidelines to good scientific practice (OeAWI 2015a). Numbers and content of the cases investigated by the RI commission can be drawn from the annual reports.

Since there was not much information readily available on the RI workshops themselves, which are the focus of this study, six qualitative interviews were conducted with two representatives from the OeAWI and four interview partners from a biomedical research campus in Vienna that includes mandatory research integrity workshops in its PhD programme:

- Interview 1: person in leading position at the OeAWI,
- Interview 2: responsible person at the OeAWI for – amongst other things – designing, organising and holding the RI workshops,
- Interview 3: PhD programme coordinator at the research campus,
- Interview 4: research group leader at the same institution,
- Interviews 5 and 6: two PhD students attending the PhD programme.

These interviews were – with the consent of the interview partners – recorded, transcribed and thematically analysed in order to answer the research questions. Additionally, a list of lectures, workshops and seminars about research integrity held by the OeAWI to date was provided by the workshop facilitator, including the approximate number of participants.

No systematic evaluation has been conducted of the RI workshops yet. Since they are held at different institutions, if and how a feedback from participants was asked for was left to the institutions themselves. The impact of the RI workshops can therefore only be evaluated on a qualitative level based on the assessment of the interview partners.

4 Input level: RRI activity

The Austrian Agency for Research Integrity was founded due to increased media attention regarding prominent cases of scientific misconduct and the growing need perceived at research institutions for an independent organisation dealing with alleged cases of scientific misconduct and good scientific practice in general. The main focus originally lay on the consultation about and investigation of alleged cases of scientific misconduct, which started off low and saw a rise in the following years, only to decline again (see annual reports 2009 to 2014, Interview 2: 62ff). In late 2010, the demand was voiced for preventive and educational measures about RI by one of the member organisations. The OeAWI developed a half-day workshop that was held at the PhD retreat of this organisation, and has since held numerous workshops, seminars and lectures about the topic, adapted to the needs of the respective institution and the target audience (Interview 1: 416ff, 2: 100ff). The workshops are held free of charge as a service for member institutions of the OeAWI (Interview 2: 504ff).

The RRI activity is implemented on an institutional level, since the RI workshops are being held at the member institutions themselves. However, the organisation providing these workshops – the OeAWI – works on a national and further on an international level, interconnecting and exchanging experiences with international institutions.

Different actors in the member institutions initiate and organise these events: lecturers or supervisors, (PhD) programme coordinates or administrative staff, or even PhD students themselves. The workshops are then designed by the OeAWI and adjusted to the wishes and needs of the institutions and the expected audience concerning format, length and content (Interview 1: 416ff; 2: 491ff, 982ff, 3: 59ff). The content is updated according to recent developments in the respective field – one example would be new forms of gathering data via social networks – and to the feedback given by participants and institutions (Interview 2: 381ff).

A typical format is a half-day workshop between three and six hours – depending on the number of participants – in order to have enough room for discussion (Interview 2: 287ff). The session usually starts with asking the audience about their understanding of scientific

misconduct and for which reasons they think scientists would commit misconduct. The participants are asked to write down their answers and keep them for later (Interview 2: 356ff).

Following this warm-up exercise is a presentation about good scientific practice and scientific misconduct, including concrete case examples. The content and examples of this input are tailored to the respective audience. The topics that are being discussed in the workshops usually revolve around data issues (recording, management, validity, storage and protection of data), authorship (conflicts in publication activities), (self-) plagiarism, or conflicts of interest in peer review processes (Interview 2: 356ff).

If there is enough time, real-life cases of scientific misconduct that were treated by the OeAWI commission are presented in anonymous form. An example that was used for an audience of natural scientists is how a lab notebook should be used and the way experiments should be recorded in it – and how it should not look like, employing a negative example. The idea of these examples is not only to show spectacular or extreme cases of scientific misconduct, but to make the participants understand that mistakes and inaccuracies occur easily and can happen to every scientist – even without being aware of it (Interview 2: 281ff). Questions that come up by the audience are discussed right away, so this part of the workshop can take up a longer time.

After the presentation, participants are divided into smaller groups and each of those deals with an assigned case of alleged scientific misconduct. The results of the group work are presented and discussed in the plenum. The session ends with going back to the starting exercise and comparing the answers given then to the ones given after participating in the workshop (Interview 2: 281ff).

The goals of the workshop as identified by the interview partners all point to the same direction: making researchers aware of challenges and possible problems, imparting principles of good scientific practice and hence ideally preventing scientific misconduct from happening (Interview 1: 290ff, 657ff, 3: 274ff). The interviewed workshop facilitator states, her objective is to get the participants to think about RI in their daily research routine and incorporate it into their work (Interview 2: 170ff).

Interviewees find it important to make attendance of research integrity sessions mandatory for students as part of their education and training, instead of an optional attendance. The intention behind this obligation, as was expressed by several interviewees, is to reach all students and to make them familiar with the topic at a preferably early stage of their studies in order to make it more natural for them to think about RI and to integrate it in their daily research routine (Interview 1: 527ff, 2:139ff, 3: 119f., 5: 205f.).

5 Output and outcome level: impact and benefits

According to the interview partners at the OeAWI, Austria takes a pioneering role in the implementation of a nationwide agency of research integrity, compared to a predominantly institutional organisation beforehand or in other countries – meaning it lies in the responsibility of Universities or other institutions whether or not to establish an organ like this at their organisations (Interview 1: 106ff, 2: 999ff).

The OeAWI interviewees could notice a change in the perception of and a raised awareness about the work of the agency since its establishment in 2008. This was achieved mostly by word of mouth amongst research institutions; the OeAWI does not have the capacities to do a lot of PR work (Interview 2: 925). The workshop facilitator presents the workshops in the general assemblies of the agency, where all member institutions take part, in order to promote this possibility. According to the interviewee, an alleged case of scientific misconduct at the institution often triggers the wish to hold an RI workshop (Interview 2: 402ff).

The main target audience are PhD students. According to information provided by one of the interview partners at the OeAWI, workshops are mostly held in a higher education context - next to PhD candidates also for master students, postdocs, assistants, lecturers or senior researchers. Outside of the higher education context, workshops were held at teacher training institutions for school librarians and teachers, preparing them for the demands of the so-called prescientific paper ("Vorwissenschaftliche Arbeit") which has to be written by high-school students as part of their graduation. Table 19 gives an overview of the participants in research integrity events with a teaching factor (workshops, seminars, lectures) and the institutions at which they were held. In total, 1067 people participated in those events, with the numbers supporting the main target group being PhD students and showing nearly an equal share of participants from universities respectively private research institutions.

Table 19 Case study 08: Participants of RI workshops/seminars/lectures[33]

(Main) target group	Number of participants	Number of events
PhD	461	19
Senior Researchers, lecturers	218	4
Mixed academic audience (students,	181	4

[33] Numbers derive from a list provided by one of the interviewees at the OeAWI.

lecturers, researchers)		
Junior researchers (Postdoc, assistants)	86	4
Master students	50	1
School teachers	47	4
School librarians	20	2
Academic administration	4	1
Institutions:		
University	482	19
Private research institution	400	12
University of Applied Science (FH)	118	3
Teacher education college (PH)	67	5
Total participants/events	**1067**	**39**

The interviewed PhD students evaluate the workshop positively They mention that they were made aware of a problem that goes beyond integrity on a personal level and that they learned about the existence of the OeAWI as a place to turn to if questions or problems connected to good scientific practice arise in the course of their research career (Interview 6: 65ff). They both do not see a direct influence of what they learned in the workshop on their work practices, but state a greater awareness and carefulness towards problematic issues and that the topic is being discussed amongst colleagues more often (Interview 5: 324ff, 338ff).

Before including the RI workshops into the PhD programme at the research campus, information about research integrity was only disseminated unsystematically or it was up to research group leaders if and how to address this topic (Interview 3: 270ff; 4: 110ff; 5: 78ff; 6: 30ff, 224ff). Therefore, the PhD programme coordinator assesses the workshops approving and she could confirm the positive feedback given by PhD students at her institution. She sees the workshops as an important part of the early stages of PhD education and it is crucial to her to integrate them on a mandatory basis into PhD programmes, so students have to deal with this topic early on in their research careers and will later integrate RI into their work (Interview 3: 107ff, 170ff, 197ff).

The implementation of these RI principles can be problematic though, as one of the interview partners points out. If young scientists work in an environment where research integrity is not an issue or seen as a barrier to science or hindrance of work, it will be hard for them to stick to these principles. Therefore, it is important that research group leaders and PhD supervisors

support, enforce and demand good scientific practice. The workshop is intended to additionally support the participants in this by providing them with the means of sticking to those principles and knowing where to turn to if RI matters are concerned (Interview 2: 877ff).

The RI workshop can also serve as an incentive to change existing or install new procedures at institutions: At one of the member organisations, PhD students found it problematic that there is no official procedure of how to store and pass on data produced by researchers once they leave the institution. They initiated an official process together with the administration to handle this matter (Interview 2: 681ff). On the other hand, sometimes participants are reluctant to some aspects of RI and see them as unrealistic and not combinable with their research routines, according to the testimony of the workshop facilitator (Interview 2: 729ff, 860ff).

Ideally, the RI workshops will be institutionalized in the future, so they will be held by the institutions themselves as part of the curriculum without involvement of the OAWI. Since the OeAWI is only financed by membership fees, there are no additional financial and personnel means to provide as many workshops and other events as requested, so handing over these workshops to the organisations themselves is highly welcome by the workshop facilitator (Interview 2: 206ff, 944ff).

5.1 Society

Possible societal benefits of the work of the OeAWI and especially of the RI workshops can be identified on various levels and might come into being through a change in work routines, but also mindsets.

On an organisational level, the RI workshops might improve the institutional culture and the societal intercourse between colleagues on different level of hierarchy (professor, assistants, students, etc.). They make aware of issues of authorship and plagiarism that otherwise might not have been addressed and ideally might lead to a fairer treatment of colleagues and students concerning work credentials.

Considering the research process and output, the RI workshops raise awareness regarding issues of good scientific conduct, e.g. the proper handling of data (security, anonymity, correct presentation, etc.) and the correct presentation of ideas of others. This might prevent (unintentional and intentional) plagiarism, data piracy, data forgery or misrepresentation of results, etc.

By attending RI workshops, scientists and other professionals are being made aware of aspects related to their work they might not have thought about before. Ideally, this leads to a change of work routines towards a more responsible science, research and innovation, a fair treatment of colleagues and students concerning work credentials and cooperations, a more cautious handling of data, etc. Society can profit further from a more deliberate and thoughtful science, research and innovation sector. Since the RI workshops are not restricted to a higher education or /research context, an audience outside this sphere – like for example school teachers – can

also profit and spread their knowledge amongst pupils in this case, which brings RI issues to an even younger audience than university students.

The wider societal benefits of research practices reflecting on and integrating RI are difficulty to estimate. However, there is a good case to believe that public confidence in science and research, which is regularly shaken by incidents of scientific misconduct, might be improved by such measures. A change in institutional cultures (e.g., better recognition of the performance of research assistants, PhD, and junior researchers through discernible authorship) might also make a career in science or R&I more attractive to students.

5.2 Democracy

Every person in Austria affected by or suspecting scientific misconduct can file a complaint with the OeAWI. This improves the access to a monitoring of the scientific or innovative sectors by the population – even if not involved in science. The RI workshops themselves are not accessible to everyone, but one could argue that scientists and other professionals educated in research integrity would also contribute to a more democratic approach to science.

5.3 Economy

Especially the preventive aspects of the RI workshops (and the consultations about RI) might avert legal problems and costs in the different problematic areas of scientific misconduct ("litigation costs"). The effort to mediate between conflicting parties in RI questions before opening an official investigation by the commission might also prevent legal costs in some cases.

The membership of research institutions – public or private – but also other of organisations in a nationwide research integrity agency signals awareness of the problem and willingness to deal with it, and thus raises the reputation of the member organisations, which in turn might raise their attractiveness as R&I partner.

The costs for the member organisations are firstly the membership fees of the OeAWI. Furthermore, the installation of processes and standards following consultations by the OeAWI or initiatives from employees after participating in RI workshops might result in costs for the organisations.

The costs on the side of the agency are mainly personnel costs, as also identified by one of the interviewees (Interview 2:951ff). The costs of organising and holding workshops are relatively low: rooms are usually available for free at the respective institutions. Travel expenses have to be paid, but can be considered relatively little especially in light of the possible outcome of students (and other participants) implementing RI in their future work.

6 Discussion

There was no material readily available on the RI workshops of the OeAWI. Information therefore had to be gathered via qualitative interviews and was provided by the workshop facilitator. General information about the OeAWI and its RI commission was available on the website.

Based on the available data, it is difficult to systematically identify and assess the impacts and benefits of the RI workshops. There are several reasons for that: Firstly, no accompanying evaluation of the RI events was conducted. It was left to the organising institutions if and how they ask for and collect feedback from the participants (Interview 2: 387ff, 689ff, 714ff). Therefore, evaluation data is scarce and not comparable. Secondly, the workshops have not been running long enough to be able to identify long-term benefits yet, as was also pointed out by the interviewees (Interview 1: 599ff, Interview 3: 263ff). An overall need for a systematic and external evaluation of the work of the OeAWI in general and the RI workshops in particular was recognised by the OeAWI interview partners (Interview 1: 621ff).

Since there was no systematic evaluation of the activities of the OeAWI and especially of the RI workshops, reliable causal links between input and outcome cannot be empirically identified. No concrete data was available or was possible to be produced in the scope of this case study in order to identify such links. Due to the relatively short time these measures exist, benefits and impacts can only be estimated. In order to systematically identify benefits and impacts of the RI workshops, a thorough accompanying evaluation of the workshops and especially the participants would have to be done over the course of a few years. Former workshop participants would have to be interviewed a few years after their graduation about the impact and implementation of RI in their work. Possible benefits – or costs – in the three identified areas can therefore only be roughly estimated.

Nonetheless, all people involved give very positive feedback on the workshops and evaluate its importance as part of the education of young scientists and researchers highly. This early contact with the topic is seen essential in making RI naturally part of science and leading to a cultural change in the future.

The broader success of the RI workshops in particular and the OeAWI in general can be perceived on two levels: there is a high demand for RI events to be held at Austrian research institutions and the Austrian model is regarded as an example for other countries on an international level.

7 References

OeAWI - Austrian Agency for Research Integrity (2015a). *Annex I to the Rules of Procedure Austrian Agency for Research Integrity (OeAWI): Guidelines for Good Scientific Practice.*

(http://www.oeawi.at/downloads/Richtlinien_OeAWI_final_April%202015_e.pdf; access: 08.07.2015)

OeAWI - Austrian Agency for Research Integrity (2015b). *Annual Report 2014.* Vienna. (http://www.oeawi.at/downloads/Jahresbericht%202014_final_e.pdf; access: 14.07.2015)

OeAWI - Austrian Agency for Research Integrity (2014a). *Rules of procedure for the investigation of alleged scientific misconduct.* Vienna. (http://www.oeawi.at/downloads/Rules%20of%20procedure_Sept_2014.pdf; access: 08.07.2015)

OeAWI - Austrian Agency for Research Integrity (2014b). *Annual Report 2013.* Vienna. (http://www.oeawi.at/downloads/Jahresbericht%202013_Kommission_e_final.pdf; access: 14.07.2015)

OeAWI - Austrian Agency for Research Integrity (2013). *Annual Report 2012.* Vienna. (http://www.oeawi.at/downloads/Jahresbericht-2012_e.pdf; access: 14.07.2015)

OeAWI - Austrian Agency for Research Integrity (2012). *Annual Report 2011.* Vienna. (http://www.oeawi.at/downloads/Jahresbericht-2011_e.pdf; access: 14.07.2015)

OeAWI - Austrian Agency for Research Integrity (2011a). *Statement of the Commission for Research Integrity on Handling Cases of Plagiarism.* Vienna. (http://www.oeawi.at/downloads/Stellungnahme_Plagiate_April2011_e.pdf; access: 09.07.2015)

OeAWI - Austrian Agency for Research Integrity (2011b). *Annual Report 2010.* Vienna (http://www.oeawi.at/downloads/Jahresbericht-2010_e.pdf; access: 14.07.2015)

OeAWI - Austrian Agency for Research Integrity (2010). *1st Report of the OeAWI Commission for Research Integrity.* Vienna. (http://www.oeawi.at/downloads/1-Bericht-der-Kommission_e.pdf; access: 14.07.2015)

OeAWI - Austrian Agency for Research Integrity (web). *Austrian Agency for Research Integrity.* (http://www.oeawi.at/en/index.html; access: 14.07.2015)

[unofficial] List of workshops and seminars on research Integrity held by the OeAWI, 09/2010 – 07/2015. Lectures and talks on the topic are not included.

European Molecular Biology Organisation (EMBO)

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1 Case abstract

This case is about the activities of the European Molecular Biology Organisation (EMBO) in developing open access/science and improving research integrity in their field of molecular biology. These efforts are concentrated in training, outreach and transparent publication processes. The online presence of EMBO and associated organisations was reviewed as well as all publicly available information. A background consultation and a specific discussion of potential OA and ETHICS indicators were provided by the EMBO Science Policy Programme Manager, Dr Michele Garfinkel. Potential data sources were scoped in this process, with the possibility of developing concrete information from existing internal raw data on process indicators for research integrity and open access/open science considered a future possibility. A positive impact on the integrity of published research was observed in the case of transparent paper publication activities, based on a specific case.

Table 20 Case study 09: Case details

RRI dimension	RRI □	Citizen Participation □	Science Literacy □	Gender equality □
	Open Access X	R&I governance □	Ethics X	Other □
R&T field	Molecular biology			
Country	European organisation. HQ based in Germany.			

2 Introduction

The case is based on the activities of the European Molecular Biology Organisation EMBO[34], an organisation established to promote excellence in the life sciences. The activities of EMBO

[34] http://www.embo.org/

include policy research, publishing, training, communication and diffusion, with an emphasis on transparency, research integrity and improving access to data and publications.

The main actors in the case are interrelated scientific research, science publishing and science policy organisations:

> *EMBO is an organisation of more than 1700 leading researchers that promotes excellence in the life sciences. The major goals of the organisation are to support talented researchers at all stages of their careers, stimulate the exchange of scientific information, and help build a European research environment where scientists can achieve their best work.*
>
> *EMBO helps young scientists to advance their research, promote their international reputations and ensure their mobility. Courses, workshops, conferences and EMBO Press publications disseminate the latest research and offer training in techniques to maintain high standards of excellence in research practice. EMBO helps to shape science policy by seeking input and feedback from our community and by following closely the trends in science in Europe.*
>
> *EMBO supports talented researchers, selected through impartial evaluation processes, to allow them to do great science. The wide scientific scope across the full range of life science research coupled with the broad geographical reach of more than 1700 members and associate members – some of the best researchers in Europe and around the world – positions EMBO optimally to serve Europe's life science community. (http://www.embo.org/about-embo)*

EMBO is funded by the European Molecular Biology Conference (EMBC)[35].

> *Founded in 1969, EMBC is an inter-governmental organisation comprising 27 Member States including most of the European Union and some of the neighbouring countries. The EMBC provides, through its General Programme, a framework for European co-operation in the field of molecular biology and closely related research areas. Molecular biology, as the fundamental basis of all life sciences, significantly impacts our daily lives.*
>
> *The General Programme focuses primarily on the provision of training, teaching and research scholarships and on the establishment of programmes for courses, workshops and study meetings. Financial contributions from each Member State carry the General Programme. The execution of the EMBC General Programme is entrusted to EMBO. Both EMBC and EMBO are driven by a common commitment to quality research at the European level. Their joint activities are characterised by quality and encouragement of co-operation within the scientific community. (http://embc.embo.org/)*

[35] http://embc.embo.org/

A subset of EMBC countries also funds the activities of The European Molecular Biology Laboratory (EMBL)[36]. EMBO and EMBL have an extensive overlapping history; today they are distinct entities but continue to collaborate on many programmes and projects.

> *EMBL is one of the world's leading research institutions, and Europe's flagship laboratory for the life sciences. The cornerstones of EMBL's mission are to: perform basic research in molecular biology; train scientists, students and visitors at all levels; offer vital services to scientists in the member states; develop new instruments and methods; and actively engage in technology transfer. (http://www.embl.de/aboutus/general_information/)*

Of particular interest is the multifaceted training programme of EMBL.

> *Along with traditional doctoral and postdoctoral training, early career mentoring and collaborations EMBL organises multiple training courses, workshops and symposia every year (often in collaboration with EMBO)… Although the majority of these events are aimed at life scientists, a significant and growing fraction has a wider audience. Courses for science teachers, seminars and the Science and Society Programme complement EMBL's extramural teaching activities in the purely scientific arena. (EMBL Programme 2012-2016)*

The final main actor among the interlinked EMBO organisations is EMBO Press[37], which is engaged in innovative science publishing.

The journals were first started over 30 years ago with the flagship publication *EMBO Journal*. Three additional journals were introduced over the next three decades. EMBO Press was launched very recently, in December 2013, as an editorially independent publishing platform capturing the four journals under a single publisher.

> *One of the goals of EMBO Press is to transform research articles into enriched and accessible records of research data that open up new possibilities for discovery and sharing. (http://www.embo.org/news/emboencounters/issue-25/announcing-embo-press)*

Of particular interest is one the EMBO Press publications, EMBO Reports.

> *EMBO reports publishes short-format papers that communicate a single major finding in all research areas of molecular biology. It offers broadly accessible scientific review and commentary as well as a 'Science and Society' section that explores how science is shaping the world. (http://www.embo.org/embo-press/our-publications)*

[36] http://www.embl.org/

[37] http://www.embo.org/embo-press

EMBO Reports mixes papers relevant to science and society and science policy as a prominent section within the publication. All EMBO Press publications have a focus on transparency, a quick single round review process and the option to make data and other elements available to readers in the interests of openness.

> *All EMBO Press journals benefit from enhancements to data publication: authors can publish unlimited source data at the same time as their papers, which are viewed online with the figures; figures and data can be searched together with article contents, making it easier for scientists to find, reinterpret and reuse research. (http://www.embo.org/embo-press/our-publications)*

The various EMBO organisations pursue an interrelated set of objectives across a broad set of activities in the life sciences that seek to transform the way in which science is done and reported. The EMBO platform explicitly embraces the concept of responsible research.

The most direct activity of EMBO in relation to RRI is the Responsible Conduct of Research[38] initiative that forms part of their Science Policy programme. The SP programme includes other initiatives relevant to the open access and gender dimensions of RRI.

> *The Science Policy Programme, established in 2011, examines concerns emerging from advances in scientific research, with an emphasis on the life sciences in Europe. We are focused on the governance of new technologies for advancing science, and the implications of the use of these new technologies for the public. Our major areas of interest are biotechnology and genomic technologies;* ***responsible conduct of research****;* ***and scientific publishing with respect to open access, the usability of data underlying publications, and the reproducibility of the scientific literature****. (bold added) (http://www.embo.org/science-policy)*

The Responsible conduct of research initiative is focused initially at the level of individual scientists and their practices.

> *EMBO is increasingly involved in work to understand the parameters of the responsible conduct of research and how best to provide this information to scientists. Our work focuses on the activities of scientists at the bench or computer, issues of research integrity in the writing and publication of research results, and the roles of scientists in society. (http://www.embo.org/science-policy/responsible-conduct-of-research)*

Current activities that seek to advance the responsible conduct of research include:

[38] http://www.embo.org/science-policy/responsible-conduct-of-research

- A Special Session on Research Integrity at the EMBO annual meeting:

  In Europe, the requirements for researchers to obtain training in research integrity are rapidly evolving. This session will give an introduction to concepts in responsible conduct and reporting of research and will illustrate the value of the knowledge and use of the principles of responsible conduct both for science and society. The wide variety of ways in which training in research integrity can be accomplished will be illustrated. The session is aimed at scientists who would like to discuss how to introduce their staff to good scientific practice. As well, this will be a good overview for young researchers who might be required to take research integrity training as part of grant or institutional requirements. This will be an interactive session with ample time for questions and discussion. (http://www.the-embo-meeting.org/programme/science-policy/research-integrity)

- Advocating for the appropriate use of research metrics, including signing the Declaration on Research Assessment (DORA)[39]

  EMBO is one of the signatories of an international declaration calling on the world scientific community to eliminate the role of the journal impact factor (JIF) in evaluating research for funding, hiring, promotion, or institutional effectiveness. (http://www.embo.org/component/content/category/26-science-policy)

- Participating in responsible research events and conferences, such as the annual World Conference on Research Integrity.
- Developing an online course for researchers on the Responsible Conduct of Research.

The EMBO case is relevant for RRI as it involves a number of connected activities, which are designed to re-orient the way life science research is conducted and communicated according to principles of research integrity, openness and ethics. The case is interesting as the EMBO organisation is at base an organisation of life science researchers. The organisation seeks to integrate the conduct of science and its impacts on society through attention to research integrity and ethics and to the changing societal demands that are shaping the way science is communicated and the openness of research data and methods that can allow for replication, comparison and extension of research results by the wider science community.

3 Methodology and data

The primary publicly available data resource on the activities of EMBO is the annual *Facts and Figures* report[40]. The measurement of RRI activity is based on the trend line statistics available

[39] http://am.ascb.org/dora/

in the Facts and Figures report. Supplementary information and detail on continuing developments in the responsible conduct of research activities of EMBO were gathered through telephone interviews with the head of the Science Policy programme.

The Facts and Figures reports contain data on: EMBO Membership: Scientific Publications; Fellowships awarded; Young Investigator grants; Installation Grants; Courses and Workshops; Women in Science; and Keynote Lectures.

Measurement of RRI activity for research ethics and integrity can only be done at the input level, such as number of courses run, the numbers of fellows to receive responsible conduct of research training. Measurement of RRI activity for openness can only be done at the input level, such as the number of datasets made available through publications, the number of datasets made available through open access publications.

The significance of the data is limited by the early stage of many initiatives in both the research integrity and open access initiatives being developed by EMBO. It is therefore useful to also take into consideration some potential future data points that might become available.

Detailed information on some key potential measures is not disaggregated within the publicly available reports. A specific disaggregation of data on training activities, including numbers of fellows trained in responsible conduct of research, their national locations, their fields of research, etcetera would be required to better inform on RRI inputs and more particularly to allow some mapping of contexts of potential benefits.

Of course, estimating impact and benefits from RRI activities – i.e. putting training received in responsible conduct of research into use in projects or laboratories – would require the development of new data collection instruments (surveys, interviews).

In terms of indicator methodology and data, it should be stated from the outset that no concrete data are currently publicly available for the potential RRI indicators discussed in this case. However, consultation with EMBO suggests promising avenues to potentially access relevant data within a longer time frame than this Second Round MoRRI case study allows.

Data collection requires strategic sampling and qualitative data collection. Consultations with EMBO suggest that relevant data is collectable, and could potentially be collated and made available. Some data sources are potentially also suitable to be developed as internal metrics within the organisation.

[40] http://www.embo.org/documents/news/facts_figures/EMBO_facts_figures_2015.pdf

4 Input level: RRI activity

The RRI related activities address research integrity and openness.

The data basis includes four feasible process indicators and one feasible outcome indicator.

Two process indicators relate to the Ethics dimension, specifically to research integrity and good research practice. These indicators document the attention EMBO is paying to normative tensions related to research integrity policies and official norms and research activities/actual practices.

The first of these indicators would be based on the numbers of enrolments and completions of online ethics courses, focusing on research integrity, available to both funded fellows of EMBOs various support programmes and to the membership of EMBO (largely faculty scientists). These data would have high validity as a process indicator. The impact of the RRI activity - how training changes actions in the laboratory - is not directly measurable at this point in time.

The second process indicator relates to the inclusion of talks and discussion sessions on research integrity issues, integrated into the Annual EMBO scientific conference as Science Policy and Society sessions. These sessions are aimed at scientific researchers, with the aim of widening their perspective on integrity and ethics issues and societal interests in the conduct and outcomes of research.[41] The Head of the Science Policy programme also gives invited talks about research integrity at the institution and/or laboratory level.

EMBO considers that the development of process indicators related to research ethics/integrity efforts could potentially also be useful in driving internal improvements in the delivery of their research integrity programme.

A first process indicator related to open access/science relates to the documentation of open science policies. The key policy for this indicator online at EMBO involves guidelines on transparency – which overlaps to some degree with the dimension of research integrity (due to the apparent linking of openness and the elimination of misconduct in many scientists' eyes).

EMBO Press promotes the publication of 'transparent papers'. These papers provide the source data for all figures included in the paper with additional annotation and information possible to ensure the process of interpretation of these data can also be followed. The proportion of transparent papers submitted to EMBO journals is a feasible process indicator of openness. [A future outcome indicator may possibly be built that monitors the proportion of such data

[41] MoRRI expert Jack Stilgoe is giving the keynote science and society address at the EMBO meeting in September 2015.

deposits that include commentaries and annotations that are explicitly designed to enable further use of the data].

Transparent paper publishing involves the inclusion of a tab marked transparent process, alongside tabs for the article and the tables and figures[42]. This tab includes a link to the review process file, where the reviewers' comments, the authors' replies, and the correspondences with the editor can be viewed. The investment in the transparent publishing process has been shown to have a positive impact on the integrity of data and information published in scientific articles[43].

A second process indicator for open access involves the documentation of institutional mechanisms for promoting open science. The data basis for this indicator is the basically the same as for the second process indicator for Ethics, focusing on the inclusion of an open science agenda in the conferences and linked training sessions at the EMBO annual meetings and other gatherings. In addition, EMBO provides funding for workshops run by scientists. It would potentially be possible to also monitor, through programmes and agendas, the extent to which open science content was present within these funded support actions.

An outcome indicator for open access is the take-up of a CC0 'no rights reserved' licence[44] option for data associated with papers published by EMBO journals. A CC0 licence is not required for EMBO publications, rather it is a suggested opt-in system. Even authors of papers that are subscription only can still opt to make their data freely available.

The data basis for the indicators can be summarised as follows:

- Ethics 1: Responsible Conduct of Research (RCoR) courses completed by a) funded postdocs and fellows and b) EMBO members;
- Ethics 2: Number of sessions/hours devoted to RCoR in annual meetings and outreach talks;
- Open 1a: Number of policies online, number of policy views/downloads from EMBO site;
- Open 1b: Number of 'transparent papers' submitted to EMBO journals annually, transparent papers as proportion of total publications
- Open 2: Number of sessions/hours devoted to promoting open science in annual meetings and outreach talks; and

[42] http://emboj.embopress.org/content/34/12/1661

[43] http://retractionwatch.com/2012/08/01/transparency-in-action-embo-journal-detects-manipulated-images-then-has-them-corrected-before-publishing/

[44] CC0 enables scientists, educators, artists and other creators and owners of copyright- or database-protected content to waive those interests in their works and thereby place them as completely as possible in the public domain, so that others may freely build upon, enhance and reuse the works for any purposes without restriction under copyright or database law.

- Open 3: Number of CC0 data licence opt-ins in EMBO journals annually, CC0 licences as proportion of total data licence selected.

In terms of the level at which the RRI activity can be monitored through data collections there are three main levels – national, organisation and project – which are particularly relevant for open access and open data indicators. EMBO is developing a system of micro-attribution that eventually could become part of the transparent paper process. For example, the handling of a particular assay or gel would include a hyperlink that nominates which technician or researcher did what part of the process, how the process was managed, etc. A system of micro-attribution of credit that extends beyond authors would also include the references back to the organisational and national location of participants as well as the source of funding for the work. In this way, contributions to transparent papers (Open 1b) could be monitored at multiple levels. The availability of such data as a basis for comparative indicators is a problem at this stage, but the further development of indicators of openness along such lines is apparently feasible.

In summary, the open access/science and the ethics/research integrity challenges being addressed by the various activities of EMBO should be understood as overlapping and interrelated. The training, outreach and innovative publishing activities being undertaken are envisaged as aspects of a version of scientific excellence that is attuned to societal expectations and a logic of self-improvement in the integrity and conduct of scientific research.

5 Output and outcome level: impact and benefits

In terms of the impact and benefits of the RRI activity, these are largely process transformation and involve a mix of tangible and intangible knowledge and are normatively defined. The main beneficiaries of the activity are within the emerging research community, postdocs, young faculty and researchers who are engaging with the RRI landscape less as a transformation from the past and more as the emergent configuration of scientific excellence, societal expectations and institutional imperatives.

The level of impact of the activities described is multi-dimensional, both in terms of organisational or institutional impacts on specific research performing organisations or on funding agencies that support specific projects that are depositing open data, and in terms of geographic distribution of RCoR training and contributions to transparent papers.

It is important to note that the research integrity and open access/science activities of EMBO that are addressed here are in the relatively early stages of development. The data sources described in this sketch are feasible data sources. EMBO have indicated that as a further step in this case study concrete data could be made available to further develop the contours of the indicators proposed here.

It would therefore be premature to try to associate specific social, democratic or economic benefits to the RRI activities described at this stage.

6 Discussion

The next stage of developing this case study could therefore focus on obtaining concrete data and making a more informed assessment of the data quality. At the descriptive level, the data sources appear robust and valid for the task of producing RRI indicators.

The attribution of causal links between process indicators and identifiable outcomes is problematic. For example, increasing trends in take-up of RCoR training by junior fellows of EMBO allows us to identify the input of a specific research integrity mechanism to address normative tensions in policy/societal expectations and actual practices. However, unless a method is developed to actually document the impact of this training in the lab, in the design or conduct of research, or in the attitudes and normative stance being transferred from trained fellows to postgraduate students, for example, a causal chain cannot be established. However, there is certainly the possibility that targeted research and data collection could seek to make this link using conventional and/or innovative research methods.

This case study suggests that there are potentially some innovative results and new insights that could emerge from focusing on the activities of institutions that are trying to renovate the model under which contemporary science is conducted, in ways largely consistent with the RRI approach, but without necessarily explicitly adopting RRI nomenclature or approaches.

7 References

EMBL programme 2012-2016
https://www.embl.de/aboutus/communication_outreach/publications/downloads/programme12-16.pdf

EMBO website

EMBO. various years. Facts & Figures. Annual reporting on activities.

EMBO. Programme description. http://embc.embo.org/documents/prolongation_rev2.pdf

Garfinkel, Michele. 2015. The Public in Peer Review. EMBO Reports Vol 16 No 6: 672-3.

Sunkel, Claudio. 2015. Excellence and the new social contract for science. EMBO Reports Vol 16 No 5: 553-56.

Wang, Fei et al 2015. http://dx.doi.org/10.15252/embj.201590960 (example of transparent paper)

UK Science Media Centre

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1 Case abstract

The case considers the Science Media Centre (SMC) in the United Kingdom. The SMC is an "independent charity working to promote the voices, stories and views of the scientific community to the news media when science is in the headlines." The SMC aims at promoting accurate and evidence-based information about scientific subjects, especially in complex and controversial topics when reporting runs a risk of becoming confused and misinformed. Thereby, the public and policy makers are protected from misleading reporting. It represents and promotes the views and opinions of the scientific community, covering all the disciplines of the natural and physical sciences as well as engineering, to the mass media. The SMC offers several products for journalists and scientists alike, for instance rapid reactions, press conferences or trainings.

Methodologically, this case study is based on mainly qualitative secondary information sources, provided by the SMC itself (specifically its website as well as an internal review document) as well as other sources, for instance the exploration into the foundation of a German SMC as well as news articles.

The **impacts** reported for the SMC in the UK mainly relate to impacts for journalists and scientists. While these impacts can be identified quite clearly, there is no information available to which extent the benefits for journalists and scientists resulted in impacts for wider society, for the economy or for democracy.

Table 21 Case study 10: Case details

RRI dimension	RRI ≤	Citizen Participation X	Science Literacy X	Gender equality ≤
	Open Access ≤	R&I governance ≤	Ethics ≤	Other ≤
R&T field	All natural and physical sciences as well as engineering			
Country	UK			

2 Introduction

The Science Media Centre (SMC) in the UK is an "independent charity working to promote the voices, stories and views of the scientific community to the news media when science is in the headlines." (SMC, 2014)

The background for the establishment of the SMC can be found in the heated debates in the late 1990s on BSE and on a study on the relationship between vaccination of children and autism. Both debates led to heightened public fears, as a result of experts acting contradictorily and partly hysterical reporting as well as insecurity and scepticism in the society towards science. Consequently, the House of Lords Select Committee on Science and Technology recommended the foundation of a SMC which was established in 2002 (SMC, 2014; Zotta, 2014).

The SMC aims to channel accurate and evidence-based information about scientific subjects, especially in complex and controversial topics when reporting runs a risk of becoming confused and misinformed towards the public and policy makers, respectively. Thereby, the SMC aims to protect the public and policy makers from misleading reporting. It represents and promotes the views and opinions of the scientific community and covers all thematic fields within natural and physical sciences as well as engineering.

The SMC offers several products for journalists and scientists alike, for instance rapid reactions, press conferences or trainings for scientists (for details see section 4). One central element of the offers of the SMC is the access to expertise with the short reaction times required in news mass media.

For the monitoring of responsible research and innovation, the SMC is of special interest because it contributes to the dimensions of public engagement, and scientific literacy and education:

- Firstly, reliable and specifically tailored information about scientific topics is an important element to foster scientific literacy of both, adults and children. The SMC provides both science journalists as well as 'generalists' with reliable and accurate information and thus enables them to inform their respective target groups correctly.
- Secondly, it may be argued that the proliferation of scientific information raises the interest in scientific topics in general and concern about the role of science in and for society.
- Thirdly, information about scientific topics could be considered as a basis for the involvement of the public in participation and engagement activities. It can be expected that without information and a general interest for the topic, involvement in participatory activities seems unlikely.
- Ultimately, it may be expected that information about scientific subjects contributes to scientific literacy and science education, which might be expected to lead to better informed decision making by citizens and politicians, for instance in the context of voting behaviour related to research and innovation.

3 Methodology and data

The methodology for this case study uses primary and secondary data. Primary data was collected through semi-structured interviews. Three interviews were conducted in the context of another project, which covered the same and related issues.[45] The material and assessment obtained in these interviews was used for the preparation of this case.

The secondary data was obtained by desk research covering several document sources, i.e. both external as well as internal SMC documents.

- One central data source was the "Explorations into a German SMC" (Hettwer, Schneider, Zotta, 2013). This analysis was funded by the German Bosch Foundation and conducted by the German Science Journalists' Association (WPK). It critically assesses the potential for the establishment of a science and media centre in Germany by analysing the British SMC closely, in particular considering the main actors, users and critics of the British model.
- Moreover, the Strategic Review Report by the SMC itself and the SMC webpages were an important source of information for this case study. The SMC Review document is based on an internal and informal, but comprehensive, review process conducted in 2012-2013. For the review over 100 stakeholders were consulted by the SMC and asked for their experiences and suggestions for improvement.

These two documents were central for the preparation of this case study, especially regarding the information on outputs and outcomes. Note that both the internal review as well as the explorations into the establishment of a SMC in Germany are not full-scale evaluations conducted by an independent organisation. However, they provide valuable guidance as they contain information about outputs and observations concerning possible outcomes on the basis of the opinions of journalists and on the basis of the expert community of other countries. In addition, news articles and reports, such as an article about the possible establishment of an SME in Germany in a magazine for innovation were used for this case study (see references).

4 Input level: RRI activity

Following heated and "partly hysterical debates" (Zotta, 2014) around scientific topics the SMC was established to promote the voices, stories and views of the scientific community to the

[45] The project 'Technology openness and innovation friendliness in Germany' addressed science communication by a specific centre as a side topic. It was conducted for the German Federal Ministry for Economic Affairs and Energy (BMWI) in 2014. The report and a summary in German can be accessed at http://www.bmwi.de/DE/Themen/Technologie/Rahmenbedingungen/technologieaufgeschlossenheit.html. The Interviews were conducted with Franco Zotta (Bertelsmann Stiftung), Volker Stollorz (German Science Journalists' Association) and Hannah Boley (British Embassy in Berlin, Germany).

news (mass) media in order to provide accurate and evidence-based information on scientific topics for the public and policy makers. The recommendation to establish such a centre was made by the House of Lords Select Committee on Science and Technology and the scientific community.

When the SMC was founded in 2002, it started with three employees and an annual budget of around £200,000. In 2012, it employed nine full time staff and an annual budget of almost £600,000. The funding rules for the SMC are strict in order to avoid conflicts of interest. No party (except for the Welcome Trust) may contribute more than 5% to the overall budget, thus ensuring financial independence. Overall, the SMC has over 100 financial supporters.

The SMC has two main target groups: scientists and the media. In their daily work, the SMC reaches out, supports and communicates with scientists to help them inform the public about their research topics. This can be done either pro-actively by the scientists or as reactions on scientific topics in the media. Moreover, the SMC supports and works alongside press officers of science institutions. For the media their main service is that they are a neutral point of information for journalists, by providing them with relevant and targeted information. Journalists registered at the SMC are supplied with information on a daily basis.

The SMC acts on a national scale in the United Kingdom. However, it has inspired the establishment of other SMCs worldwide and also cooperates loosely with them. Therefore, while its concrete reach is limited to the UK, its effects can be observed internationally, even globally.

5 Output and outcome level: impact and benefits

In the following section we present the outputs and outcomes of the SMC, based on the abovementioned sources. Outputs are defined as the immediate or direct results whereas outcomes are the longer-term achievements.

Outputs

The SMC offers several services to journalists, scientists and press officers. Each will be described briefly in the following.

Registered journalists receive daily information in different formats. The following formats are provided by the SMC:

- Fact Sheets: short summaries on new scientific areas, which received little media attention in the past, but which are suddenly in the spotlight.
- Briefing Notes: notes on controversial scientific topics, which provide a snapshot of the basics and an objective run-down of controversial points from a scientific perspective.
- Rapid Reactions: respond to breaking news by providing leading experts to media for interviews or immediate comments.
- Roundups: ensure the media have easy access to scientists and their views to put new research findings into context. This service differs from the 'rapid reactions' in the sense

that scientists can prepare for the announcement of new research without time pressure and that they allow for a longer planning horizon.
- Briefings: agenda setting for scientists in the form of regular briefings, taking either the form of background briefings (introducing journalists to the best experts on controversial topics) or news briefings (providing a news story on developments within science).
- Before the headlines: provision of brief, independent statistical analyses of scientific papers with accompanying critiques of the authors' conclusions in a short format (provided by volunteer statisticians).

All formats are tailored to the needs of journalists in terms of reaction time. Hence, they are available within short time-spans - for instance new roundups and rapid reactions are made available almost on a daily basis. Moreover, the diversity of formats ensures that large parts of the media landscape are catered for, ranging from quality-journalism and the yellow press to public and private TV channels, journals as well as news agencies.

The SMC also offers specialised resources and support for scientists and press officers:

- Support for scientists: support for scientists to engage with the media, offering expertise in the area of science media relations.
- Guides: guides advising for instance on how to answer complex questions in a two-minute interview, risk and uncertainty, the peer review process etc.
- Media induction training: a one-day training session with media-experienced scientists, journalists, etc. These experts provide insights into the work of the news media for other scientists who wish to better understand its demands and facilitate working with them.
- Brainstorming sessions: off-the-record discussions on how the scientific community can coordinate its media relations on controversial issues.
- Advisory sessions: occasional subject-focused sessions in anticipation of big controversial stories.
- Provision of a neutral venue: press officers of companies and other organisations can use the SMC as a neutral venue to engage with the press.

The outputs of the SMC have increased 10-fold between 2002 and 2012. For example, the number of rapid reactions increased from some 25 in 2002 to more than 280 in 2012 (Hettwer, Schneider, Zotta, 2013). In 2013, the SMC issued 80 press briefings, 260 rapid reactions and roundups responding to breaking and upcoming stories and handled several hundred media calls and requests (Hettwer et al 2013, SMC, 2014).

Outcomes

It is reported that the SMC is highly accepted within the **scientific community** as well as appreciated by journalists (SMC 2014: Hettwer et al 2013). For scientists it is an opportunity to present their own research in a low-risk environment and it increases efficiency, as they only have to give one comment or interview and not several. Also, the expert basis provided by the SMC is considered to be broad and selected in a differentiated manner. For **journalists** the SMC

contributes to a minimisation of factual errors and misjudgements. Journalists argue that the SMCs improved the standing of science topics in the news media, increased the coverage of science topics, reduced anti-science reporting and contributed to a positive public view on science. It has also been argued that the SMC has been able to objectify public debates about science (Hettwer et al, 2013). However, critics have argued that the SMC is biased towards science and fosters reporting that is too science friendly at times (see also Callaway, 2013). This critique implies that SMC can hardly contribute to (scientific and) societal debates about fundamental issues, for instance the governance of science.

The model is **internationally** considered a success story. Following its example, comparable institutions were established in other countries, adapted to local conditions. Examples include Australia, New Zealand, Canada and Japan. In Germany, an SMC was established in the spring of 2015 and will start to operate in 2016. Explorations for the setup of a SMC are ongoing in the US and China. This outcome suggests that also in other countries, the benefits and impacts of a SMC are acknowledged and analysed.

Concerning possible impacts on **society**, the public perception of science in the UK has changed notably over the last decades. The reports in the series Public Attitudes to Science (2000, 2005, 2008, 2011, 2014) show that the public continues to perceive science as beneficial to society, respects scientists' and engineers' work and is generally interested to know more about science. Overall, the public climate towards science has improved. This shows in several dimensions. For example,

- generic trust in scientists seems to have increased,
- the proportion of citizens who believe that science contributes to growth in the UK, and
- the proportion of people who believe that the benefits of science outweigh the costs has grown (Castell et al., 2014).

With the overall attitude towards science having become more favourable in recent years, it is difficult to isolate the contribution of the SMC to this trend. However, the SMC plans to investigate its impacts more closely in the future.

Further long-term effects on **democracy** and **economy** have not been identified yet.[46] However, one could speculate about the effects the SMC might have on democracy and the economy. Generally, well-informed citizens and policy makers should be expected to make **more informed decisions** with regard to research and innovation issues as additional knowledge enables them to weight possible risks and benefits more rationally. Secondly,

[46] It has to be noted that a structured approach with pre-defined indicators and a long time frame is necessary to measure the effects of interest which might not be feasible at the present.

information is often considered a prerequisite for public engagement, for instance in policy agenda setting.

Concerning the **economic impacts**, one might argue that better information leads to higher acceptance levels of certain technologies or industries. Moreover, with concepts like open innovation and citizen science becoming more important, information may act as a prerequisite for involvement in these types of activities. These activities (especially open innovation or participatory product development) are expected to lead to broader acceptance of the developed products and services. In consequence, this might reflect in higher market shares as well as a competitive advantage for the economy in general (through the establishment of a lead market). Thus, the proliferation of scientific knowledge may stimulate economic activity and productivity. However, these effects are purely speculative at this stage and point more towards potential pathways of how the SMC could have democratic or economic impacts rather than concrete results.

6 Discussion

This case study is based on secondary sources, parts of which are published by the SMC, while other parts stem from sources critical of the SMC. Especially the insights about the outputs and outcomes are based on information from the SMC's internal review process. This process, while surveying a large number of stakeholders, was not a fully-fledged evaluation carried out by an independent organisation. Nevertheless, the results concerning outcomes, in particular the benefits for journalists and scientists should be considered valid, as the internal review has been conducted according to acknowledged standards of research. The overall impact of SMC on society, the economy or democracy have not been analysed (yet), hence it is not possible to make any causal claims in that respect.

7 References

Callaway, E. (2013). Science media: Centre of attention. Nature Magazine. Retrieved from http://www.nature.com/news/science-media-centre-of-attention-1.13362

Castell S., Charlton, A., Clemence, M., Pettigrew, N., Pope, S., Quigley, A., Navin Shah, J., Silman, T. (2014). Public Attitudes to Science 2014 – Main report. Retrieved from https://www.ipsos-mori.com/Assets/Docs/Polls/pas-2014-main-report.pdf

Hettwer H., Schneider, M., Zotta, F. (2013). Explorationsphase zur Gründung eines Science Media Center (SMC) in Deutschland – Executive Summary. Retrieved from http://www.wpk.org/upload/download/dokumente%20aktuelles/SMC_Executive%20Summary_Abschlussbericht%20RBS_het_13-04-17.pdf

Science Media Centre (2014). Science Media Centre Strategic Review Report. Retrieved from http://www.sciencemediacentre.org/wp-content/uploads/2014/09/SMC-Strategic-Review-2014-FINAL.pdf

Zotta, F. (2014). Erfolgsstory kopieren – Ein Plädoyer für ein Science-Media-Center für Deutschland. *Innovationsmanager*, 30, 58

Websites:

www.sciencemediacentre.org

Open Air Laboratories

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1 Case abstract

The OPEN AIR LABORATORIES (OPAL) project mobilised citizens to collect data for the environment through national and regional surveys feeding into existing scientific research and demonstrating that citizens are in a position to reliably contribute to academic research. Quantitative data from the monitoring process of the project and qualitative data based on interviews were used to get a better insight into the project. The resources were distributed equally between research activities (preparation of data collection and exploitation of results) and services (regional data collection, education and awareness raising). Thematic research coordinators, research teams, community scientists (a governance novelty of the programme) and a wider circle of citizens were involved for a period of six years. The results were highly encouraging in terms of contribution to research, education, citizen involvement and the public image of science, hence pointing at the need for research policy to take this type of data collection and wider community involvement into consideration.

Table 22 Case study 11: Case details

RRI dimension	RRI X	Citizen Participation X	Science Literacy X	Gender equality □
	Open Access □	R&I governance □	Ethics □	Other □
R&T field	Academic research			
Country	UK			

2 Introduction

The OPEN AIR LABORATORIES (OPAL) was a *Citizen Science (CS) project* initiated by Imperial College, London. The main idea of the project was to organise a network and design a set of activities that would mobilise civilians to collect data about the environment through national and regional surveys. The project was meant to combine incentives for a better lifestyle (teaching young people, in particular from deprived areas, to spend more time outdoors), education of the public, environmental sensitisation, contribution to research activities and partnership building. Its relevance as a case study for MORRI lies in the increasing interest of citizen science in its multitude of dimensions ranging from 'crowdsourcing' (level 1) where the

citizen acts as a sensor, to 'distributed intelligence' (level 2) where the citizen acts as a basic interpreter, to 'participatory science' where citizens contribute to problem definition and data collection (level 3) to 'extreme citizen science' which involves collaboration between the citizen and scientists in problem definition, collection and data analysis (Haklay, 2013)

Citizen science (also known as crowd science, crowd-sourced science, civic science, volunteer monitoring or networked science) is scientific research conducted, in whole or in part, by amateur or non-professional scientists. Citizen science has been defined as "the systematic collection and analysis of data; development of technology; testing of natural phenomena; and the dissemination of these activities by researchers on a primarily avocational basis".[47] Citizen science is sometimes included in terms such as "public participation in scientific research", participatory monitoring and participatory action research.[48] Citizen science is defined as the participation of non-specialists in research projects, in particular more recently using the power of the internet. "Citizen scientists may act as volunteer classifiers …, they make observations of the natural world… and they even solve puzzles …..".[49] Citizen science has evolved over the past four decades. Recent projects place more emphasis on scientifically sound practices and measurable goals for public education and modern citizen science differs from its historical forms primarily in the access for, and subsequent scale of, public participation; technology is credited as one of the main drivers of the recent explosion of citizen science activity[50]. The idea of CS has been rapidly adopted in many countries in particular in the areas of environment and medical research and Citizen Science Associations have emerged[51].

The opportunity for an experiment to test such a wide participation was offered by the activities of the Big Lottery Fund (BLF), an endowment funded by the National Lottery, which aim to give money to good causes. More specifically, the BFL's good causes include community groups and projects that improve health, education and the environment. The fund distributes about £650 million through calls for proposals with the aim to act as grant maker and catalyst for the empowerment of civil society. Its primary concern is skill development and engagement of the community. Imperial College was the champion, which responded to a BFL call, taking the initiative to exploit the *engagement of society* opportunity requested by the Fund with the

47 http://www.openscientist.org/2011/09/finalizing-definition-of-citizen.html

48 Hand, E. (2010). "Citizen science: People power". Nature 466 (7307): 685–687. doi:10.1038/466685a

49 https://www.scientificamerican.com/citizen-science/

50 Silvertown, J. (2009). "A new dawn for citizen science". Trends in Ecology & Evolution 24 (9): 467–201. doi:10.1016/j.tree.2009.03.017.

51 Australian Citizen Science Association http://www.citizenscience.org.au/wordpress/, European Citizen Science association http://ecsa.biodiv.naturkundemuseum-berlin.de/about Even the American Association for the advancement of Science is embracing the term http://www.aaas.org/search/gss/citizen%20science

interests of the participating researchers. Hence, the project is classified as incentive driven; citizens participated actively and willingly and Imperial as a champion was crucial for the projects development and success[52].

The process was as follows:

1. Imperial College formed a network of research teams and responded to a BLF call for proposals, applying for a grant, which aimed to mobilise citizens to provide researchers with data in the spirit of the Citizen Science[53] idea. The main scientific drivers were: Global and national concerns about loss of ecosystems and the need for sustainable development and a UK crisis in taxonomy. The initial proposal covered England only.
2. The grant was approved with a total budget of about £13 million, with the objective of raising awareness and enhancing local community participation in the area of environmental deterioration/protection.
3. Additional awards were granted by the BLF in 2010 and 2012, of £1.3 million and £1.4 million respectively. An extension of the programme to expand from England to the whole of the UK was decided in December 2013 for another 3 years with a new budget of £3 million[54].

The key objectives were (as explained by the team)[55]:

1. A change of lifestyle – a purpose to spend time around us
2. An exciting and innovative educational programme that can be accessed and enjoyed by all ages and abilities
3. An inspiration for a new generation of environmentalists
4. A much greater understanding of the state of the natural environment
5. The establishment of stronger partnerships between the community, voluntary and statutory sectors

The research part was mainly Number 4, on the list above, as it was mentioned that OPAL wants to ensure that everybody can participate in projects to monitor the state of the natural

52 Using the incentive-driven, compliance-driven, citizen-driven and champion(s)-driven classification the project may be classified as in the interaction of all but the compliance driving force.

53 Citizen science is defined as organised research where the balance between scientific, educational, societal and policy goals varies across projects. It is a growing worldwide phenomenon recently invigorated by evolving new technologies that connect people easily and effectively with the scientific community. New technology provides a valuable tool for citizens to play a more active role in sustainable development. Through collaboration with scientists in organised research projects citizens can contribute valuable information that can be used to develop and deliver policies, improve understanding and respond to many of the challenges facing society today http://ecsa.biodiv.naturkundemuseum-berlin.de/about

54 (OPAL) Open Air Laboratories – a case study of engagement, raising awareness, evidence and reporting, Dr Slawson D., Imperial College, London

55 OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

environment and its biodiversity. It aimed to help some of the most disadvantaged communities to identify, quantify and highlight environmentally deprived spaces.

OPAL is implemented by 15 public sector partner organisations from across England, including 10 universities. OPAL has also two associate partners (the Environment Agency and the Department for Environment, Food and Rural Affairs) and is affiliated to Research Councils UK[56].

The two main actors represent the two different expectations of the project, but with the common goal to demonstrate that citizens can be a valuable resource of research. The two main actors are:

- BFL (the funding agency): Engagement of Society (eventually targeting education and social participation)
- Imperial (the coordinator) and the consortium participants: research results relevant for their respective field of study

The case is relevant for RRI since it enhances active community participation in environmental research and awareness raising, not only mechanically (data collection based on survey guidance) but also actively as the activities encourage participants to also think about the conditions that animals, plants and fungi need for survival and come up with their own assumptions, ideas and hypotheses. Although there is a growing discussion and interest in Citizen Science there are limited large-scale research-related projects. OPAL helped big data collection but also demonstrated that data collection by the public, which is significantly less costly and covers a larger ground compared to collection by scientists, can be reliable, provided the exercise is carefully designed. Citizens are in a position to reliably contribute to academic research.

3 Methodology and data

The methodology followed by the case study included thorough desk research on the internet, study of hard-copy reports, telephone and face-to-face interviews (list in Appendix). The data we were looking for were:

- Quantitative, regarding the level of inputs (funding, human resources involved in the project implementation), community engagement (number of people involved on a voluntary basis) and research output (publications).
- Qualitative, regarding the governance of the project and the quality of results obtained.

[56] OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

The data used were those collected by OPAL itself, which as a data collecting-project, had a monitoring exercise built into the process. Data for the case study were initially collected from presentations and reports available on the Internet. Since the project started in 2007, a lot of information and statistics were available. The project itself has a monitoring and evaluation task that helps identify and report the indicators relevant for the funder, BLF. These are mainly the indicators referring to the Community engagement and project spending. These data were made available and are included here to the extent that they are in the public domain and relevant for the case study.

However, what was more relevant for MORRI were the data on research and the impact OPAL had on the research results. As these were not systematically reported but of interest to the individual research teams, the input for the case study was complemented with desk research, relevant publications and interviews with the coordinator and selected project directors.

The qualitative data on satisfaction of the participating citizens and researchers could be collected by systematically studying all available policy documents and via semi-structured interviews covering the following themes:

- Involvement of citizens in terms of data provision
- Quality of the data obtained
- Quality of research results
- Active involvement of citizens in new research ideas
- Implications for future projects

4 Input level: RRI activity

The project was delivered by a partnership of 15 organisations from across England, including ten Universities undertaking the surveys (Imperial College London, University of Birmingham, University of Central Lancashire, University of Hertfordshire, Newcastle University, University of Nottingham, University College London, University of York, Plymouth University, The Open University) and five public or non-profit organisations (Field Studies Council, The Met Office, National Biodiversity Network, Natural History Museum and the Royal Parks) responsible for the provision of support services. OPAL has also two associate partners, the Environment Agency and the Department for Environment, Food and Rural Affairs and it is also affiliated to Research Councils UK through the Living with Environmental Change (LWEC) programme[57].

[57] OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013 http://www.opalexplorenature.org/CEreport

The governance of the project was as follows: *Five* distinct but methodologically connected *themes were selected* for data collection, educational and research activities: Soil; Air; Water; Biodiversity and Climate. The areas were carefully selected to include previous in-depth research, which allowed for comparison and control of the citizen-collected data with pre-existing knowledge. The *thematic coordinators* (researchers) in the five areas prepared *the surveys.* They were organised to create and distribute packs of information with the description of the issue and questions to be filled in by the participating citizens (partly in hard copy and partly directly digitally). The packs included booklets with information, designs of the items to identify and (different by survey and depending on the information to be collected) rudimentary tools of research (e.g. plastic magnifying loupes).

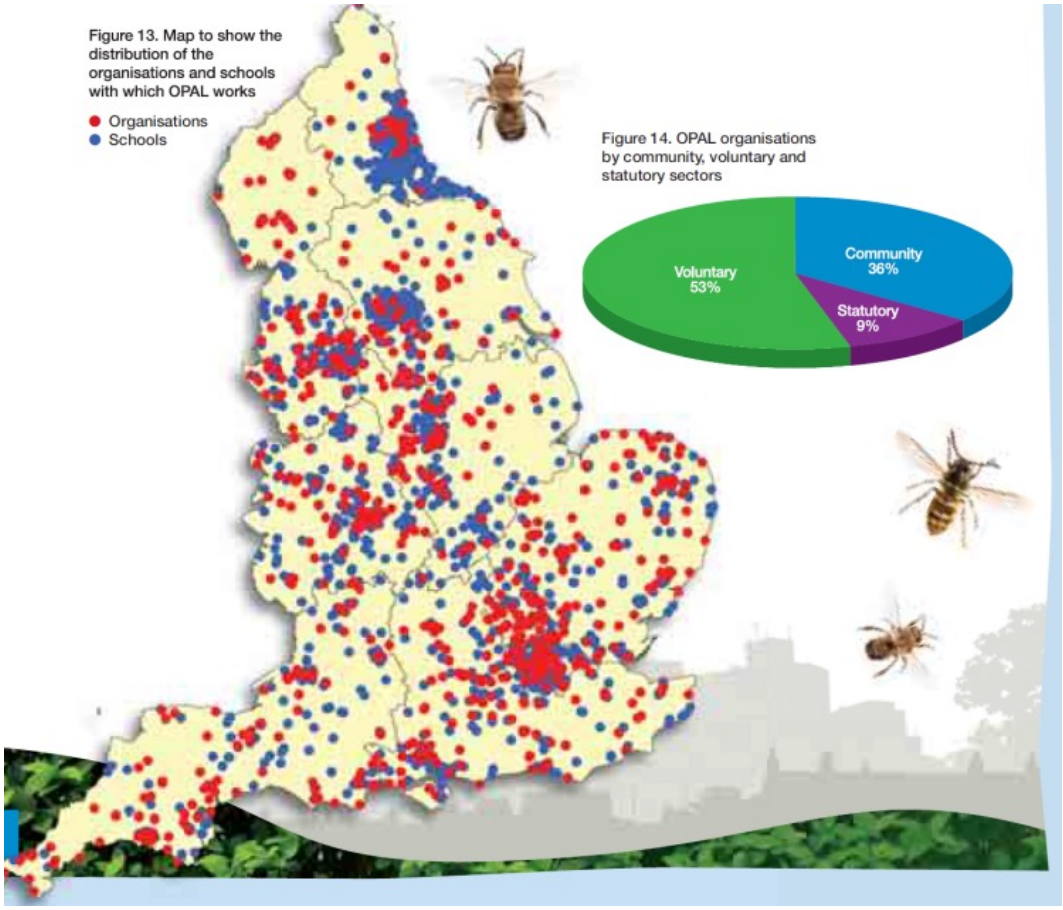
The survey preparation was a very challenging task, because involving citizens in research is notorious for risks of bias or inaccuracy (Bird et al., 2014). The validity and significance of data was tested internally by OPAL. The challenge of this process was that, while the BLF was interested in the public engagement, scientists often tended to mistrust data collected by the public. To make up for the mistrust, the methodology of the project included an initial design phase, which was composed of the identification of questions that were sufficiently clear for public to complete as well as different data quality control methods (quizzes, comparison with science surveys, side experiments) that would ensure the accuracy of the responses. The design phase, which took about a year for each survey was the one that enabled science coming from the public and being used for research. As a consequence, the preparatory work was very cumbersome, as it had to design the packages in a way to be both interesting and simple enough for citizens to be willing and able to respond properly. This included for instance Master theses to understand which was the most appropriate age of school children to participate (if they are too young they are unable to identify the specifics required, if they are too old they might not be interested in the specific observation) or other type of scientific research to identify appropriate participants and methodologies. The success of OPAL is attributed largely to the researchers involved and to the resources devoted to the preparation of the surveys.

These five packs were distributed to nine regions all over England and were coordinated by a *Community Scientist*[58], who would supervise the activity in his/her region. The Community Scientist's role was unique in academic institutions, with public engagement being their primary purpose, motivating people to get involved in OPAL activities. Academics supervised the Community Scientists and, in most cases, OPAL-funded students in the research teams, who supported the preparatory work and the data processing. To ensure effective collaboration with

[58] In reality there was one Full-time-equivalent job for a Community Scientist in each region; in certain cases the job was shared by more than one part-timers

all sectors of the community, regional meetings and workshops, open days, training sessions and community visits were built into the programme. Groups included in this collaborative approach involved local governments, government agencies, schools, wildlife and naturalist groups, communities and voluntary sector organisations, all working directly with the academic team. The regional coordinators activated their respective communities, accessed via schools and via other means, like media, roadshows, internet etc. The complexity of the interaction of the different organisations involved is reflected on the map below:

Figure 1 Interaction of organisations involved



Source: OPAL Community Environment Report

The statistics on people involved are impressive with different indicators used, depending on the year, the direct and indirect involvement and the web statistics (unique visitors or otherwise). In 2011, over 200,000 people had participated in the OPAL project; 1,000 schools and 1,000 organisations had registered. By 2013, the number of participants engaged in OPAL had more than doubled (425,000 people) from 11,000 sites around the UK. Nearly 2,000 schools had registered for OPAL resources. A total of about 230,000 field packs were distributed, 50% directly to schools and 50% to the public. Within this context, it is worth observing the high participation of schools from deprived areas. Over 10% of the organisations and schools, that

OPAL works with, and 6% of submitted OPAL surveys, originated from the 10% of the most deprived areas in England[59]; 50% of participants participated for their first time in a survey[60] and only 8% were reluctant to complete another survey[61]. 75% of respondents said that they would try to do more OPAL surveys in the future[62]. By 2014, OPAL had engaged more than 850,000 users[63].

Half of the OPAL budget goes to research into the five thematic Centres (soil, air, water, biodiversity and climate), while the remaining half is channelled to support services. The latter include an OPAL portal, the provision of a national database, the operation of a communications office (all offered by the Natural History Museum), the provision of biological recording software (National Biodiversity Network), the provision of training facilities (the Field Studies Council) and the conduct of exhibitions (the Royal Parks)[64].

OPAL targeted society as a whole, but, following the BLF requirement there was a particular focus on minority groups, disadvantaged sectors of society and areas of deprivation. At the end of the English Phase in 2012, for which data were available, a total of 40,000 packs were produced for each survey with 46% coming from schools, mostly in deprived areas, and the remainder went to local communities. Repeated sampling was encouraged but any follow up would be considered as a long-term positive impact without additional funding.

The input data of the projects is composed of:

- the number of participants in the surveys, analysed into individuals, schools and organisations,
- the number of packs produced for the surveys, and
- the number of surveyed sites.

Other RRI aspects were also addressed through the findings of online questionnaires filled in by survey participants and released by the OPAL statistics team. The findings revealed:

- the willingness of the participants to repeat surveys,
- a degree of behavioural change towards the environment and
- an enhancement of skills.

59 OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

60 OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

61 695 out of 9,261 people who answered this question (OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013)

62 Online questionnaires (593) and findings from interviews by social scientists (OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013)

63 Statistics provided from OPAL coordinator

64 OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

Data transmission proved to be a problem: there were participants who lacked confidence in their own observation, computer skills or willingness to transmit electronically. In this case the results were not registered on the website. This was an important lesson learned and efforts to improve the situation were undertaken in the form of the introduction of text messaging and more interaction between the participants and the project team through feedback to respondents, making them feel that their findings were reviewed and useful.

5 Output and outcome level: impact and benefits

The groups affected included practically all participants and the appropriateness of measures for output and outcome depend on the point of view of the three benefitting communities:

- The research community because of the data received.
- The wider public because of access to knowledge (engagement).
- Children at school because of their increased interaction with nature (education and open air activities).

OPAL's direct benefits to research:

There was a very systematic data collection of outputs by the Monitoring team of OPAL, as a Monitoring Report was one of the deliverables of the project. However, research output was not in the direct interest of the funding organisation, hence the data closely monitored were related to education, community participation and involvement. Hence, data on direct output for research purposes was discussed during the interviews. Additional data regarding environmental awareness raising, lifestyle changes and open-air activities were systematically collected by the project team and suggests that OPAL created an increased interest in science and research that is expected to lead to spillover effects.

The direct output of the project can be subdivided into measureable outputs and qualitative, non-measurable ones.

Quantifiable outputs:

1. The entries of new data for the researchers: approximately 25,000 surveys were submitted to the OPAL database.
2. The number of Master and PhD theses resulting from the project: while there are no systematic statistics collected in this topic, in all interviews it was mentioned that both in the context of the research teams preparing and assessing the surveys as well as in the case of Community Scientists, Master (in the Soil area alone there were 16 Master projects associated with OPAL) and PhD students were hired (approximately 2-3 per

area; there was no systematic reporting for a total accurate figure). OPAL has also funded 10 post-graduate PhD students[65].

3. The peer-reviewed scientific publications that were prepared based on the specific project were not systematically collected in the project website. However, through the interviews six scientific publications in journals with high impact factors were collected. There is a general perception that many more publications were prepared and published by the 15 associated universities but there is no OPAL repository of project-supported publication. Hence, the data on publications may be underestimated.

Qualitative assessment:

1. OPAL generated new knowledge from areas that were in the past inaccessible and offered an overview of the environment that professional scientists alone could not have provided. The wider public provided data from previously inaccessible areas by scientists (e.g. gardens, inner city areas, allotments and playing fields) from all over the UK. A pertinent indicator for the additional coverage would be the share of territory covered by OPAL compared to the share of territory covered by corresponding scientific surveys but this was unavailable.
2. Data could be collected in much more cost-effective ways than if scientific instruments and professionals were used. Again, comparable quantitative data were not available.
3. The high quality materials used to study biodiversity, climate, water, air and soils (qualitative appraisal of the research coordinators after data cleaning and quality control).
4. The information available on the project website has generated new knowledge equally accessible by scientists and citizens.
5. The project allowed for significant new insight into methodologies and ideas on the design and quality output of CS: the five surveys used different methods for data quality and their comparison and discussion raised new research topics on alternative approaches to data quality control (quizzes, side experiments, monitoring), addressed data cleaning problems and the use of cross reference questions ex ante to facilitate quality control ex post.

A (subjective) measure of success was the increasing recognition from the side of the funder: Big Lottery Fund made additional awards of £1.3m (2010) and £1.4m (2012) as the impact of the public participation activities were recognised (surveys on Bugs Count and Tree Health). In 2014, BLF launched 'Supporting UK-Wide Great Ideas' and awarded OPAL a new 3 year, £3m to extend the community engagement work to Scotland, Wales and Northern Ireland (OPAL-UK), expanding the coverage from a sub-national impact (England only) to the whole of the UK.

[65] OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

5.1 OPAL's contribution to the relevance of citizen science

A major contribution of the project was its ability to indicate that *Citizen Science can be scientifically rigorous*. The control mechanisms proved that researchers can trust the public to provide big data, provided the preparatory work is sufficiently professional and meticulous. This is a very significant outcome of the project, which indicates that similar projects can be used in a wider scale and allow for more data provision.

In addition, compared to conventionally conducted surveys back in 1971 and 1972, OPAL offered a higher response rate of 7.5% against 6.6% previously achieved[66].

5.2 Dissemination of knowledge

Alongside providing new knowledge to researchers, a significant contribution was the *dissemination of knowledge to the wider public*, which ranged from greater awareness (participants indicating that they became more careful with their interaction with nature after having participated in the project) to teachers using the OPAL material for their classes. The new experience of science by one million people created a group of young people who have been inspired to think of science differently and many of them are hoped to consider careers linked to it.

The media, which were initially mobilised to help and attract the attention of participants from the civil society, proved a valuable ally. There is a perception (not measured) that after their involvement in OPAL local media and national broadcasting have continued being more involved in citizen science. Several interviewees mentioned local channels and even the BBC discussing the project and its merits.

In terms of dissemination, there were too many websites associated with the project to be able to count all visits, but as demonstrated below 2.5 million visits were recorded on the main website up until November 2013, originating from the whole world. There have been 194,094 downloads of resources[67]. There is extended media coverage, including newspapers (The Guardian, The Times, The Independent, Sunday Telegraph, Telegraph, Daily Mail and Daily Express), radio (over 180 radio stations), TV and print media. Total circulation figures exceeded 100 million. Figures have greatly exceeded targets, as evidenced by the table below (data November 2013). The target was linked to the original budget. The success is the exceeding of the particular case.

[66] Open Air Laboratories (OPAL): A community-driven research programme, Davies L. et al., Environmental Pollution 159 (2011) pp 2203-2210

[67] Statistics provided by OPAL Coordinator

Table 23 Case study 11: Comparison of target and actual dissemination results

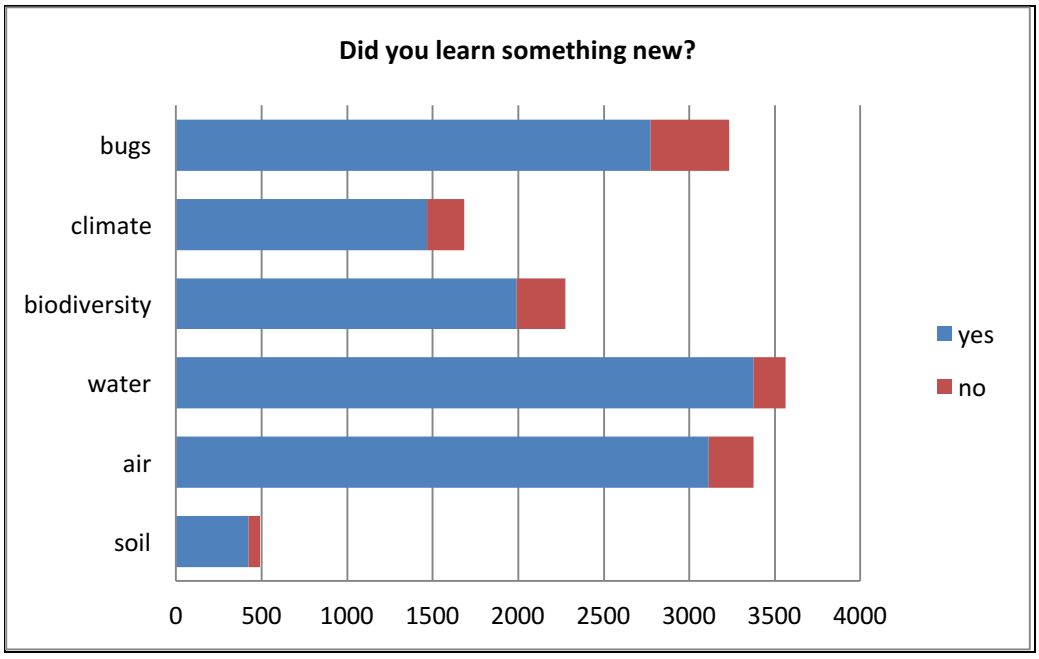
Type	Community	Web	Media[68]
Total	855,586	2,519,839	799,348,850
Target	496,672	1,185,700	6,454,000
Difference	+358,914	+1,334,139	+792,894,850

Source: OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

The main OPAL online education site, iSpot, run by the Open University, has been accessed by over 1,120, 000 people.

Internal surveys demonstrate that citizens benefitted greatly from their participation, as pointed out by the response to the question: **Did you learn something new about your environment? Have you learnt new skills?**

Figure 2 Case study 11: New knowledge by type of survey



[68] Figures based on cumulative circulation or views per month figures for respective periodical, television/radio programme, or website.

Source: Internal Monitoring Report OPAL

At least two tools are extensively used for the dissemination of knowledge:

- Indicia has been adapted for use in Europe: Indicia was developed as open source software and therefore can be used and adapted by anyone, anywhere in the world. Software has been implemented in Italy by the Museum of Natural History of the Maremma and in Paris by the Natural History Museum, proving the viability and value of the software beyond England's borders.
- A new online interactive tool was launched in July 2013 to engage all OPAL portal visitors. It can be accessed through http://www.opalexplorenature.org/learning-lab. This facility is particularly important because it seeks to direct web-visitors towards the outdoor environment and to some extent replace the work of the community scientists whose posts were due to come to an end in May 2013. Traffic to this tool has increased steadily since its launch.

In addition, invitations to speak at international events about OPAL and citizen science have been received from many European countries, the EU, Australia, Israel and the list is increasing. OPAL Soil Centre staff invited to Sorbonne to lecture on results and lessons learned.

5.3 OPAL beneficiaries

Using the MORRI methodology an effort is made to break down the benefits into the following three types:

5.3.1 Benefits to Society

Societal impacts were important in terms of educational and environmental awareness:

Environment:

- A change of the behaviour of people towards the environment was observed, with 43% of people taking part in the surveys having declared that they had changed the way they thought about the environment and more than a third (37%) declaring they will change their behaviour towards the environment[69] Overall, the programme engaged 500,000 people directly and 500,000 people indirectly through the OPAL portal and iSpot. A total of about 230,000 packs were distributed[70];
- An improvement of the awareness raising regarding the environment, was observed since OPAL worked with more than 1,000 organisations from the voluntary sector (53%), the community sector (38%) and the statutory sector (9%) and 46% of OPAL

[69] Online questionnaires (593) and findings from interviews by social scientists (OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013)

[70] Statistics provided by OPAL Coordinator

grant-funded societies have increased their membership by more than 10% due to OPAL works[71];

Education:

- An enhancement of personal skills was also observed with 90% of survey participants claiming they had learnt something new[72] and 83% of participants reporting that they had developed new skills[73];
- Training of a new generation of environmentalists through education of teachers and pupils on environmental issues and offering the opportunity for lessons outside the classroom. Schools participated by more than 54% in the surveys and schoolchildren alone contributed data from approximately 15,000 sites. OPAL also raised membership of environmental societies (10% increase in about 10 societies in 2010)[74];
- Outreach to impoverished parts of England through the participation in surveys of people from disadvantaged groups (learning and physical disabilities, homeless individuals, immigrant communities, people with no or low levels of literacy, black and ethnic minority groups). In total, over 100,000 people from deprived communities participated in the surveys[75].
- Enhancement of academic curricula and the provision of new educational materials in the 10 universities participating in the programme and in youth organisations[76]:
  - The CREST Star Investigations Programme, ran by the British Science Association, was enriched by activities sent from OPAL to 785 schools and club-members of various clubs that joined the programme. Pupils were also assisted by OPAL survey material;
  - Over 40 clubs, scouts, guides have used OPAL Surveys and contributed data, with a greater interest in climate and weather, while OPAL sponsored the relaunch of the Scout Association's Weather badge and helped more than 150 young people to complete their Weather badge;
  - OPAL was invited in 2011 by Catch 22, a support organisation for young people, to be part of National Citizen Service, a government initiative and pilot scheme;
  - All OPAL surveys have been promoted by National Geographic Kids Magazine. The magazine also launched an environmental competition for young people and OPAL provided the awards.

[71] OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

[72] 13,142 out of 14,621 people who answered this question (OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013)

[73] 12,277 out of 14,765 people who answered this question (OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013)

[74] Statistics provided by OPAL Coordinator

[75] Statistics provided by OPAL Coordinator

[76] OPAL Community Environment Report, EXPLORING NATURE TOGETHER, 2013

5.3.2 Benefits for Democracy

The project had no influence on democracy, unless one wishes to measure the contribution of education to democracy. In particular, people involved in the project management hope that the beneficial role of OPAL in deprived areas may have a positive influence on civic behaviour.

5.3.3 Benefits for the Economy

In monetary terms direct benefits included:

- Over GBP 220,000 was awarded to amateur natural history societies through the OPAL Grant Scheme[77].
- Projects have been fortunate to benefit from the in-kind contribution for the whole of the portfolio, including support and services of volunteers, institutional staff, and other organisations, which amounted to GBP 1,304,39578.

Economic benefits were mainly indirect, long term and associated with:

- Benefits expected from academic research, in particular the influence these research activities have in influencing the adoption of regulation (e.g. European Union Soil Directive).
- The declaration of farmers that they are now more interested to check their land.
- Suggestions from the community for new research topics: invasive crayfish and a new project on waste management.

But by and large the conclusion of the project is that "a more informed and active society can make a real contribution towards addressing some of the major environmental challenges facing us today. It also shows that exploring nature can be fun and exciting for everyone and can have a positive impact on people's lives"[79].

6 Discussion

The nature of the project allowed identification of the necessary data, which were sufficiently detailed and well presented to help assess the benefits of a citizen science project. It would have been useful to monitor more data on scientific (e.g. number of papers and citations per paper produced) and economic outcomes, but as this was not the initial target of the call this data was not available.

[77] For further information see the OPAL website: http://opalexplorenature.org/Societyfunding

[78] Statistics provided by OPAL Coordinator

[79] OPAL Community Environment report, op. cot, p. 5

The issues arising from this case study that are of relevance for RRI refer to the role of CS for research, its advantages and disadvantages and the lessons learned from the specific project.

Does citizen science contribute to RRI?

Actually, CS is part of the RRI definition. It has long been acknowledged that governments alone cannot resolve the big environmental challenges facing society today[80] and CS may be a significant means to help. Hence, certain important features identified by the project need to be discussed here:

- Citizen involvement in research seems to be appropriate only for research associated to societal challenges, not in corporate research of direct economic interest.
- CS contributes to a selection of topics that is more relevant to everyday life.
- People can exercise their influence on research agendas when they are informed and inspired. This has to be done through sparking awareness and interest. Community groups have to see the relevance of their own activities and interests in the bigger picture.
- Citizen involvement is a lot more than data collection: The activities encourage participants to also think about the conditions of the project they are collecting data for (in the case of OPAL conditions that animals, plants and fungi need for survival).
- CS can offer new ground for research topics as one can use the characteristics of the citizens involved for additional research (e.g. combine results with levels of poverty and other independent variables).
- A challenge for CS is its continuity.

An interesting point for discussion is the extent to which CS (through publicly available results) can contribute to research integrity.

How can citizen science be best organised to add value to R&D?

OPAL was about the collection of big data, which would improve the knowledge of the individual research teams in their respective fields. The problem was to mobilise the public and ensure accuracy of data, the challenge was to dedicate the necessary preparatory work to make the citizen research collaboration succeed.

The elements of success in terms of conducting high-quality research included:

- The involvement of high-quality research centres.
- Sufficient attention and resources dedicated to preparation and science-community interaction. A dedicated "intermediary" such as the Community Scientists plays an important role.
- People could see the data they collected and identify themselves with good results.

[80] Office of the Deputy Prime Minister (ODPM) (2006). *Securing the future: Delivering UK Sustainable Development Strategy*

- Media played a key role. Engaging the public is easier through events with celebrities on TV, public launches, etc.
- Big data is important for identifying trends, even if it is not as accurate as scientific measurements.

It is important to draw attention to the replicability (or not) of such endeavours: it has to be investigated to what extent the background and culture of a country, and the maturity of institutions related to citizen involvement, would be prerequisites for success. Citizen involvement in England worked, but would it work in other countries equally as well?

What are appropriate policies for CS?

It seems that there is increased likelihood of policy success if the public is involved and adopts the results leading to specific regulation. However, (at least in the UK) Research Councils do not fund citizen science. OPAL's success may be challenging this decision. In countries where there is no tradition of foundations, funding research is practically no possibility to mobilise citizen science.

If CS is to be adopted by incentive schemes, a few points need to be mentioned:

- Citizen-science projects are very complex and require a lot of administration, hence many organisations are reluctant to submit such proposals because they want to avoid the personnel cost that is not eligible for funding. If CS is to be promoted a higher share of funds for project management is necessary than in conventional research projects.
- The European Commission may offer incentives (Horizon topics) to connect national surveys with European wide ones

7 References

Bird, T. J., Bates, A. E., Lefcheck, J. S., Hill, N. A., Thomson, R. J., Edgar, G. J., ... & Frusher, S. (2014). Statistical solutions for error and bias in global citizen science datasets. Biological Conservation, 173, 144-154.

Bone, J., Archer, M., Barraclough, D., Eggleton, P., Flight, D., Head, M., ... & Voulvoulis, N. (2012). Public participation in soil surveys: lessons from a pilot study in England. *Environmental science & technology*, *46*(7), 3687-3696.

Bone, J., Barraclough, D., Eggleton, P., Head, M., Jones, D. T., & Voulvoulis, N. (2014). Prioritising soil quality assessment through the screening of sites: the use of publicly collected data. *Land Degradation & Development*, *25*(3), 251-266.

Bone, J., Head, M., Barraclough, D., Archer, M., Scheib, C., Flight, D., & Voulvoulis, N. (2010). Soil quality assessment under emerging regulatory requirements. *Environment International*, *36*(6), 609-622.

Bone, J., Head, M., Jones, D. T., Barraclough, D., Archer, M., Scheib, C., ... & Voulvoulis, N. (2010). From Chemical Risk Assessment to Environmental Quality Management: The Challenge for Soil Protection†. *Environmental science & technology*, *45*(1), 104-110.

Davies, L. (2013). OPAL Community Environment Report: Exploring Nature Together. Open Air Laboratories (OPAL).

Davies, L., Bell, J. N. B., Bone, J., Head, M., Hill, L., Howard, C., ... & White, P. C. L. (2011). Open Air Laboratories (OPAL): A community-driven research programme. *Environmental Pollution*, *159*(8), 2203-2210.

Donovan, S. M., Skartsila, A. M., Head, M. K., & Voulvoulis, N. (2011). An initial investigation into the use of a flux chamber technique to measure soil-atmosphere gas exchanges from application of biosolids to UK soils. Applied and Environmental Soil Science, 2011.

Haklay, M. (2013). Citizen science and volunteered geographic information: Overview and typology of participation. In *Crowdsourcing geographic knowledge* (pp. 105-122). Springer Netherlands.

Seed, L., Wolseley, P., Gosling, L., Davies, L., & Power, S. A. (2013). Modelling relationships between lichen bioindicators, air quality and climate on a national scale: Results from the UK OPAL air survey. *Environmental Pollution*, *182*, 437-447.

Going public: The OPAL Labs by Kerry Noble

www.opalexplorenature.org

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Websites

Going public: The OPAL Labs by Kerry Noble

www.opalexplorenature.org

iSpot – the wildlife identification website, www.ispot.org.uk

Indicia – new biological recording software, free to download from www.nbn.org.uk

Interviews

Evans, Laurence, OPAL Data and Evaluation Manager

Head, Martin, Soil and Earthworm Survey, Environmental Research Centre, Imperial College

Lakeman Fraser, Poppy L, OPAL Coordinator

Voulvoulis, Nick, Soil and Earthworm Survey, Head of Environmental Research Centre, Imperial College

Wolseley, Pat, Air Survey, Natural History Museum

National Open Access Policy in the Netherlands

Clifford Tatum, Ingeborg Meijer, Thed van Leeuwen
CWTS

1 Case abstract

Table 24 Case study 12: Case details

RRI dimension	RRI □	Citizen Participation □	Science Literacy □	Gender equality □
	Open Access x	R&I governance x	Ethics □	Other □
R&T field	Publishing			
Country	Netherlands			

2 Introduction

Measuring open access "is complicated by the growing diversity of what counts as Open Access, the copyright restrictions for when a publication can be made openly accessible, and the lack of clear and consistent identification of Open Access publications in bibliographic data" (MoRRI Analytical report - D2.4, p2). As the proposed RRI indicators for open access (Indicators of RRI - D3.2) are not immune to these challenges, contextual information is needed to aid in the interpretation of indicator outcomes. The aim of this case study is to situate proposed RRI indicators for OA in the context of a national-level policy for open access. This case study examines how a European Member State (the Netherlands) is organizing the governance of open access publishing. The study involves interviews of key stakeholders, document analysis, and a baseline quantitative analysis of open access publications in the Netherlands.

The Netherlands is among a small but growing number of European countries with a national policy aimed at 100% open access publishing. Others countries with a national-level policy for open access include the United Kingdom, Denmark and Sweden. The Netherlands' policy, published in a letter from the Ministry of Research and Education, outlines a two-step goal of 60% open access within five years and 100% open access within ten years. Transition to open access publishing involves disruption and realignment of numerous situated practices and procedures among diverse stakeholders such as: researchers, peer reviewers, journal editors, university libraries, research funding agencies, and indeed journal publishers.

A crucial aspect of implementing the national OA policy is the ability to monitor progress on a regular basis. This case study incorporates both quantitative and qualitative approaches. First, a

baseline analysis is conducted to (a) establish the proportion of open access journal articles produced in the Netherlands, and (b) assess the efficacy of using a commercial bibliographic database, Web of Science (WoS), for monitoring open access. Second, interviews and document analysis are used to assess activities associated with implementation of the open access policy.

In the next section, we outline the methods and data. The remaining sections follow the input (section 4), output and outcome (section 5) level. An outline of the open access policy is provided as the input. Following from this, the output section is comprised of activities and developments associated with implementation of the policy. And finally, in section 5, we discuss (a) challenges in monitoring open access in the Netherlands, (b) identification of gaps in research information infrastructure, which hinder assessment of policy implementation, and (c) important factors to consider when measuring and/or interpreting the RRI indicators of openness within and across different contexts.

3 Methodology and data

Methods

In this study, we present a number of indicators. In cases where we present numbers of publications, this is indicated with a P. In cases where citation data are presented, we use MNCS (Mean Normalised Citation Score), as well as the MNJS, the field normalised journal impact indicator, to indicate the normalised impact scores in the study (Waltman et al, 2011a, and Waltman et al, 2011b).

While the output indicator can be used for the various electronic systems we use in the study, and P can relate to various documents types analysed, the citation impact indicators are used only within the context of the CWTS WoS database. In case of the impact indicators, the length of the citation window is one year longer than the presented year block (so in case of the last block, 2009-2012, the citation impact is measured up until 2013, which was the last year fully covered in the CWTS WoS database when we conducted this analysis).

In addition, we use document analysis and semi-structured interviews to identify mobilisation of Dutch stakeholders and material resources associated with enabling Open Access, but which is not apparent from the quantitative analysis. The documentary analysis is focused on the implementation of Open Access policy and associated infrastructure development. Interviews subjects included stakeholders from the Ministry of Education, Culture and Science (OCW), the Association of Universities in the Netherlands (VSNU), and journal publishing. The interviewees served as informants regarding the implementation process (rather than as subjects of the study).

Data

Data collection and analysis consists of a direct linking of DOAJ listed journals, in a double linking process. First, by using the ISSN of the journal as the matching principle between the DOAJ list and the WoS database, and second, by using the start year of the journal in the DOAJ list (the year

of becoming open access) as simulation of the publication year.

It is important to note that self-archived articles (Green OA) are excluded from our analysis. While the Netherlands maintains a national repository for Green OA (NARCIS), within bibliometric datasets there is not yet a reliable system of identifying published articles that have also been self-archived.

As the data sources we use are incomplete with respect to open access publications, the analysis focuses on comparison of relative output and relative impact among three European countries of similar size and scientific production: the Netherlands (NL), Denmark (DK), and Switzerland (CH), in order to show developments in time, as well as differences resulting from both approaches.

4 Input level: RRI activity

The national policy for open access publishing in the Netherlands is based on a parliamentary meeting in April 2013, and was first published as an open letter on the Ministry of Education, Culture and Science website. The letter was published first in Dutch (Dekker 2013) and later in English (Dekker 2014). In the letter, Secretary of State Sander Dekker identifies problems with present efforts as, "*A wide variety of rules, agreements and options for open access publishing have emerged in the research community. The situation is confusing for authors, readers and publishers alike, and the stakeholders would like this confusion to be resolved as quickly as possible* (p1). According to Secretary of State Dekker:

1. Relevant stakeholders in the Netherlands "including publishers" indicated that a quick transition "from subscription-based publishing to open access" would be beneficial.
2. Academic research is international, therefore the solution to be compatible with international publishing norms.
3. A national policy for open access is consistent with the interests of the European Commission and the European Research Council.

The policy outlines explicit targets leading to 100% open access via the gold open access model within 10 years (by 2024). There is also an interim target of 60% open access with 5 years (by 2019). Key institutional stakeholders taking care of national coordination activities are identified as: higher education institutions, the Netherlands Organisation for Scientific Research (NWO), the Royal Netherlands Academy of Arts and Sciences (KNAW), the Netherlands Federation of University Medical Centres (NFU), the Association of Universities in the Netherlands (VSNU), the Dutch consortium of university libraries and the National Library of the Netherlands (UKB), Data Archiving and Networked Services (DANS), the Collaborative organisation for ICT in Dutch education and research (SURF) and the National Library, and academic publishers.

Translating the policy would involve coordination activities such as:

1. Consult European countries with similar objectives (United Kingdom, Germany, Denmark, Finland, Belgium and France).
2. Facilitate conditions for open access through negotiation with publishers, such that new subscription contracts preclude double payment.
3. Annual reporting of open access, submitted by universities, Royal Academy, and the national funding agency (NWO).

With this in mind, the Ministry of Education, Culture and Science (OCW) solicited a baseline study to determine the proportion of Dutch publications already available through open access. Although there have been numerous initiatives in the Netherlands to facilitate open access over the past ten years, the ability to measure open access is complicated by several factors. Chief among these initiatives is the National Academic Research and Collaborations Information System (NARCIS). While NARCIS serves as a national portal that links to open access repositories throughout the Netherlands, there is inconsistency in whether and how open access articles are registered and/or archived in the repositories. (See Analytical Report - D2.4, p.2, for detailed account of challenges to measuring open access.)

5 Output and outcome level: impact and benefits

5.1 Netherlands Open Access Baseline — analysis

The objectives of the quantitative analysis are to establish a baseline of Open Access output in the Netherlands as measured with commercial bibliographic data, and in so doing to identify the challenges and limitations. We use the internet version, available to most Dutch researchers, of the Web of Science (WoS) database. We also used a modified version of the WoS data, prepared by the Centre for Science and Technology Studies (CWTS) at Leiden University. Including the CWTS dataset enables use of the CWTW suite of advanced bibliometric techniques and indicators for impact analysis. In this CWTS version, the functionality to search for OA output is not yet available. Finally, we make use of the journals and the publications listed in the Directory of Open Access Journals (DOAJ). From this data source we focus on the digital object identifiers (DOIs), while leaving out other elements (such as licence types, as this information is unclearly defined as well as unclearly linked to the publications). Two analytical approaches are compared.

Analysis I: The first approach to data collection from WoS starts from the desktop interface of the WoS database. The functionality to collect this information is not yet available in the in-house WoS database at CWTS, so we therefore had to collect these data from the internet version directly. This approach followed the following steps:

1. Collect the output of one of the selected countries for a particular year;
2. Within that set, further distinguish the OA part of that selected output;
3. Download these publications from the WoS database (including the so-called UT-code, a unique identifier within WoS that allows for linking to the CWTS WoS database);
4. Select within the CWTS WoS database the output for the three countries;

5. Match the selected output from the Internet version of the WoS with the in-house CWTS version;
6. Create for each country two sets within the CWTS database, an OA formatted set of publications, and a non-OA formatted set of publications.
7. These steps were taken for all three countries, collecting publications from 2000-2013.

Analysis II: The second approach consists of a direct linking of DOAJ listed journals, in a double linking process. First, by using the ISSN of the journal as the matching principle between the DOAJ list and the CWTS WoS database, and secondly, by using the start year of the journal in the DOAJ list (the year of becoming open access) as simulation of the publication year. There is one issue with this approach, namely the fact that ISSN is not a clearly distinguishing entry here: some journals have two ISSN numbers, while it also occurs that one ISSN numbers is related to two journal names. However, that should not distort the analysis too much. Therefore, for this analysis, we used a third approach to the OA output of the three countries taking the following steps:

1. First select within the CWTS database the output for the three countries;
2. Collect the journal's ISSN numbers, and publication years in that set;
3. Match these with the ISSN numbers and starting years downloaded from the DOAJ list;
4. Create two sets within the CWTS database, an OA formatted set of publications, and a non-OA formatted set of publications.
5. These steps were taken for all three countries, collecting publications from 2000-2013.

We focused on articles, letters and reviews only, excluding other types of documents, such as editorials, meeting abstracts, book reviews, etc. Following CWTS practices, the choice for these types is based upon the importance of these three types in communicating scientific findings among peers, and their relative homogeneity within the system.

5.2 Netherlands Open Access Baseline — results

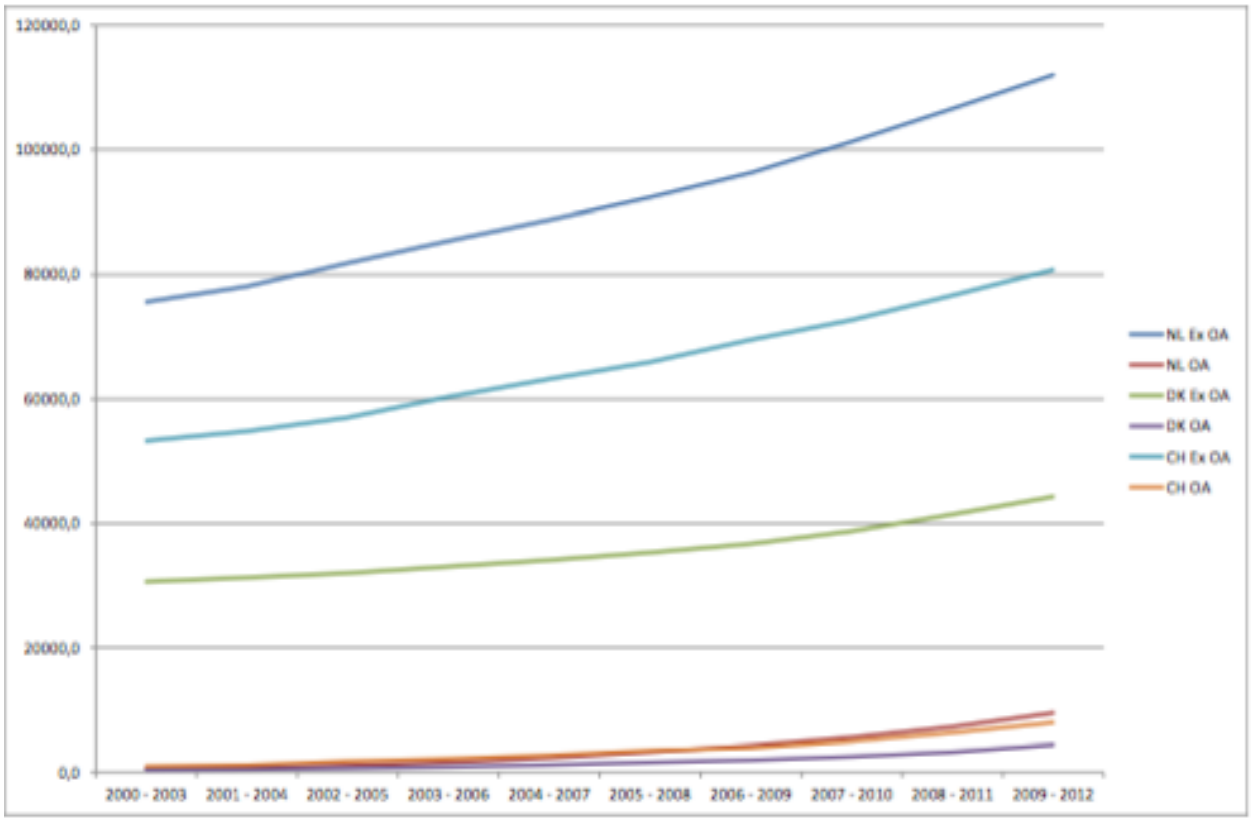
Analysis I: Output numbers of the three countries according to the methodology I are found in Table 25. These fall into two categories, namely the publications in OA format and non-OA format. This is indicated by the labels 'ex OA' ('non OA') and 'OA' after the country abbreviation. The analysis covers the period 2000 up until 2012 for publication data, and up until 2013 for citation impact data. In this analysis, we use moving publication year windows, in order to create more solid and stable trend lines, as we are mostly interested in the trends than in variation from year to year. Table 25 contains the output numbers from 2000 onwards, for the three countries, and the two separate parts of the output, distinguished by openness.

Table 25 Case study 12: Output (P) of Denmark, the Netherlands, and Switzerland, distinguishing OA and non-OA output, 2000-2012.

	NL Ex OA	NL OA	Share OA	DK Ex OA	DK OA	Share OA	CH Ex OA	CH OA	Share OA
2000 - 2003	75607	712	1%	30616	452	1%	53283	995	2%
2001 - 2004	78087	858	1%	31262	557	2%	54793	1220	2%
2002 - 2005	81849	1180	1%	31972	728	2%	56982	1836	3%
2003 - 2006	85386	1663	2%	33024	949	3%	60319	2217	4%
2004 - 2007	88745	2349	3%	34082	1244	4%	63205	2790	4%
2005 - 2008	92349	3265	4%	35273	1631	5%	65920	3517	5%
2006 - 2009	96278	4269	4%	36672	1997	5%	69518	3912	6%
2007 - 2010	101270	5587	6%	38726	2554	7%	72687	4981	7%
2008 - 2011	106560	7299	7%	41417	3264	8%	76658	6354	8%
2009 - 2012	111990	9504	8%	44264	4420	10%	80786	7990	10%

The data presented in Table 25, and in particularly the percentages presented therein, clearly show that OA publishing is becoming increasingly important in all three selected countries. The Netherlands is lagging somewhat behind Denmark and Switzerland, albeit with only a small part of the total output.

Figure 3 Case study 12: Output development (P) of Denmark, the Netherlands, and Switzerland, 2000-2012/2013.



In Figure 3, we have distinguished between the open access format output of the three countries (indicated by the 'OA' label attributed to the country names), and the non-OA format part of the output (indicated by the 'Ex OA' label to the country names). What we observe are increasing trends for the parts of the output not published in OA format, which is also visible for the OA format of the output of these three countries, and as shown above in Table 25, increases somewhat faster for Denmark and Switzerland as compared to the Netherlands.

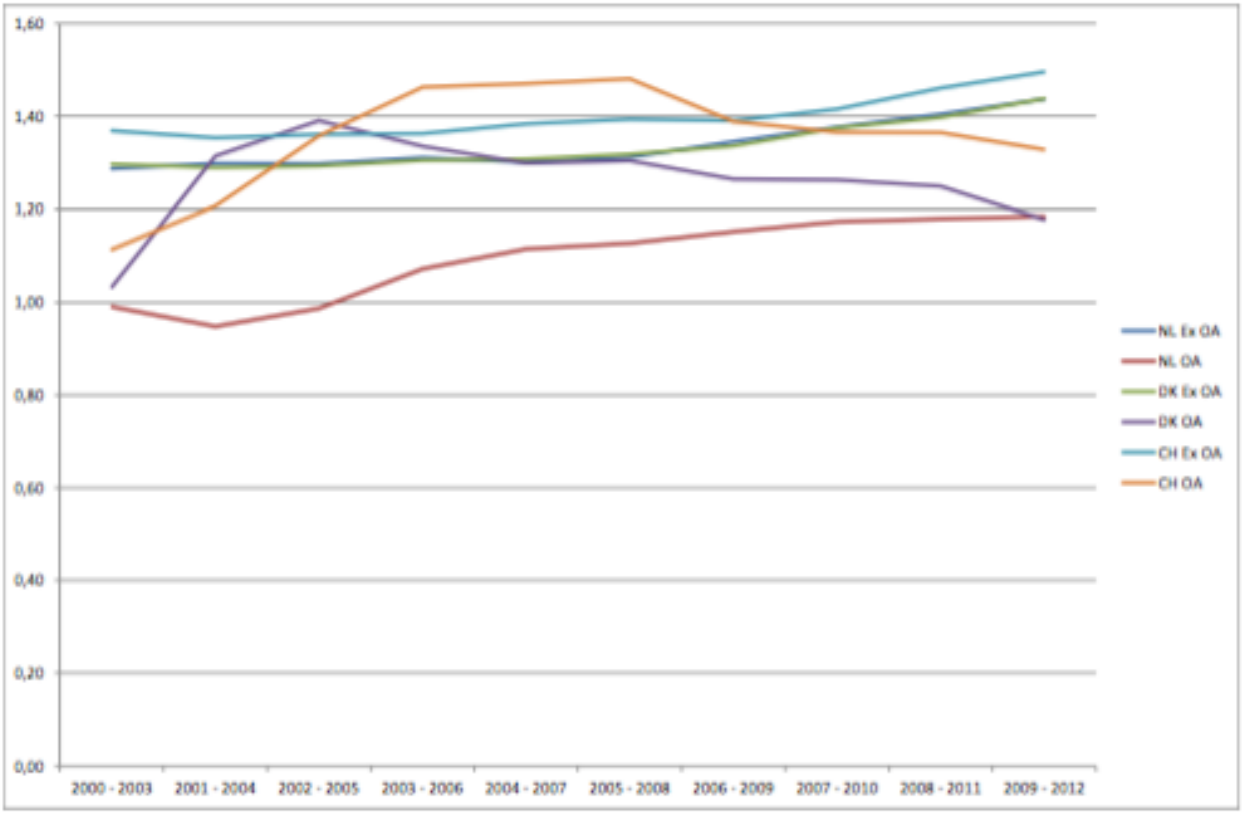
In Table 26, we present the citation impact scores as represented by the MNCS indicator, the field normalised impact of the outputs of the three countries, again separated by the two types of publication output: open access and non-open access publications.

Table 26 Case Study 12: Citation impact (MNCS) of Denmark, the Netherlands, and Switzerland, distinguishing OA and non-OA output, 2000-2012.

	NL Ex OA	NL OA	DK Ex OA	DK OA	CH Ex OA	CH OA
2000 – 2003	1,29	0,99	1,30	1,03	1,37	1,11
2001 - 2004	1,30	0,95	1,29	1,31	1,35	1,21
2002 - 2005	1,30	0,99	1,29	1,39	1,36	1,36
2003 - 2006	1,31	1,07	1,31	1,34	1,36	1,46
2004 - 2007	1,30	1,12	1,31	1,30	1,38	1,47
2005 - 2008	1,31	1,13	1,32	1,30	1,39	1,48
2006 - 2009	1,35	1,15	1,34	1,26	1,39	1,39
2007 - 2010	1,38	1,17	1,37	1,26	1,42	1,37
2008 - 2011	1,40	1,18	1,40	1,25	1,46	1,36
2009 - 2012	1,44	1,18	1,44	1,18	1,50	1,33

Figure 4 shows that for all three countries the non-OA part of the output has a citation impact well above world average, with Switzerland topping the other two countries, which have a nearly equal field normalised impact score. The impact of OA publications is lower for all three countries. The impact of the OA part of the national outputs of Denmark were initially well above world average (which is equal to 1.0 for this analysis). This is also the case for Swiss publications, as the OA format published output is lower on MNCS only from 2007-2010/2011 onwards. In case of Denmark, this drop started somewhat earlier, while in the case of the Netherlands, the OA output never got an impact higher than the non-OA format output. Another interesting phenomenon is the increase of the gap between the impact of OA and non-OA output. This is particularly the case for Switzerland and Denmark, where we observe a clear drop of the impact of OA format output compared to their non-OA formatted output, and to a lesser extent for the Netherlands, where the two impact lines are more slowly diverging.

Figure 4 Case study 12: Impact development (MNCS) of Denmark, the Netherlands, and Switzerland, 2000-2012/2013.



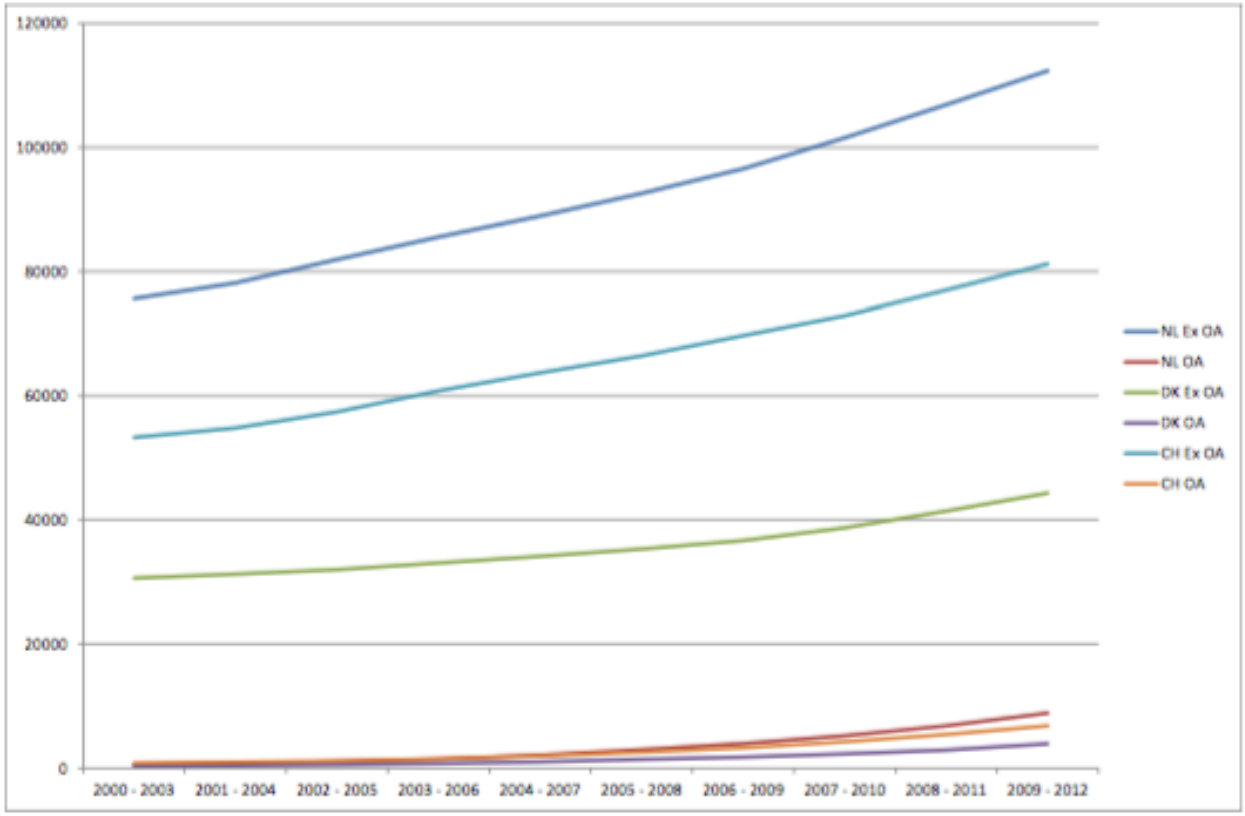
Analysis II: The results of the output analysis are shown in Table 27, which again covers a similar distinction between OA and non-OA format output, but now according to the definition described above under Method II. Therefore, we matched the datasets from WoS with the publications in the journals on the DOAJ list based on the ISSN numbers, and in addition to that, assuming that starting year on the DOAJ list is similar to the publication year in WoS, a 'year' similarity.

Table 27 Case study 12: Output (P) of Denmark, the Netherlands, and Switzerland, distinguishing OA and non-OA output (based on journal ISSN-number and starting/publication year matching), 2000-2012.

	NL Ex OA	NL OA	Share OA	DK Ex OA	DK OA	Share OA	CH Ex OA	CH OA	Share OA
2000 - 2003	75625	681	1%	30669	372	1%	53340	841	2%
2001 - 2004	78124	808	1%	31312	477	2%	54857	1020	2%
2002 - 2005	81916	1092	1%	32041	616	2%	57464	1189	2%
2003 - 2006	85539	1489	2%	33116	797	2%	60833	1502	2%
2004 - 2007	88928	2140	2%	34175	1065	3%	63732	1996	3%
2005 - 2008	92557	3012	3%	35350	1442	4%	66497	2636	4%
2006 - 2009	96524	3981	4%	36719	1801	5%	69745	3313	5%
2007 - 2010	101536	5247	5%	38760	2327	6%	72944	4277	6%
2008 - 2011	106877	6848	6%	41480	2943	7%	77001	5458	7%
2009 - 2012	112333	8924	8%	44377	3951	9%	81186	6855	8%

The numbers of publications resulting from this method is clearly higher as compared to the previous method, in which the DOAJ list was used as well. We solved the issue of the missing doi's by matching by ISSN and year. The numbers are somewhat similar to the results derived from Method I (as one might expect, given the definition of WoS OA disclosure, in which DOAJ also plays a role), although they are somewhat lower in Method II compared to Method I. This is probably due to the fact that the method of data collection underlying Method I also included hybrid OA publications: Open Access publications in journals that are otherwise not open Access (yet).

Figure 5 Case study 12: Output development (P) of Denmark, the Netherlands, and Switzerland, based on journal ISSN-number and starting/publication year matching, 2000-2012/2013.



As stated above, the results of Method I and II as presented in Tables 1 and 3 do resemble each other. Consequently, Figure 3 and Figure 4 do resemble each other when it comes to output trends for OA and non-OA format output.

Table 28 contains the MNCS scores for the three countries, for both the OA and the non-OA format output. Given the resemblance of the results of Methods I and II, the normalised impact scores (MNCS) for particularly the non OA format output shown in Table 4 and Figure 4 are nearly exactly the same as the ones presented in Table 26 and Figure 4. The differences are observed in the MNCS scores related to the OA format output, which can be explained by the presence of hybrid publications in the OA format output underlying Method I (and consequently, in the Tables

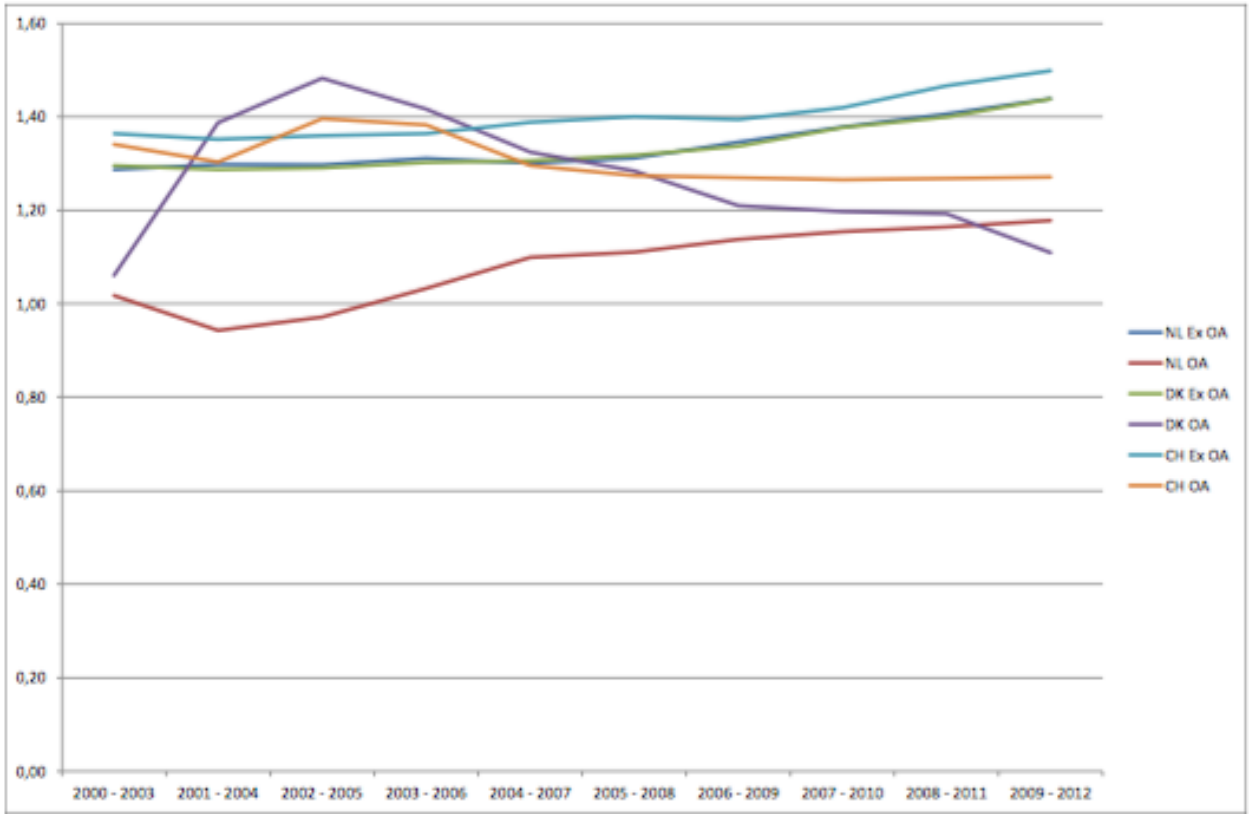
and Figures related to this Method). These publications in OA format in journals that offer the space to publish OA in an otherwise non-OA journal might have a somewhat higher impact compared to the non-OA output from those same journals (these journals often exist for many years, and have very strong reputations, contrary to many new OA journals).

Table 28 Case study 12: Citation impact (MNCS) of Denmark, the Netherlands, and Switzerland, distinguishing OA and non-OA output (based on journal ISSN-number and starting/publication year matching), 2000-2012/2013.

	NL Ex OA	NL OA	DK Ex OA	DK OA	CH Ex OA	CH OA
2000 - 2003	1,29	1,02	1,30	1,06	1,36	1,34
2001 - 2004	1,30	0,94	1,29	1,39	1,35	1,30
2002 - 2005	1,30	0,97	1,29	1,48	1,36	1,40
2003 - 2006	1,31	1,03	1,30	1,42	1,36	1,38
2004 - 2007	1,30	1,10	1,31	1,32	1,39	1,30
2005 - 2008	1,31	1,11	1,32	1,28	1,40	1,27
2006 - 2009	1,35	1,14	1,34	1,21	1,39	1,27
2007 - 2010	1,38	1,15	1,38	1,20	1,42	1,27
2008 - 2011	1,41	1,16	1,40	1,19	1,47	1,27
2009 - 2012	1,44	1,18	1,44	1,11	1,50	1,27

In Figure 6, we observe the decrease of the MNCS values for the OA format output for the three countries start somewhat earlier as compared to Figure 4. Finally, MNCS scores do end up being somewhat lower as compared to the scores based upon the Method I approach.

Figure 6 Case study 12: Impact development (MNCS) of Denmark, the Netherlands, and Switzerland, based on journal ISSN-number and starting/publication year matching, 2000-2012/2013.



5.3 The Open Access Definition Framework (Netherlands)

The Association of Universities in the Netherlands (VSNU) is a central node in coordinating implementation of the national OA policy. This includes establishing a project manager to coordinate among stakeholders regarding ongoing negotiations with journal publishers and development of new infrastructural resources to support the transition to OA publishing. In response to the identified challenges in measuring OA, the VSNU developed a definitional framework for registering and monitoring open access (VSNU 2015). In a pragmatic move, the framework reduces the constellation of OA types, from the nine identified in the MoRRI OA analysis report, to three: (1) Gold, DOAJ classified, (2) Gold, not DOAJ classified OA, and (3) Green only OA. This reduced set of OA types demonstrates a bottom up effort to simplify and improve regrestation of open access publications. In addition, it exemplifies ongoing difficulties for establishing local solutions that link up to global practises.

The reduction process is based on an operational definition of open access and clarification of what counts as a publication. The definition of open access in operationalised as: "peer-reviewed articles [that are free of cost to the user] and permanently available on the website of the publisher or in a trusted repository" (VSNU 2015, p.1). For what counts as a publication, the framework draws on an existing "agreed definitions" established by the VSNU General Council

(VSNU 2011). This is divided into the definition for a scientific publication with criteria for both refereed and non-refereed status, as follows:

> 1. Scientific publication - a publication by (a member or members of) staff relating to the results of scientific research aimed at the forum of researchers, published in the reporting year (x).
>
> a) Refereed article in a journal - An article that has been subject to a critical, independent review by one or more experts in the field, called “referees”, who are responsible for determining whether the topic of the article falls within the scope of the journal and who establish the originality, quality of the research, clarity of presentation etc.
>
> b) Non-refereed article in a journal - an article that has not been subject to a critical review as referred to under a.
>
> (VSNU 2011, p. 10)

For pragmatic reasons the OA definition framework further narrows what is monitored by limiting the domain of interest to journal articles (as implied in the refereed criteria) and also by excluding preprint versions of a manuscript. Although the OA policy document explicitly calls book and book chapter formats, the definition framework endeavours to establish a measurable subset through a reduced scope of output combined with specific registration procedures. Including registration guidelines is an explicit effort to align with concurrent deployment of contemporary Current Research Information Systems (CRIS) in the Netherlands.

As most research institutions in the Netherlands have recently implemented a new CRIS system (or presently implementing), there is heightened attention to registration of research output for research evaluation purposes. As such, efforts to improve monitoring of open access are linked to related developments in registration of research output in local CRIS systems.

6 Discussion

In this section, we first summarise the main bibliometric findings, and then move towards limitations in the ways OA is now disclosed in electronic systems supporting bibliometric analyses. Finally, we will discuss how the Netherlands' approach diverges from recent efforts to standardise open access metadata.

Please note that the conclusions from our quantitative analysis mainly relate to the domains in which journal publishing is the dominant way of communication (the natural, life and medical sciences, and to a much lesser extent the social sciences and humanities (van Leeuwen 2013). While the current political discussion mainly centres around journal publishing, and the publishing industry slowly moves towards finding ways to operationalise OA journal publishing, issues related to the OA publishing of books is far less well developed.

We observe for the three countries that the share in output in OA journals is lagging behind as

compared to the journals that maintain the non-OA format. We observe a divergence in the development of citation impact for (Gold) OA and non-OA publications with consistently lower impact for the OA publications in the last time frames as compared to earlier periods (where impact of OA publications were more or less similar to non-OA publications).

Second, we observe that OA journals have lower journal impact scores than non-OA journals (data not shown). This may mean that they still struggle to find their position within the total 'reputational hierarchy' of the domain, and as such also within the WoS database. This is a common problem for new journals and OA journals are no exception.

A third conclusion relates to the messy situation around the various manners by which Open Access is defined in electronic databases. The two different ways Open Access can be operationalised within the world of WoS is an example of this unclear and somewhat messy situation. Moreover, the fact that the Scopus database also does not have the functionality to clearly define Open Access for users of the system is another expression of the unclear situation around Open Access.

Further examples of this unclarity are the various ways Open Access is operationalised by the publishing industry. There is no clear way of operationalizing in the larger databases of the various business models (such as Gold, Green, and Hybrid Open Access). Yet another example relates to the various licence types related to Open Access.

To address this, the Netherlands created a simplified open access definition framework (described above), coinciding with implementation of new current research information systems (CRIS) at Dutch universities and research institutes. This deployment of institutional CRIS systems provides an opportunity for national level tracking of Open Access through coordinated deployment of the definition framework and common registration practices. However, the Dutch approach deviates from a recently published metadata standard for open access.

This NISO (2015) standard specifies metadata elements for free to read and licence reference, the latter of which should point to copyright information publicly accessible on the Web. Whereas the Dutch framework specifies open access types, the 'free to read' condition does not meet generally accepted definitions of open access (e.g. BOAI 2002; BDOA 2003).

Whichever metadata scheme employed, it becomes important to assign openly accessible, persistent identifiers to all research objects (Tatum and Wouters 2014). This would increase the potential use of institutional research information for tracking open access as part of regular research assessment practices, and would contribute to bottom up improvement of bibliographic data in conjunction with CRIS operations.

7 References

Archambault, Eric, Didier Amyot, Philippe Deschamps, Aurore Nicol, Françoise Provencher, Lise Rebout, and Guillaume Roberge. 2014. "Proportion of Open Access Papers Published in

Peer-Reviewed Journals at the European and World Levels—1996–2013." Rapport, Commission Européenne DG Recherche & Innovation; RTD-B6-PP-2011-2: Study to Develop a Set of Indicators to Measure Open Access.

BDOA. 2003. "Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities."

BOAI. 2002. "Budapest Open Access Initiative." http://www.soros.org/openaccess.

Björk, Bo-Christer, Patrik Welling, Mikael Laakso, Peter Majlender, Turid Hedlund, and Guðni Guðnason. 2010. "Open Access to the Scientific Journal Literature: Situation 2009." PLoS ONE 5 (6): e11273. doi:10.1371/journal.pone.0011273.

Dekker, Sander. 2013. "Tweede Kamer der Staten-Generaal: BRIEF VAN DE STAATSSECRETARIS VAN ONDERWIJS, CULTUUR EN WETENSCHAP."

Dekker, Sander. 2014. "Open Access to Publications: The Netherlands Parliamentary Document | 21-01-2014." https://www.government.nl/documents/parliamentary-documents/2014/01/21/open-access-to-publications.

NISO. 2015. *Access License and Indicators NISO RP-22-2015*. National Information Standards Organisation. ISBN: 978-1-937522-49-0

Tatum, C. and P.F. Wouters. 2014. "Next Generation Research Evaluation: The ACUMEN Portfolio and Web Based Information Tools." *OpenAIRE-COAR Conference: Open Access Movement to Reality - Putting the Pieces Together*. Athens. doi:10.6084/m9.figshare.1033681.

Van Leeuwen, Thed. 2013. "Bibliometric Research Evaluations, Web of Science and the Social Sciences and Humanities: A Problematic Relationship?" Bibliometrie - Praxis Und Forschung 2 (0). http://www.bibliometrie-pf.de/article/view/173.

VSNU. 2011. "Association of the Universities in the Netherlands - Scientific Research: Agreed Definitions."

VSNU. 2015. "Association of the Universities in the Netherlands - Definition Framework Monitoring Open Access."

Waltman, Ludo, Nees Jan van Eck, Thed N. van Leeuwen, Martijn S. Visser, and Anthony F. J. van Raan. 2011a. "Towards a New Crown Indicator: An Empirical Analysis." Scientometrics 87 (3): 467–81. doi:10.1007/s11192-011-0354-5.

Waltman, Ludo, Nees Jan van Eck, Thed N. van Leeuwen, Martijn S. Visser, and Anthony F. J. van Raan. 2011b. "Towards a New Crown Indicator: Some Theoretical Considerations." Journal of Informetrics 5 (1): 37–47. doi:10.1016/j.joi.2010.08.001.

Participatory action research (PAR) in environmental management

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1 Case abstract

The case study at hand features a research project whose aim it was to test and develop Participatory Action Research (PAR) as a radical 'deep' participatory approach that might allow communities to harness their local knowledge and feed this into environmental policy frameworks to effect change. The use of PAR, here in the case of river catchment management – was a ground-up, open-ended collaboration in knowledge production with members of a charitable river protection organisation in the UK working as equal partners throughout the research process, and it was the first in the UK. This focus arose from the growing imperative for participation and public engagement in environmental management and the fact that traditional research approaches were limited in their levels of participation from all directly and indirectly affected stakeholders.

The RRI related impacts seen were the following:

Societal impacts

- Higher openness towards new approaches to environmental management in society;
- Higher levels of knowledge about academic disciplines in general and, in particular, the problematic in question;
- Questioning the traditional modus operandi of research

Democratic impacts

- PAR has a specific notion of co-production - both in principle and in practice; all partners work collaboratively at every stage of the research to forge new ideas and results. Researchers and citizens collaborate in order to co-develop the research questions, design methods, and carry out fieldwork and analyses together.
- Citizens and local administrators can make more informed choices; citizens can participate in political decision making. The locals are knowledge producers, by contributing to solving of concrete problems at the local level. For them the impacts consist the opportunity for open and fair discussions among citizens (democratic deliberations) which lead to higher levels of democracy in general (democracy gains).
- Researchers: Rethinking participation in future research.
- Policy makers/local authorities: they can use the guidelines developed for future similar activities.

Economic impacts

- Economic impacts resulting from the improved environmental situation can be expected to occur; however, such impacts have not been quantified in the project at hand (most likely because it would be extremely difficult to measure those).

Table 29 Case study 13: Case details

RRI dimension	RRI X	Citizen Participation X	Science Literacy X	Gender equality □
	Open Access □	R&I governance □	Ethics □	Other □
R&T field	Participatory Action Research (PAR) in environmental and land management			
Country	United Kingdom			

2 Introduction

This case study features a research project that applied a critical alternative framework for science and knowledge production, namely Participatory Action Research (PAR). PAR consists of collaborative research, education and action used to gather information for change on social or environmental issues. It offers an alternative mode of science, involving collaboration and co-production of research from question definition through to outcomes (Pain et al. 2012).

A research team from Durham university, in the framework of the UK's Rural Economy and Land Use Programme , implemented the research project entitled "Building Adaptive Strategies for Environmental Change with Rural Land Managers" from 2010 to 2012. The Rural Economy and Land Use Programme aimed to advance understanding of the challenges that the UK rural areas are experiencing today and in the future. Interdisciplinary research was funded between 2004 and 2013 in order to inform policy and practice with choices on how to manage the countryside and rural economies. The Rural Economy and Land Use Programme enabled researchers to work together to investigate the social, economic, environmental and technological challenges faced by rural areas. It was an unprecedented collaboration between the Economic and Social Research Council (ESRC), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Natural Environment Research Council (NERC). It had a budget of £24 million, with

additional funding provided by the Scottish Government and the Department for Environment, Food and Rural Affairs.[81]

The objective was to test and develop PAR as a radical 'deep' participatory approach for integrated river catchment management[82]. The approach was sought to allow communities to harness their local knowledge and feed it into environmental policy frameworks to effect change. The use of PAR in river catchment management – a ground-up, open-ended collaboration in knowledge production with members of the Lune Rivers Trust working as equal partners throughout the research process – was the first in the UK (Pain et al., 2012).

The research project concluded that co-production should be reframed as the circulation of expertise, and argued that PAR can enrich the learning, knowledge and skills of all those involved, and led to innovation and positive environmental outcomes. It furthermore recommended to address a number of structural and institutional barriers to deep participatory processes (Whitman et al., 2015).

3 Methodology and data

The individuals and groups directly affected by the PAR approach were locals (in particular, Lune Rivers Trust (LRT)[83] members, including land managers and landowners), researchers (natural and social scientists) as well as policy makers.

The project evaluated whether PAR led to the co-production of knowledge. It considered both the value of the knowledge produced and the suitability of wider adoptions of PAR.

The project was evaluated throughout its entire duration with frequent iterations of planning, reflection and action, involving all group members (Pain et al., 2012):

[81] http://www.relu.ac.uk/ (11/08/2016)

82 Integrated catchment management is a subset of environmental planning which approaches sustainable resource management from a catchment perspective, in contrast to a piecemeal approach that artificially separates land management from water management. Integrated catchment management recognizes the existence of ecosystems and their role in supporting flora and fauna, providing services to human societies, and regulating the human environment. Integrated catchment management seeks to take into account complex relationships within those ecosystems: between flora and fauna, between geology and hydrology, between soils and the biosphere, and between the biosphere and the atmosphere. Integrated catchment management recognizes the cyclic nature of processes within an ecosystem, and values scientific and technical information for understanding and analysing the natural world. Bowden, W., (1999) Integrated catchment management rediscovered: an essential tool for a new millennium, Landcare Research. URL: http://icm.landcareresearch.co.nz/knowledgebase/publications/public/What_is_ICM_Te_Papa_2002_Bowden.pdf (11/08/2016)

83 The Lune Rivers Trust is a charity dedicated to the conservation, protection, rehabilitation and improvement of the River Lune throughout its whole length and its associated tributaries in Cumbria, Yorkshire and North Lancashire. Its aim is to protect and improve the riverine habitat to encourage the biodiversity of the River Lune and its tributaries. The trust is working closely with local farmers, landowners, anglers, canoeists, environmentalists and a wide range of voluntary, community and government bodies. URL: http://luneriverstrust.org.uk (01/03/2016).

- An audio diary was kept throughout the field research period by the three academic team members,
- Periodic short reviews were conducted at the end of meetings,
- A whole-group discussion was conducted at the end of the research process,
- Follow-up interviews were conducted with PAR group members.

An evaluation of this PAR approach was thoroughly documented, because the aim of the project was to make broad recommendations for the use of PAR in river catchment research and management. The process was evaluated through group discussions and in-depth interviews with each participant conducted separately by one of the academic researchers. These evaluations informed the outputs of the research, and led the project team to several reflections on the use of PAR in this context (Whitman et al., 2015).

4 Input level: RRI activity

The research activity arose directly from the growing imperative for participation and public engagement in environmental management and planning, and the fact that many existing approaches are limited in their levels of participation. Across the field of environmental management, statutory bodies are increasingly charged with the need to include the public in some way or the other in planning and decision-making processes (Pain et al., 2012).

Moreover, the DG Environment of the European Commission considers **citizen science** as added value in driving environmental policy and as a field where the process of education between professional scientists and other stakeholders and the public is seen as two-way[84]. The Science for Environment Policy in-depth report Environmental Citizen Science (2013), highlights that the usual thinking of scientists as the only ones who have and produce all the knowledge is out of date; rather, it is often the case that citizens can find "blind spots". This is referred to as shared ownership of science, where answers to questions are reached through dialogue, especially between policy makers and scientists, but also all other concerned stakeholders (described as a long process of mutual dialogue and training). Especially when issues arise, insight from citizens directly is seen to be of high value.

However, one key issue remains (both in connection to local examples as well as in relation to the wider field of participation in environmental management). According to Pain et al. (2012, p. 2), there is a conflict between (a) the goals of 'deep' participation, as reflected in the principle of equal collaboration in knowledge co-production between communities and 'experts' such as scientists, academics or statutory bodies, and (b) the contexts and imperatives which usually

84 http://ec.europa.eu/environment/integration/research/newsalert/multimedia/citizen_science_en.htm

inform actual on-the-ground participation in areas of environmental planning, such as catchment management.

PAR directly involves people who are concerned about or affected by an issue, and makes them take a leading role in producing and using knowledge about it. PAR is distinct from other participatory approaches because (Pain et al., 2012):

- "it is driven by participants (a group of people who have a stake in the environmental issue being researched), rather than an outside sponsor, funder or academic (although they may be invited to help),
- it offers a democratic model of who can produce, own and use knowledge,
- it is collaborative at every stage, from the definition of research questions onwards, involving discussion, pooling skills and working together,
- it is intended to result in some action, change or improvement on the issue being researched." (p. 4)

This case study focuses on the use of PAR to develop and conduct a UK research project that involved physical geography questions and methods. The researchers suggested that its use enriched and enhanced the scientific outputs, as well as provided democratic model of knowledge production. The project was a collaboration between three academic researchers (a physical geographer, an environmental social scientist and a human geographer) and members of the Lune Rivers Trust (LRT) in northwest England. These actors worked together over three months, meeting regularly, and all group members conducted 'homework' between meetings.

The PAR-related work consisted of two main elements: co-production of the research outputs (see following section); and co-production of the research process: PAR is an approach based on a set of core values that follows a broad process, rather than specific methods mapped out in advance. Together, the project team worked iteratively to develop the focus of interest, methods and findings, sometimes dividing tasks according to experience, and always reflecting at each stage. Both the enquiry and decision making were therefore open and jointly negotiated. While the researchers argued this might at first appear to be a poor fit to the usual scientific research process, they suggested that it does not fundamentally alter the scientific method: *"rather, it places it within a process where it is developed and discussed by 'uncertified' as well as 'certified' scientists"* (Whitman et al., 2015, p.5).

Co-production of the research process

This activity included co-developing the research questions, designing methods and collaboratively carrying out fieldwork and analyses.

In PAR, research questions are defined by the 'community of interest' – those at the sharp end of environmental issues – rather than scientists. The project team therefore left it to the participants to identify what the key issues were that needed research and how they might go about tackling them. They facilitated discussions about possible topics using participatory diagramming techniques (Whitman et al., 2015, p.6).

In the PAR study, the research process proceeded as follows (Pain et al, 2012, the following points are quoted from p. 10-11):

i) "First, the group decided on the topic that the research would focus on. The key issues considered to be facing the Lune catchment were raised, debated and prioritised by the group using participatory diagramming techniques. They initially brainstormed 24 ideas for topics, narrowed down over the course of three meetings. Between meetings, group members conducted background research in order to see what was already known. They then discussed what would be the most useful focus. The iterative reflection at this stage included the skills and expertise required for the research, and any sensitive political issues.

ii) The issue chosen was slurry pollution. They identified a set of questions to answer, which included: Why is it bad? What is in it? Can we map issues in the catchment? Can we develop a risk assessment tool around slurry for farms?

iii) The group asked whether the team could use SCIMAP for the project, a modelling tool already known to some members of the group as a tool for assessing and mapping risks associated with diffuse pollution. It provides a clear interface to hydrological data mapping which is accessible to non-specialists. The academics brought SCIMAP to the next meeting and began to explain how it worked and what the group might do with it. This had two important consequences for the project; firstly, almost immediately the group began to critique SCIMAP, for example for its aggregation of 'improved grassland'. Local members of the group felt this

aggregation was impractical in trying to rank different forms of grassland in terms of their risks associated with the transport of slurry to nearby watercourses. Secondly, the question was raised by a trust member, whether SCIMAP could be used to see whether some farmyards are more vulnerable than others. It was this question that led to the innovative use of SCIMAP to develop the Farm Vulnerability Tool (FVT). This was not something that the academics in the group had thought of, neither was it something that SCIMAP had been applied to previously - it would represent a structural change in the way the model was used. As a group they discussed this idea, and had to address the concerns of some members that the issue was 'too hot' to pursue as they thought it might be interpreted as a finger pointing tool to identify 'dirty' farms or 'bad' farmers. Through discussion they agreed a way to work around this and keep farmers on side in the application of the model and the subsequent work of the Trust.

iv) The FVT was developed over several weeks, involving all members in fieldwork between meetings, ongoing analysis and interpretation before the final model was produced. An explanatory guide was produced which the group fed into.

v) Each week, the results were critically assessed and interpreted by the whole PAR group, and follow-up actions using and extending the FVT were planned which had been undertaken after the project's end. As part of the evaluation of the field approach, the whole group undertook an evaluation session to appraise the strengths and weaknesses of the PAR approach. Lessons from the project and its evaluation informed the PAR toolkit. The Lune Rivers Trust also planned to use PAR in their future research and planning."

5 Output and outcome level: impact and benefits

On many participatory projects, participation ends after the data collection or consultation stages, at which time those controlling the project (often external researchers) withdraw to make sense of and use the findings. A foundational tenet of PAR is that outputs and action also continue to be conducted with, by and for all participants, and that they are diverse to suit the different audiences for, and users of, research (Whitman et al, 2015, p.10).

In this case, tangible outputs from the PAR – to be used by citizens - included the following:

- Production, testing and evaluation of a toolkit for using PAR (Pain et al., 2012) in the field of water management for adoption by policy-makers, policy-delivers, NGOs, land owners and land managers.
- a guide to the Farm Vulnerability Tool (FVT) (Milledge et al., 2012), which explained the theory behind the tool and the limits of its applicability with the aim of being transferrable for use in different contexts; joint conference presentations; and a final report. Co-production of knowledge by groups of landowners, land managers and social and natural scientists, which resulted in this specific product, which was disseminated nationally and made available online for use elsewhere. (Whitman et al., 2015, p.10).

5.1 Society

Positive impacts on the local/regional society level can be documented:

- higher openness towards new approaches to environmental management in society;
- higher levels of knowledge about academic disciplines in general and the problematic in question in particular;
- The power relationships that often characterise research were challenged. While according to the researchers it was not possible to completely dismantle these, they strove to create a process where the usual hierarchies around whose knowledge and expertise counts were broken down (Whitman et al., 2015).

5.2 Democracy

PAR has a specific notion of co-production - both in principle and in practice; all partners work collaboratively at every stage of the research to forge new ideas and results. Overall, the following positive impacts on democracy, which are usually documented, could also be found in the project at hand

- Citizens and local administrators can make more informed choices,
- Citizens can participate in political decision making.

Specific impacts for the three main stakeholder groups from the PAR project in question are documented as follows:

- Locals/LRT members: The locals were knowledge producers, they contributed to solving of concrete problems at the local level. For them the impacts consist of democratic deliberations and democracy gains. The LRT members felt that their knowledge and expertise were respected and placed centre-stage in the research process. The Lune Rivers Trust also gained greater capacity to use the tool SCIMAP, and gathered experience of conducting PAR (and to also use to collaboratively developed PAR Toolkit). They also received the Farm Vulnerability Tool, which they are already using in their work in the catchment.
- Researchers: Rethinking participation: wider contributions have arisen from the research process on the nature, potential, limitations, and role of participation when used on issues that involve traditional ('hard') science and are more often approached in a technocratic manner. Overall, the researchers learned more about PAR principles and techniques. The capacity of all three researchers to work on further interdisciplinary projects was enhanced by this training, and by experience and dialogue throughout the project. The developed publications benefit the wider research community (3 peer-reviewed publication, 5 conference papers, 2 conferences organized, 2 guidelines). More widely, the project has fed into extending understanding and building capacity amongst (a) postgraduates and early career researchers at Durham University working on related topics involving participation and science, as they attended and took part in the final project workshop; (b) other researchers on related RELU projects, through discussions, meetings and the final RELU conference in November 2011.
- Policy makers/local authorities: they can use the guidelines developed for future similar activities.

5.3 Economy

The economic impacts that arose through the application of the newly developed tool at local level, which aims to solve a concrete issue in environmental management, were not quantified by the project managers. However, the PAR approach used led to outcomes that could not have been brought about by traditional research methods alone: the collaboration with local experts was crucial. As such, impacts that could be expressed in monetary terms include, for instance, the fact that the project identified which farmyards were more vulnerable to slurry reaching watercourses. This in the long run could lead to adaptations and monetary savings.

6 Discussion

The research project featured in the case study at hand has argued that PAR presents a more radical and democratic mode of knowledge co-production that can enrich the learning, knowledge and skills of all those involved, leading to positive environmental outcomes. The case has outlined an application of PAR conducted with a UK Rivers Trust, in which both the problem and the tools produced to address this were driven by the participants' priorities and decisions throughout. The researchers suggested that,

"if the scientific method is removed from its traditional hierarchy of expertise and scientists work with others in collaboration, research may become more democratic and innovative, but by no means unscientific… PAR can be seen not as in conflict with science, but as an alternative mode of public science where critical participatory action research commits at once to human rights, social justice and scientific validity." (Whitman et al. 2015, p. 14)

However, despite the potential benefits of radical participatory approaches to environmental science, a number of structural and institutional barriers to deep participatory processes exist. Because collaboration needs to be maintained throughout the entire process, genuine co-production of this nature currently tends to exist only at small and local scales while higher-level policy structures , even while calling for greater public participation, are a barrier to wider take-up" (Whitman, 2015, p. 15). Furthermore, "there remains a significant knowledge gap among funders and reviewers about collaborative and participatory forms of research, their traditions, practices and requirements" (ibid), in the sense that such open participatory research approaches have not found their way yet into mainstream research practice. Participatory research may require longer timeframes, as dialogue and trusting relationships must be developed before project design can commence, as was done in the project at hand. PAR is therefore a challenge to traditional modes of applying for funding (ibid).

Finally, identifying the focus for research with participants remains a prospect that fills many scientists with alarm. It challenges basic premises about who knows what should be studied and how. This may appear a risky decision to share, given the pressures and expectations under which research projects function (Whitman, 2015, p. 11-12).

The research makes a number of contributions to rethinking participation within this context (ESRC 2016, quotations below)[85]:

- "Participation in knowledge production and planning is not about 'including' relevant publics/stakeholders in what is being done, or about building trust in policy. It is about devolving the whole process of knowledge production to local groups, with external facilitators and specific expertise brought in from outside if needed. Such collaborations have the potential to enrich the learning and knowledge of all parties, and leave behind new tools, skills, and ways of working.
- Participation cannot be reduced to data collection. Specific methods are not central to participatory processes. What defines real, productive participation is (i) a shift of control over research processes; and (ii) the 'feeling of participation'.
- There is no contradiction between adopting a more radical ground-up participatory research process and the questions and methods associated with traditional science. On this project, the coding of the model remained with the natural scientist, but other participants drove the research process and contributed to many other aspects of it, including generating the problem to focus on, the idea for FVT, adaptations to the model, and its eventual use for their purposes. Thus, knowledge production was a shared and negotiated process between academic scientists and local people.
- Issues of power must be addressed explicitly in participatory processes. The origins of PAR are as an approach for people who are marginalised or excluded from sources of power to empower themselves through research, learning and action. The ways that participation has been co-opted (and institutionalised) mean it often falls short of these goals. Often participatory processes include only the already-empowered (see the issue of trust/confidence above).
- The research leads us to question the phrase 'redistributing expertise', because its underlying assumption is that the academic/scientist/policy maker is the active partner who is benevolent and able to 'empower' local knowledge. With the conditions in place for real collaboration, this can happen on both sides. Instead, the project illustrates a circulation of expertise – a more fluid, dynamic and equable exchange.
- A significant issue remains that successful local 'deep' participatory processes may produce knowledge to address specific issues in catchment management, yet be unable to access funding or support to resolve these. National regulatory frameworks remain a barrier. A genuinely participatory model of working with local public authorities (e.g. national and regional Ministries) would involve restructuring a greater proportion of funding so that local groups and organisations identify issues that need problem-focused research, and have access to funding to support this research and follow-up action. One role of academics, scientists and policy makers should be to support these projects rather than decide or drive their priorities."

[85] ESRC (2016). Economic and Social Research Council project description: http://www.researchcatalogue.esrc.ac.uk/grants/RES-240-25-0004/read/keyfindings (29/02/2016).

7 References

Pain, R., G. Whitman, & D. Milledge (2012) Building Adaptive Strategies for Environmental Change with Rural Land Managers Full Research Report, ESRC End of Award Report, RES-240-25-0004. Swindon: ESRC. URL: http://www.researchcatalogue.esrc.ac.uk/grants/RES-240-25-0004/outputs/read/eaa803bd-cc03-4f46-98d8-0dad8355bda2 (29/02/2016).

Pain, R, et al (2012). Participatory Action Research Toolkit: An introduction to using PAR as an Approach to Learning, Research and Action. URL: https://www.dur.ac.uk/resources/beacon/PARtoolkit.pdf (29/02/2016).

Science Communication Unit, University of the West of England, Bristol (2013). Science for Environment Policy In-depth Report: Environmental Citizen Science. Report produced for the European Commission DG Environment, December 2013. URL: http://ec.europa.eu/environment/integration/research/newsalert/pdf/IR9_en.pdf (29/02/2016).

Whitman, G.P., Pain, R Y D.G. Milledge (2015). Going with the flow? Using participatory actin research in physical geography. Progress in Physical Geography, 2015; 39 (622-639).

Third round case studies: Extending knowledge about RRI benefits

Nanotechnology RRI in the Netherlands

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1 Case abstract

In this case, responsible research and innovation in nanotechnology in the Netherlands is addressed. The focus of the case study is on the economic effects on companies participating in publicly organised/funded RRI activities. The RRI activities of Nanopodium (the public debate on nanotechnology) and of NanoNextNL, a research programme explicitly addressing RRI, are discussed; the former from a company's perspective and the latter from the perspective of the programme management trying to involve companies in RRI. The case has been described based on data collected through interviews and desk research.

The results of the case study show that the company's participation in the Nanopodium debate has led to considerable and valuable output and outcomes for the company. The effect of the Nano RRI activities on the companies could be measured mostly in terms of direct outputs and outcomes, such as gaining necessary knowledge on nanotech and new network links. An important result was that the company, due to participating in the Nanopodium debate, could successfully continue its activities. NanoNextNL created awareness for RRI among academic and industry partners through its Risk Analysis and Technology Assessment theme and course and created business cases in which RRI aspects were explicitly addressed, eventually resulting in start-ups that could be termed responsible.

Table 30 Case study 14: Case details

RRI dimension	RRI X	Citizen Participation X	Science Literacy -	Gender equality -
	Open Access -	R&I governance X	Ethics X	Other X
R&T field	Nanotechnology			
Country	The Netherlands			

2 Introduction

In June 2008, The Dutch government published the 'Actieplan Nanotechnologie'. The Action Plan gives a description of the national nanotech policy. The plan presents the opportunities and a research agenda and addresses the potential risks of nanotech and the ethical aspects, social dialogue and communication on nanotech in the Netherlands. In the plan, two activities were announced that can be considered as a means of integrating 'responsible research and

innovation' (RRI) in the plan. The first is the installation of the Committee Societal Dialogue Nanotechnology (2009-2011); the Committee should organise a public debate on several stages and involving various stakeholders in the period 2009-2010 on nanotechnology (Nanopodium). The second is the successor of the running national nanotech research programme (NanoNed, 2006-2010) and that would include also the risks, ethical and social aspects of nanotech. This new programme - NanoNextNL (2011-2016) – is structured into themes of which one is specifically devoted to RRI.

This case study focuses on what have been the costs and benefits for companies to participate in Nanopodium and NanoNextNL. These are two examples of how RRI is addressed in Dutch national nanotech policy; the case study describes how companies are involved and analyses the economic impacts thereof.

Nanopodium

With the genetic modification (GM) controversy on the possible risks of genetically modified organisms, plants and animals for human health and safety and the ethical questions that GM raised[86] still fresh in mind, Dutch policy makers, business and science communities were keen to avoid nanotechnology becoming 'the next GM'. One lesson from the Dutch GM debate was to take public engagement more 'upstream', to a point early enough in the development process for a feasible change of direction.

The Committee Societal Dialogue Nanotechnology (CoSDN) was installed in March 2009. The committee's task was to prepare an agenda for the public dialogue, and stimulate and facilitate a public dialogue using this agenda. One of the first activities of the Secretariat of the CoSDN was the publication of an appealing name that would serve as the flag under which the dialogue would be staged: 'Nanopodium'. The choice of the name illustrated the position and mission of the Committee: providing a place/the means for the dialogue and publishing opinions on nanotechnology, but not interfering in or influencing the dialogue.

After the kick-off in March 2009, in July 2009 a working conference was organised with experts and stakeholders that – together with interviews with various stakeholders – was an important input to the agenda for the public dialogue that was launched in a public opening event in September 2009. Based on this agenda, individuals and organisations were invited to submit ideas for projects through which the public dialogue should take place.

The selection of project proposals led to the selection of 35 projects:

[86] See for instance: Bonny, Sylvie. "Why are most Europeans opposed to GMOs?: Factors explaining rejection in France and Europe." Electronic journal of Biotechnology 6.1 (2003): 7-8.

- 16 for delivering publications, TV programmes, YouTube videos, teaching materials, etc.,
- for exhibitions, artistic impressions, etc.,
- 16 for organising debates: live, online, theatre, etc.

The Nanopodium activities came to a close in January 2011 with the Nano-festival in the NEMO Science Centre in Amsterdam with about 600 visitors. During this festival, the report summarising the results of the public dialogue (i.e. the 35 projects) was presented to the Minister (Enzing, 2011; Enzing et al. 2014).

NanoNextNL

The mission of this Dutch national research and technology programme is "to accelerate the creation of durable economic and social value by developing and commercializing innovative nano- and microtechnology, and by forming a sustainable ecosystem of researchers, entrepreneurs and policy makers". The NanoNextNL consortium – in which academia and industry collaborate – consists of 130 partners (30 from academia; 100 from industry) (NanoNextNL, 2013).

NanoNextNL is the largest innovation programme in the Netherlands and has a budget of 251 million Euros over the period 2011-2016. The Dutch Ministry of Economic Affairs funds half of the budget; the other half is provided by the academic (25%) and industrial (25%) partners.

The research within NanoNextNL covers nearly all nanotechnology domains. It consists of 10 themes, 28 programmes and 235 projects. Risk Analysis and Technology Assessment (RATA) is a theme that cross-cuts all other areas. The RATA theme includes three research programmes: Human Health Risks, Environmental Risks and Technology Assessment of Nanotechnology. Two other RATA activities are the two-day RATA course[87] and the valorisation programme with embedded RATA aspects. About 15% of the total NanoNextNL budget is invested in the RATA theme.

3 Methodology and data

The methodology for this case study is based upon interviews and desk study. Two semi-structured interviews were held; one with a company director who participated in Nanopodium and one with the RATA programme officer of NanoNextNL. This provided us with the perspective

[87] The two-day RATA course is part of a broader set of RATA education, which also entails coaching, intervision groups and teaming with professionals to help PhD students to better deal with RATA aspects.

from a Dutch company participating in nanotech RRI and the perspective of a Dutch nanotechnology programme office that aims to involve companies in nanotech RRI.

For the desk research we used several sources of which the majority is provided by Nanopodium and NanoNextNL. Technopolis Group operated as the secretariat for the CoSDN and was involved in writing many documents, of which some were written by a professional journalist.[88] For NanoNextNL we used the Midterm Self Evaluation Report (2010-2013)[89], thematic brochures, website, and data provided by the interviewee (R. Vandeberg, 2016) – the RATA programme officer of NanoNextNL.

NanoNextNL measures the impact of the programme; for this, it has defined several Key Performance Indicators (KPIs) and associated targets. Also for the RATA theme, impacts are measured. For the case study, the following 'economic' KPIs are relevant: the number of patent filings, the number of business cases, the number of start-ups created, the number of RATA public events. Additionally, budgets and numbers about the participation in the NanoNextNL Valorisation programme and the RATA course were found to be relevant in measuring the RRI impacts of NanoNextNL.

4 Input level: description of the RRI activity and the involvement of the company/ies

Nanopodium

In March 2009, Dutch newspapers wrote about the appointment of the CoSDN by the Minister of Economic Affairs. When Dimmen Breen, director of NanoServices, a company in hygienic nano-products, read this in the newspapers he immediately contacted the committee. Breen had started his company two years ago and he found that almost everybody with whom he talked about his nano product – such as potential clients or agents that would market and sell his products in other places – immediately felt stuck when they heard about the nanotechnology character of the product. Nanotechnology gave rise to a wall of unwillingness; people refused to listen anymore while referring to the dangers of nanotech (risks for health, such as cancer). Breen and colleagues were not able to counter this reaction and to come with a suitable answer. As he hardly had any knowledge about the nanotechnology behind the product that he sold (he bought the product in bulk sizes and repacked it in smaller quantities), he decided that he first should be informed about what nanotechnology exactly is and what its (potential) risks for

[88] Some of these documents are still available at: http://www.nanopodium.nl/CieMDN/.

[89] Currently NanoNextNL is drafting its End-term Self Evaluation Report.

health and safety are. After that, he could inform others about it. For that reason, he contacted the chairperson of the CoSDN.

Breen was invited by the CoSDN to give a presentation at the working conference in July 2009. He also contributed to the project 'Inter-religious dialogue Nanotechnology'[90] and participated in the Nano-festival in January 2011.

NanoNextNL

NanoNextNL explicitly acknowledges that insight in risks of nanomaterials is important for authorities, society and industry to make nanotechnology successful and to make successful innovations; not addressing risks will be detrimental for innovative nanotechnology products and services. As half a billion euros were invested in nanotechnology by the Dutch government by 2006, this would be unacceptable for the Dutch government. For that reason NanoNextNL organises several RRI activities to create awareness for RATA among its public and private partners and to strengthen business cases.

Three RATA activities are discussed[91]:

1 the research within the RATA theme (risks and TA);
2 the two-day RATA course; and
3 the RATA activities incorporated in the valorisation programme.

The RATA theme focuses on **research** about human health risks, environmental risks and technology assessment. It includes 25 projects, such as 'Anticipating on technological developments and their embedding in society', 'Governance of responsible development of nanotechnology' and 'Society's response to nanotechnology'. The total budget of the RATA theme is 21.2 million euros. In the RATA theme the TA part is only financed by the governmental and academic partners, while the two RA parts are matched by both public and private partners. Two companies are involved in the RATA risks research, and they match the government funding with 1.6 million euros. The two companies in the RA part participate partly from a marketing interest: they like to profile themselves as responsible and sustainable (NanoNextNL, 2013; R. Vandeberg, 2016).

[90] In this project Christians, Muslims, humanists and followers of other religions or philosophies discussed in small, heterogeneous groups about nanotechnology on the basis of a number of statements. The aim of the project was to inretest these groups for nanotech and to know what their opinions are on nanotechnology and discuss it with representatives of other religions or philosophies.

[91] Not discussed are the intervision groups after the course and the possibility to buy research and consultancy on RATA for the business case in the valorisation programme, the safety-by-design concept that is promoted and the risk issues that companies and governments deal with.

NanoNextNL regularly organises a **RATA course** on the importance and basics of risk analysis and technology assessment in nanotechnology. This two-day course is open to all involved researchers and entrepreneurs, and interested external stakeholders. It is organised by an external company bureau in close cooperation with NanoNextNL and its RATA experts. The costs for NanoNextNL partners (750 euros per person) are covered; the participants must pay for accommodation and meals through their project budget. The course focuses on the purpose, relevance, art and application of RATA in nanotechnology research and innovation. Coaching is available during and after the course to address RATA aspects in the research and thesis of PhD students, which is mandatory to address in all themes (NanoNextNL, 2016, 2015b).

The **valorisation programme** also includes RATA aspects. So far, 2.5 million euros have been allocated to the programme (two calls). The programme consists of five stages in which applicants can improve their business case; in each stage, applicants can drop out. In the first stage, the Lean Business Model Canvas includes a 'Safety and Society' item, both aspects have to be rated (using a system similar to the European energy labels – A to E). In the second stage a commercial online business tool – 'the Golden Egg Check'[92] – is used to rate several aspects of the business case, including RATA aspects[93]. As the next three stages build on the first two, the RATA aspects will be recurring in later stages. Here also a Life Cycle Analysis (LCA) is carried out (NanoNextNL, 2015a).

The programme has had two calls. In the first call (summer of 2014), 40 applicants received some sort of business support. Out of those, 16 applicants were awarded 125,000 euros after having successfully finished the fifth stage for improving their business case. The second call (summer 2015) with a similar number of applicants had a slightly smaller budget, awarding 100,000 euros in the end to each successful participant (NanoNextNL, 2015a).

5 Output and outcome level: impact and benefits

Nanopodium[94]

Breen mentions as the main outputs and outcomes of his participation in the Nanopodium debate:

[92] See: http://goldeneggcheck.com/

[93] Both the adaption of the Lean Business Model Canvas and the Golden Egg Check was initiated by NanoNextNL.

[94] Source of information for this section is: Dimmen Breen, 2016.

- The acquisition of knowledge on the new technology and its applications;
- The expansion of the company network;
- The contribution to a development (social opinion forming on nanotech and its risks) that affects the company now and in the future.

Breen's personal network started to grow, and still does: members of the committee, persons who were involved in Nanopodium projects and others. He is now also involved in a number of EU funded projects (FP7, GUIDEnano, NanoReg) on the risks of nanotech and nanomaterials.

During the debate, he continued to contact new clients and agents and observed that – with mentioning the existence of the CoSDN and the Nanopodium dialogue – he introduced an authority and this gave credibility to what he talked about. His presentation was increasingly perceived as more reliable. The prestige of the company grew by referring to the committee and the debate. For his company this implied that the attitude of clients and agents was totally different from what he experienced before; it was rather easy to find new clients and agents. This started more or less immediately after the committee started its work.

Breen concludes that after the debate, the health and safety risks of nanotechnology are still an issue but it is not that critical anymore (as GM still is). In his communication with clients/agents and his lectures[95] he always addresses the potential risks of nanotechnology: as soon as it has been proven that the nanotech substances that are in the products his company sells are harmful, the products will be taken from the market immediately.

Each cost/benefit analysis of Breen's involvement in the debate and what it has brought his company would show a negative outcome, as the costs – in terms of time spent on participating in the debate and preparing and giving lectures – are very high. This means that purely from a cost/benefit perspective hardly any small company would participate in public debates and projects: it costs too much time and the benefits cannot be measured.

However, Breen's participation in the Nanopodium debates and meetings had a positive effect on the company, but this cannot be measured in a quantitative (economic) manner. The committee and the Nanopodium debate as well as his presentations and communications had the effect that potential clients contacted the company, and it still works that way. Breen states that this is not because he is very good at selling products, but because he is very much interested in the technology and the risks and ethical issues related to the technology. Due to

[95] Since the Nanopodium debate Breen has been giving many lectures on nanotechnology and health, its risks and ethical aspects and the use of nanotechnology products for better hygiene (ca. 40 lectures, since January 2011). These lectures are mostly for health care professionals and an interested public.

these developments the company processes began to run more smoothly and the management's focus could switch to other bottlenecks. However, Breen states rather explicitly that in case there would have been no CoSDN and no Nanopodium debate, his company would not have survived.

NanoNextNL

The **research** within the RATA theme has led to some economic outputs. During the first three years, at least three business cases have been developed, but no start-ups have been realised yet. Since the beginning of the programme one patent has been filed (NanoNextNL, 2013; R. Vandeberg, 2016).

To date, the **RATA course** has been organised three times a year. Mostly PhD students have participated (and used it for successfully addressing RATA in their thesis)[96]. They learned the basics of risk analysis and technology assessment. Only one company has attended the course so far, although by accident. In hindsight, the company participant found the course interesting, it was useful for addressing nano aspects in the company's product sheets, which is notoriously difficult. He also considered using another material for their solar cell product: one that has a slightly reduced performance, but has far fewer associated risks. Awareness for RATA has thus been created.

The **valorisation programme** affected researchers and innovators who had ideas for valorisation through business development. They explicitly had to address RATA aspects in the process of starting a new company. This led to lean business model canvasses that address safety and society. So far, the RATA aspects have not been a reason for an applicant to drop out during the valorisation programme, there were no RATA aspects found that would hamper a potential successful business.

Technology assessment has proven to be very useful as a strategy instrument in analysing business cases. For example, in the preceding national nanotech programme (NanoNed 2006-2010) participants working on the development a lab-on-a-chip device used for a quick analysis of specific blood values found that they had to target another group of customers. Instead of targeting GPs to quickly measure specific blood values - thereby bypassing established laboratories - they identified ambulance personnel as a much more suitable customer. Having them as customers would not be competitive with established laboratories and they have a

[96] Within NanoNextNL PhD students, regardless of the theme involved, have to address RATA aspects in their theses. This often leads to dedicating a special chapter, paragraph, appendix or peer reviewed article to RATA in relation to the research covered in the thesis.

much higher need for fast analyses. There is thus a better competitive advantage and a much more promising entry to the market, strengthening the business case. Technology Assessment has thus led to stronger business cases for potential start-ups.

During the first three years of NanoNextNL, 19 technology assessment or risk related public events have been attended or organised, while at the start of the programme for this KPI only five public events were targeted by NanoNextNL (NanoNextNL, 2013).

Awareness for RRI has been created, first of all among PhD students and the participants to the valorisation programme. Furthermore, RATA has been disseminated to the other partners through the annual RATA day and the attendance at other theme meetings. This has led to at least some awareness for RATA aspects among industry partners. Overall, it can be concluded that RATA activities had a number of 'economic' short-term results. In the long term, all industry partners benefit from RATA, in terms of acceptance and clarity about risks.

6 Discussion

In this case study the focus has been on companies to identify economic impacts of RRI in nanotechnology. The economic impact of RRI in nanotechnology is hard to measure in monetary value, profits, growth of GDP or similar. These types of economic impacts of RRI mostly materialise in the long term, and they are hard to attribute directly to RRI. In this case, the study of economic impact was measured in terms of the number of business cases and start-ups, in improved marketing, strategy or business operations and in company survival.

The figures mentioned above for NanoNextNL (such as number of events, of RATA courses, applicants, budgets, etc.) were measured by NanoNextNL itself for their own management purposes. The quality and the reliability of the data is considered to be good and in line with those mentioned during the interview, although the figures are not the most recent (mostly from November 2013 as figures are currently updated for the period up to 2016).

As we found for the company that participated in the Nanopodium debate, its survival can be considered as an important economic result, further case studies could investigate businesses that were hampered in their growth or even went bankrupt due to not addressing RRI aspects or getting involved in nano RRI activities. For example, companies that focussed on products that were banned due to health or environmental risks or on products that were based upon technologies that became subject of (fierce) public debate (e.g., GM). Economic impacts, albeit negative, are expected to be easier to quantify.

7 References

Enzing, C.M. (2011) Nanopodium: Public debate on nanotech in the Netherlands, presentation at the NanoEthics 2011 Conference, Warsaw, Poland.

Enzing, C.M., Warta, K. and Talmon-Gros, L. (2014) Report 'Technologieaufgeschlossenheit in anderen Ländern' addendum to the main report 'Technologieaufgeschlossenheit'. Dr. Enzing wrote the country reports on the national nanotech debates in The Netherlands, UK and France.

Dimmen Breen (2016), personal communication, January 8, 2016.

Rens Vandeberg (2016), personal communication, January 11, 2016.

NanoNextNL (2013). *Midterm Self Evaluation Report (2010-2013)*. Utrecht: NanoNextNL

NanoNextNL (2015a). *NanoNextNL Valorisation Programme*. *2nd call June-December/2015*. Utrecht: NanoNextNL

NanoNextNL (2016). *Risk Analysis and Technology Assessment (2 days)*. Retrieved January 13, 2016 from NanoNextNL: http://www.nanonextnl.nl/courses/risk-analysis-and-technology-assessment-rata-two-days/

NanoNextNL (2015b). Coaching on risk analysis and technology assessment. *NanoTextNL*. June 2015. p. 15

Infineon Technologies Austria AG

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JOANNEUM RESEARCH

1 Case abstract

This case is about activities in the area of RRI, which are undertaken on the level of an individual company. The focus is laid on the company's understanding of RRI, activities implemented and measures used to evaluate the output and impact of RRI activities. For data collection, a semi-structured interview and information publicly available were used. The analysis of the data shows that activities related to ethics, gender and diversity as well as to open access and participation (or cooperation) are realised. Most of the actions identified are implemented as part of the CSR policy of the company. For those actions also a number of indicators and calculations exist to demonstrate their societal and environmental impact. Indicators to evaluate the benefits of activities related to other dimensions of RRI (for example gender) are less developed. The case shows that efforts already exist to make RRI activities measureable.

Table 31 Case study 15: Case details

RRI dimension	RRI X	Citizen Participation □	Science Literacy □	Gender equality X
	Open Access □	R&I governance □	Ethics X	Other X
R&T field	Semiconductor industry			
Country	Austria			

2 Introduction

This case outlines the activities in the area of RRI, which can be identified at the level of an individual company. It focuses primarily on the economic dimension of effects.

Infineon Technologies AG is world leader in the semiconductor industry. Infineon Technologies Austria AG is a group subsidiary and has its main seat in Villach with further branches in Graz, Klagenfurt, Linz and Vienna. In 2015, the Infineon Technologies AG had 35,400 employees and made sales of € 5,795 million. Infineon Technologies Austria had 3,493 employees in 2015. Sales of € 1,427.1 million and 25% R&D expenditures in percent of sales were reported.

The focus of interest in this case study is laid on the understanding of RRI, the type of activities undertaken and approaches to measure the (economic) impact of these activities. Special attention is given to the Corporate Social Responsibility (CSR) policy of the company, which covers important parts of RRI and comprises a number of measures and indicators to demonstrate their output or impact. Other RRI activities portrayed are related to ethics, diversity and gender as well as open access (or cooperation). The main actors and stakeholders in the case are the management and employees of the company, its clients and the local population.

This case is relevant as it sheds light on a company-specific perspective on RRI. It can be illustrated how RRI is understood and framed within companies as well as which types of activities are being promoted by management and why.

3 Methodology and data

The case is based on one semi-structured interview and information made available by the company. The impact of the RRI activities is described following the considerations and measures used by the company.

Generally, it can be said that the quality of the data is limited and information regarding the effects of RRI-related activities is sparse. Furthermore, only limited approaches within the company to measure quantitatively the impact of RRI activities exist.

4 Input level: RRI activity

The company has several activities that can be classified as RRI activities. All activities related to RRI which were presented in the interview or that can be found in publicly available information are outlined in the following.

Ethics: A general objective of the company is to help mastering grand challenges like energy shortage, limited resources, population growth, etc. The idea behind this objective is that only by generating value for clients and society in general can the company be economically successful. Economic success also depends on fulfilling demands from clients related to RRI. Clients request a clean supply chain and sustainable raw materials. These requests have to be followed by the company, as incompliance would lead to business loss. Requests related to ethical questions can also come from the staff, e.g. in one case, employees explicitly asked the company to distance itself from the defence industry.

In the company, there is a "**Corporate Social Responsibility Policy**" in place. This policy comprises voluntary commitments in the areas of human resource management and human rights, environmental sustainability, occupational safety and health, corporate citizenship, CSR

supply chain management as well as business ethics. The company is listed in the Dow Jones Sustainability Index and it is member of the UN Global Compact.

Gender and diversity: Infineon promotes diversity as part of its H&R policy. Diversity includes the dimension gender, internationality and age. The company has set the goal to have 20% female executives on the international level and 15% female executives in Austria by 2020. To support international employees, three specific measures have been taken: the foundation of an international club that supports new employees, the provision of international day care and the establishment of an international school.

Open access and participation: Clients are involved in the innovation process in order to provide solutions to their needs. Moreover, the company cooperates with research institutes and partner organisations. In Austria, about 25% of all research and product development projects are conducted with external partners.

5 Output and outcome level: impact and benefits

Generally speaking, the company engages in activities that seem useful to generate value clients are ready to pay for. This means that the perceived demand is used as an indicator or measurement of the benefit of RRI activities. Activities to enhance energy efficiency were mentioned as an example of activities clients are willing to pay for and are carried out by the company.

Output and impact measurement is most developed regarding CSR activities. In the Annual Report 2015 various goals, measures and results related to the CSR activities of the company are stated. Indicators to assess the impact of the activities include, for example[97]:

- Health & Workplace security:
  - injury rate: for 2015: 0.46; Calculation: total number of injuries/total hours worked x 200,000; holidays and public holidays are included in the working hours
  - lost day rate: for 2015: 5.65; Calculation: total number of lost days/total hours worked x 200,000; holidays and public holidays are included in the working hours
- Environment:
  - water consumption: for 2015: about 21 million cubic meters of water
  - waste generation: for 2015: 32,940 tons

[97] All indicators refer to Infineon Technologies AG.

- energy consumption: for 2015: 1,467 gigawatt hours
- CO_2 burden: for 2015: 1.6 million tons of CO_2 equivalents; the calculation of CO_2 emission is based on the ISO 1400 standard[98] substantiated by the PAS 2050 guideline[99]

An example of the contribution of Infineon Technologies to sustainability is the fact that their products and solutions enable CO_2 emissions to be reduced by around 35 million tons. Furthermore, it is calculated that the company uses resources more efficiently than the global average for the semiconductor industry[100]:

- About 40% less electricity consumed per square centimetre of wafer produced than the global average.
- About 21% less water consumed per square centimetre produced of wafer produced than the global average.
- About 50% less waste generated per square centimetre of wafer produced than the global average.

Infineon is listed in the Dow Jones World Index and thus is among the top 10% of most sustainable companies in the Dow Jones Global Total Stock Market Index or, as the company states, "is among the top 10% of the most sustainable companies in the world."[101]

As (very crude and in fact not directly attributable) indicators for the benefit of adhering to **ethical principles**, the market position or the market share is used. In 2014, the market positions and market shares for the distinct product segments were the following:

- Automotive: market position 2 with a market share of 10.5%
- Industrial Power Control: market position 1 with a market share of 19.2% for discrete power semiconductors and modules
- Power Management & Multimarket: market position 1 with a market share of 27.8% for standard MOSFET power transistors
- Chip Card & Security: market position 2 with a market share of 23.9% for microcontroller-based chip card ICs

98 http://www.iso.org/iso/iso14000; last access. February 8, 2016

99 http://shop.bsigroup.com/upload/shop/download/pas/pas2050.pdf; last access, February 8, 2016

100 Basis for the calculations are the square centimetres processed wafer area in the front-end production and consumption according to WSC definition. Data given apply to the Infineon Technologies group, except for International Rectifier companies.

101 http://www.infineon.com/dgdl/IFX_2016_Q1_web_en.pdf?fileId=5546d4614815da88014855cbf595171a; last access: February 8th, 2016

The benefits of **diversity** are not directly measured. However, the company believes in the benefits of a diverse team. As a very general indicator of the benefits of diversity the business performance was suggested (for example: revenue 2015: € 5,795 million; gross profit 2015: € 2,080 million).

To measure the impact of activities related to gender the share of female employees is used (16% in 2015 for Infineon Austria). The following two indicators are used to evaluate the success of measures implemented in order to promote internationality: staff departures (2015: 3,048 for the Infineon group) and turnover rates (worldwide employee turnover rate 2015: 9.0%; calculated on the basis of the monthly workforce in the 2015 fiscal year).

Another form of success indicator related to the activities for international employees is the number of people benefitting from the various initiatives of the company: the Carinthian International Club has 30 members (companies), in the International Day Care Centre 90 children are enrolled and in the International School Carinthia 91 children are studying.

Related to **open access and cooperation** there is a (mainly qualitative) monitoring of research partners in place. How well cooperation with partners functions is measured in the time needed to identify a suitable partner and to set up a contract with it.

Regarding the **societal impact** of the company, there have been some attempts to measure this impact. In the interview, it was referred to a study on Austrian leading companies from Schneider et al. (2013). In this study, it was shown that leading companies cooperate with about 900 SMEs. Furthermore, the purchasing volume of Infineon (not publicly available) and the workplaces generated (for example 3,000 in Villach) were suggested at indicators for the company's societal impact. It was also mentioned that due to the internationality of the staff the company has an impact on tourism. However, this impact has not yet been calculated.

6 Discussion

This qualitative case study is based on an expert interview and a document analysis of information obtained from the interview partner as well as information publicly available on the website of Infineon. The data is therefore based on information from the company. No external evaluation of the RRI-related activities has been undertaken.

Generally speaking, it is difficult to measure the impact of companies' RRI activities in terms of economic impact. This is underlined by this case study. However, a number of approaches used by Infineon to evaluate costs and benefits of RRI activities could be identified. The company has a comprehensive CSR policy and CSR reporting which includes several indicators to measure output and impact of activities in this field. In this case, activities undertaken can be linked causally to outcomes. Most of the indicators, though, are physical ones to which rarely economic values are attached.

For other RRI activities, for example regarding ethics, diversity or open access, the measurement of outcomes is less developed. In these cases no causal link between RRI activities and outcomes can be drawn. Neither can the overall economic or societal impact of the company's RRI activities be identified, though the case study at least gives some hints on possible outcome measures in physical terms. As such, those are idiosyncratic and do not lead easily to comparability themselves.

7 References

Infineon (2013). *Infineon Corporate Social Responsibility Policy*. http://www.infineon.com/dgdl/EN_CSR+Policy+final_PRINT_logo.pdf?fileId=5546d46149b40f650149e1bb8d6405a0; last access: January 19, 2016

Infineon (2015). *Sustainability at Infineon*. In: Infineon Technologies Annual Report 2015, p. 92-107. http://www.infineon.com/dgdl/Sustainability+report_EN.pdf?fileId=5546d46150cc1eda0151430bb01a0500; last access: January 19, 2016

Andreas Kopp (2015), interview, December 11, 2016.

Schneider, H. W., Lengauer, S. D., Brunner, Ph., Dorfmayr, R., Ramharter, Ch. (2013). Österreichische Leitbetriebe als Marktführer auf globalen Märkten. http://www.iv-net.at/d3927/leitbetriebe_studie-pressekonferenz_dezember_2013.pdf; last access: February 8, 2016

AVL List GmbH

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JOANNEUM RESEARCH

1 Case abstract

This case study is about activities in the area of RRI that are realised at the level of an individual company. The focus is on the company's understanding of RRI, activities implemented and measures used to evaluate the impact of RRI activities. For the collection of the data, a semi-structured interview, informal information from the environmental manager and publicly available information were used. The analysis shows that activities related to ethics, gender, environmental impact and open access are realised. Most is done related to sustainability and reduction of the environmental impact of the company. Regarding these activities, attempts to measure their impact also exist. The reduction of CO_2 or the amount of energy savings are examples for that.

Table 32 Case study 16: Case detail

RRI dimension	RRI X	Citizen Participation □	Science Literacy □	Gender equality □
	Open Access □	R&I governance □	Ethics X	Other X
R&T field	development of powertrain systems with internal combustion engines as well as instrumentation and test systems			
Country	Austria			

2 Introduction

This case is about activities in the area of RRI that are realised at the level of an individual company. AVL List GmbH has been chosen for this case. It is the world's largest independent company for development, simulation and testing technology of powertrains for passenger cars, trucks and large engines. The company was established in 1948 and has its headquarters in Graz (Austria). AVL has 45 branches around the world and an export quota of 96%. The company employs 7,470 people of which 3,220 work in the headquarters in Graz. In 2014, the turnover amounted to € 1.15 billion. Ten per cent of the turnover is used for research.

The case study focuses on the following questions: What is the understanding of RRI by the company? Which RRI activities are implemented and how is the (economic) impact of these activities measured? The focus is laid on activities related to sustainability and environmental

impact, as the company puts special emphasis on these areas. Other activities discussed relate to ethical aspects, gender aspects and open access and participation. The main actors and stakeholders in the case are the management and employees of the company and its clients.

The relevance of this case arises from the company specific perspective on RRI. It can be shown how the topic of RRI is framed within companies and which types of activities are being promoted from the management.

3 Methodology and data

The case is based on one semi-structured interview, informal information from the environmental manager and information publicly available. The impact of the RRI activities is described following the considerations and measures used by the company.

Regarding the quality of the data, it is problematic that due to confidentiality issues not all internal data/guidelines could be obtained. Furthermore, only limited approaches within the company to measure the impact of RRI activities exist.

4 Input level: RRI activity

The company has several activities that can be classified as RRI activities. As this case study has an explorative character all activities related to RRI which were presented in the interview or that can be found in publicly available information are outlined in the following.

Ethics: Regarding ethical aspects, the company has introduced a compliance guideline that addresses ethical aspects in the interaction with partners and clients. The compliance guideline focuses on the business processing. Its provisions include no bribery, no acceptance of gifts, no distortion of competition. The guideline was introduced as ethical aspects are important in the view of the management.

Gender: The share of female engineers is low in the company. This is problematized but no specific action to increase the share of women was mentioned.

Sustainability: The company aims to reduce its environmental impact and at improving its energy efficiency. It meets ISO 14001 standards[102] and is part of the ÖKOPROFIT®

[102] "The ISO 14000 family of standards provides practical tools for companies and organizations of all kinds looking to manage their environmental responsibilities. (…) ISO 14001:2015 sets out the criteria for an environmental management system and can be certified to. It maps out a framework that a company or organization can follow to set up an effective environmental management system. It can be used by any organization regardless of its activity or sector. Using ISO

programme[103]. The ÖKOPROFIT programme is a collaborative effort between local businesses, the public administration and external experts, with the aim of reducing emissions and preserve natural resources while reducing operational costs. It can be understood as a win-win idea and a model for sustainable economic development of a region.

The AVL has the following environmental policy:

- "The sense of responsibility for the environment of all employees is encouraged by means of regular trainings and information.
- An objective assessment, monitoring and reduction of the effects on the environment are carried out as early as [possible] in the planning phase, during design, procurement, at the place of work and during storage.
- The application and the further development of energy- and water-saving low-emission and low-waste technologies are promoted incessantly. Preventive measures for saving resources are taken, and furthermore for preventing environmentally relevant incidents and minimizing their effects on the environment (during normal and abnormal operation).
- In-house rules serve to monitor the environmental management system and result in the implementation of corrective measures when the environmental objectives are not reached.
- AVL List GmbH undertakes to comply with acts, directives and regulatory restrictions.
- The general public (residents, government authorities, customers) is given the information necessary for a better understanding of the industrial site and its implications. The dialog [sic] with the general public and the scientific community takes precedence over confrontation.
- Precautionary measures are taken to ensure that suppliers, customers and subcontractors working on site are made aware of the environmental policy applicable at the site and are requested to comply with it.
- The management is required to lead by example."[104]

The company has already implemented a variety of measures to reduce its environmental impact. Examples are the use of LED lights, electric vehicles for short distance journeys and the implementation of a sustainable energy strategy. The impact of some of these activities is measured and assessed as explained in the next section.

14001:2015 can provide assurance to company management and employees as well as external stakeholders that environmental impact is being measured and improved." http://www.iso.org/iso/iso14000, last access: February 8, 2016

[103] http://www.umwelt.graz.at/cms/ziel/4850005/DE/, last access: February 8, 2016

[104] https://www.avl.com/quality-environment-safety, last access: February 8, 2016

Open Access/Participation: Products are developed with the input and in cooperation with the clients. The company is present in institutions like, for example, EARPA, an association of automotive R&D organisations, where they cooperate with competitors in order to draft grant programmes and consult funding agencies. The company participates in these activities to eventually benefit from them in the form of received grants/subsidies.

5 Output and outcome level: impact and benefits

Comprehensive attempts to measure the impact of activities related to RRI do not exist. However, some approaches to the identification of effects or even indicators could be observed.

The most developed approach for impact measurement can be identified for the company's activities related to **environmental aspects:** Regarding the (economic) impact of activities to promote sustainability, the following measures have been calculated and published:

- Change to LED lights led to energy savings of about 60%.
- Improvement of the air conditioning of the data centre led to energy savings in the area of air conditioning of 8% per month.
- Installation of waste heat utilization saved 145 MWh/a and made a CO2 reduction of 71 t/a possible.
- Optimization of the packing of goods that has a potential to reduce the weight of package by 155 t/a.

Activities of the company to promote sustainability can be described as having a generally positive impact on the environment and also the society on a global level.

In addition, the activities of the company related to **open access** follow cost-benefit considerations though on a less formalised basis. The company cooperates with competitors in various fora in order to benefit from these activities in the form of funds (e.g. for EU projects). An indicator of the success of such cooperative activities is the number of secured funds/received grants. However, no calculations or numbers on that could be obtained.

In the interview, it was mentioned that it would be nice to have more female engineers. Up to now, **gender** has not been a relevant criterion to receive funds. However, it was suggested that in the future more women could help to get funding as this aspect becomes more relevant for funding agencies.

Regarding **ethical aspects**, there is no intention or approach to measure costs and benefits.

In general, it can be said that until now there have been little attempts to measure outputs or impacts of RRI activities. RRI is rather described as something inherent to the business purpose and something that does not need to be justified by numbers. For example, the business purpose was defined as the improvement of powertrain systems in order to reduce energy

consumption and negative impacts on the environment. This was said to be already a contribution to sustainable development. Furthermore, high ethical standards were described as central to the corporate culture. In both cases, outputs or impacts were not calculated.

The interview partner stated that it is very difficult to measure the impact of (RRI) activities, single projects or ethical standards. Measures seem to be most advanced for activities related to CSR and the environment. Possible reasons for this are: 1) the participation of the company in the ÖKOPROFIT programme and 2) the fact that these activities belong into the area of CSR and are rather "extra activities" than part of the core activities of the company. Therefore, there seems to be a greater need to measure outputs/impacts and to present them to the general public.

6 Discussion

This qualitative case study is based on an expert interview, informal communication with the environmental manager and a document analysis of reports from the AVL for the ÖKOPROFIT programme. The data is therefore based on information provided by the company. No external evaluation has been undertaken. The calculations regarding the impact of activities related to environmental aspects can be considered as valid.

Generally speaking, it is difficult to measure the impact of companies' RRI activities in terms of economic impact. This case study shows that in the investigated company there are only limited attempts to measure costs and benefits of RRI activities. The most developed considerations exist regarding environmental aspects: energy savings and CO_2 savings are used to evaluate the activities undertaken. For these activities a causal link to the identified outcome can be drawn. The outcomes and impacts of RRI activities related to open access, gender or ethics remain unclear.

7 References

Peter Prenninger (2015), interview, December 4, 2016.

Christine Pussarnig (2016), personal communication, January 14, 2016.

Umweltamt (2013). *Ökoprofit Auszeichnung 2013*. http://www.umweltservice.graz.at/infos/oep/oep-auszeichnung2013.pdf

Umweltamt (2014). *Ökoprofit Auszeichnung 2014*. http://www.umweltservice.graz.at/infos/oep/oep-auszeichnung2014.pdf

Umweltamt (2015). *Ökoprofit Auszeichnung 2015*. http://www.wolfconsult.at/wp-content/uploads/2015/07/%C3%96KOPROFIT-Broschuere-2015-low.pdf

FemPower Bonus for Female Project Leaders

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1 Case abstract

The FemPower Bonus aims to support greater involvement of women in innovation and research projects. With the FemPower Bonus, the Vienna Business Agency provides a specific incentive to increase the share of women among project leaders. When a woman is the leader of an R&D project funded by the Vienne Business Agency, the company receives 10,000 Euros additional funding. It is assumed that greater involvement of women in research projects not only opens up new career opportunities for women but also increases the quality of projects and consequently strengthens the competitiveness of the company and therefore constitutes a competitive advantage for Vienna.

The case study mainly refers to the evaluation of FemPower (Thaler/Hofstätter 2012). The evaluation is complemented by a comprehensive desk research (documents, reports, homepage). The evaluation showed that with very few exceptions, those women who became project managers for the first time were assigned further project management tasks and/or management functions. Women who were already working in a managerial capacity were able to expand their departments and development activities.

Table 33 Case study 17: Case detail

RRI dimension	RRI □	Citizen Participation □	Science Literacy □	Gender equality X
	Open Access □	R&I governance □	Ethics □	Other □
R&T field	ICT, life sciences			
Country	Austria / Vienna			

2 Introduction

The Vienna Business Agency (Wirtschaftsagentur) is a service and funding organisation for national and international companies. The objective is to strengthen Viennese companies and their innovative force. The Vienna Business Agency prioritises and promotes activities in the following fields that have been identified as regional strengths: life sciences, urban technologies, creative industries and ICT. The Vienna Business Agency was founded in 1982 as the Vienna Economic Development Fund (Wirtschaftsförderungsfonds) by the City of Vienna, the Vienna

Chamber of Commerce, the UniCredit Bank Austria AG (formerly the Zentralsparkasse) as well as the Erste Bank der Österreichischen Sparkassen AG (formerly the Erste Österreichische Sparkasse). The services offered by the Vienna Business Agency are primarily financed from the City of Vienna's public funds.

The target group for financial support are Viennese companies of different sizes and sectors: from services and local shopping to research and innovation through to creative industries. Viennese companies are companies with at least one operating branch in Vienna. To get funding in the field of R&D companies have to develop a R&D strategy containing explicit goals for R&D, a description of a general framework for R&D as well as general ideas about new processes, products or services that will be introduced in markets.

The current funding programme "FIT15 plus – funding for research, innovation and technology projects" covers the period 2015 to 2017. Funding ranges from 50,000€ to a maximum of 500,000€. Funding is higher for small and medium sized companies compared to big companies (more than 250 employees and a yearly turnover of more than 50,000,000€).

From 2015–2017, several calls will be launched which will be devoted to selected topics addressing companies that already have established R&D activities as well encouraging new companies to deal with R&D and develop their potential. Within the framework of FIT, 15 plus projects are supported which correspond to the definitions of "industrial research" or "experimental development" provided by the programme. It is assumed that these projects contribute directly or indirectly to innovative products, services or processes, for which a basic economic implementation strategy can already be presented. This implementation strategy should lead to economic added value for the region of Vienna.

Table 34 Case study 17: FIT15 plus - research, innovation, and technology promotion for Vienna 2015-2017

Eligible costs	• Staff costs directly related to R&D work • Costs for external services for work performed by third parties entrusted with R&D that are in connection with the acquisition, validation and defence of patents and other intangible assets.		
Minimum asset basis	50,000€ per research project		
	Small companies	Medium companies	Big companies
Experimental development (ED)	45%	35%	25%
ED with supplement for cooperation	60%	50%	40%
Industrial Research (IR)	70%	60%	50%

IR with supplement for cooperation	80%	75%	65%
Obtainment, validation, or defence of patents and other intangible assets	50%	50%	---
Max. funding	500,000€ / project		
Max. duration of project	3 years		
Bonus11 for projects led by women	If the scientific project management is proven to be carried out by a competent woman, then the subsidy will be increased by EUR 10,000 as long as the max. funding is reached.		

Source: funding guideline 2015–2017, p. 7f.

FemPower Bonus

In 2004, ZIT – the Technology Agency of the City of Vienna, which became part of the Vienna Business Agency in 2014 – implemented a gender mainstreaming strategy. Part of this strategy was the introduction of FemPower Calls and FemPower Bonus aiming to support greater involvement of women in innovation and research projects. Both instruments are still in force. The case study presented focuses on the FemPower Bonus because of the data availability, which allows discussing its effects more specifically.

With the FemPower Bonus, the Vienna Business Agency provides a specific incentive to increase the share of women among project leaders. In case a woman is the leader of an R&D project funded by the Vienne Business Agency, the company receives 10,000 Euros additional funding. It is assumed that greater involvement of women in research projects not only opens up new career opportunities for women but also increases the quality of projects and consequently strengthens the competitiveness of the company and therefore constitutes a competitive advantage for Vienna.

Furthermore, there are gender and diversity indicators implemented in the evaluation of grant applications (see for example the evaluation framework for the current call "Users in Focus"; Vienna Business Agency 2016[105]). The assessment of applications is based on 13 indicators or underlying questions. Three of these indicators are formulated as exclusion criteria: Does the proposed project meet the specific focus of the call? (Indicator 1) Does the proposed project

[105] Available in German only.

meet the definition of R&D formulated in FIT15 plus? (Indicator 3) Are the resources applied adequate for the proposed project? (Indicator 13) If the answer to any of these questions is "no", then the proposal will be rejected. For each of the remaining 10 dimensions the maximum of points to be reached is defined.[106] Indicator 11 focuses on equality and diversity and addresses three questions: (1) Is the project led by a qualified woman? (yes: 2 points) (2) Do more than 50% of working hours apply to women? (in case of small companies: 33% of working hours; yes: 2 points) (3) Does the application discuss different forms of usage of the innovation for different groups or are similar aspects relevant with regard to diversity explicitly dealt with in the application? (yes: 2 points).

3 Methodology and data

The case study is based on the evaluation report of FemPower (Thaler/Hofstätter 2012) and complemented by comprehensive desk research (documents like yearly reports of the funding institution, guidelines for applications, brochures, homepages) conducted within MoRRI.

In 2012, ZIT commissioned an evaluation of the impacts of FemPower on careers of female project managers (Thaler, Hofstätter 2012; ZIT 2012). The evaluation was conducted by the Interuniversity Research Centre for Technology, Work and Culture (IFZ) in Graz. The evaluation focused on projects funded in the two most relevant fields: information and communication technologies (ICT) and life sciences. In total 23 researchers were interviewed: 20 of them had been project leaders of the respective projects. From the given population comprising all projects in ICT and life sciences headed by women the sample covered 60% of ICT project leaders and 69% of project leaders in life sciences.

The methodology applied in the evaluation comprises guided interviews and questionnaire-like career data sheets. For quality assurance, the vast majority of interviews were conducted by two interviewers and all interviews were analysed by two interpreters for triangulation. The research questions addressing the impact of the FemPower Bonus were formulated as follows:

- How have the careers of project leaders progressed after their companies received the Women Bonus for their projects?

[106] These are: Assessment of research and innovation potential of company applying for funding (I2, max. 15 points); scientific excellence of the proposed project (I4, max. 13 points); subjective added value of the proposed project for the company in the context of its R&D strategy (I5; max. 13 points); assessment of economic implementation strategy (I6, max. 13 points); subjective added economic value of the proposed project for the company (I7, max. 13 points); assessment of employment effects on company level (I8, max. 8 points); assessment of regional relevance of the proposed project (I9, max. 9 points); assessment of ecologic effects (I10, max. 5 points); equality and diversity (I11, max. 6 points), project management (I12, max. 5 points).

- What impact did measures for women's advancement have on the biographies of these project leaders, in particular the Women Bonus?

4 Input level: RRI activity

The objective of FemPower Bonus is to increase female participation in management positions in R&D. It is assumed that the financial incentive makes companies think about qualified women who are willing to take up management positions. Consequently, the primarily male-dominated culture in projects is thus called into question.

There is no specific application necessary for the FemPower Bonus. Hence, it is part of the general competitive application process for research funding. Because of this setting, it is assumed that negative stereotypes associated with positive action measures are avoided. As a first step, the best-qualified projects are identified and only in the second place the sex of the project leader is taken into consideration. The use of the bonus is not dedicated to the respective research project; it can be used for any purpose.

Furthermore, as the FemPower Bonus is part of general research funding and calls it is combined with gender criteria implemented in the application process. Therefore, applicants as well as reviewers have to deal with gender dimension in the context of R&D. Thus, the gender dimension is implemented at organisational level (effecting all programmes and projects funded by the organisation) and at local level (Vienna).

5 Output and outcome level: impact and benefits

In 2014, 57 projects received in total 225,000€ bonuses because of a female project leader. The volume of projects amounted to 4,000,000€ funding in total (Czernohorszky/Rauscher 2016: 3). This is an increase compared to 2011 the year the evaluation refers to (48 projects; Thaler/Hofstätter 2012).

The evaluation discusses the effects on individual level – on the career of women leading a project with FemPower bonus. The incentive increases chances of women to assume their first project lead within the company. Women in their first project management function see this as a possibility to consolidate their individual research interests and develop them further. The project management position leads to higher visibility within their research group. Women leading a project for the first time report an increase in self-confidence. With very few exceptions, those women who got positions as project managers for the first time were assigned further project management tasks and/or management functions.

For 'experienced' project managers – women who have managed projects before and sometimes even have a management position in their company – the bonus has less impact on their personal career, but they report positive effects on their position within the company: by getting their project funded they bring in funding with high reputation to the institution so they can discover new research fields and use the funding strategically for their career (e.g. introducing specific research fields in their institution or establish new cooperations). The bonus increases resources and brings more recognition in the scientific community and also within the company, especially in small companies, the funding is an important source for research projects/business. Experienced female project managers "appear in the first row" (Thaler/Hofstätter 2012: 22) while up to now their presence had commonly been in the second.

Thaler and Hofstätter argue that with the FemPower Bonus more women are project leaders and thereby in the position to recruit researchers in a different way. They assume that female project leaders will promote female researchers which will contribute to an increasing female participation in R&D. Experienced female project managers see this as a step to "break through the glass ceiling" (Thaler/Hofstätter 2012: 19).

Hence, it may be concluded that the bonus creates not only effects at the individual level but also a structural incentive to assist women in assuming more leadership positions, which also contributes to a cultural change in the company.

In order to assess the impacts at different levels it is important to see the FemPower bonus as part of a policy mix implemented at the Vienna Business Agency, which also consists of the implementation of gender criteria in funding.

5.1 Society

- Companies are asked to elaborate potential differences in usage of an innovation for different groups already in the proposal. This leads to more diverse and targeted products and innovation.
- The bonus contributes to an increasing participation of women in R&D and leads therefore to additional role models for younger generations. An increasing number of female role models is a precondition for a cultural change in R&D as well as a change of gender stereotypes. Consequently, one can argue that the FemPower Bonus contributes in the long run to a change of gender stereotypes.
- The design of the bonus as general part of the funding process avoids negative associations with measures to promote women (Frauenförderung) like a conflict between gender and excellence/merit.

5.2 Democracy

- The incentive increases female participation in R&D, which is a democratic effect as such. These effects appear at the level of project teams, research groups as well company level.

5.3 Economy

- The bonus as part of R&D funding is interpreted as an instrument to strengthen competitiveness of Viennese companies.
- The economic effects of the bonus were not part of the evaluation. It seems to be difficult to identify causal effects of a measure that is part of a broader policy mix.

6 Discussion

The case study is mainly based on the evaluation of FemPower conducted in 2012 with focus on the effects of the intervention on careers of women in R&D. The evaluation allows drawing of conclusions for company-based research in ICT and life sciences in Vienna. The evaluation draws a causal link between the initiative and women assigned project leadership for the first time. This conclusion is based on a qualitative study. The authors of the case study did not identify any restrictions with regard to explanatory power of evidence used. The analysis of documents indicates that the integration of the bonus in all funding schemes caused an important multiplier effect and avoided stigmatising effects of the instrument. The latter because the bonus is not a specific instruments to promote women but an additional incentive ("goody") for projects selected for funding.

7 References

Czernohorszky, Eva; Rauscher, Andrea (2016), FemPower Initiative. Frauenförderung und Gender Mainstreaming in der Wirtschaftsagentur Wien, Wien. (https://wirtschaftsagentur.at/fileadmin/user_upload/Ueber_uns/Die_FemPower_Initiative_der_Wirtschaftsagentur_Wien.pdf; access: 07.03.2016)

Thaler, Anita; Hofstätter, Birgit (2012), Studie über Karriereverläufe von Frauen in der betrieblichen Forschung, Studie im Auftrag von ZIT – der Technologieagentur der Stadt Wien, Graz: Interuniversitäres Forschungszentrum für Technik, Arbeit und Kultur.

Vienna Business Agency (2015), FIT15 plus - research, innovation, and technology promotion for Vienna 2015-2017. Directive, Vienna. (https://viennabusinessagency.at/fileadmin/user_upload/Foerderungen/Forschung/FIT15_plus_Richtlinie_final_en.pdf; access: 07.03.2016)

Vienna Business Agency (2016), Bewertungssystem FORSCHUNG Call Users in Focus 2016, Vienna. (https://viennabusinessagency.at/fileadmin/user_upload/Foerderungen/Call_Users_in_Focus_2016/CUIF16_Bewertungssystem_Final.pdf; access: 07.03.2016)

ZIT (2012), ZIT FemPower. Studie 2012. Effekte der ZIT FemPower Maßnahmen auf die Karriereverläufe von Frauen in der betrieblichen Forschung, Wien.

Gender Criteria in the Austrian Science Fund (FWF)

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1 Case abstract

In this case, the gender equality strategies of the Austrian Science Fund (FWF) are analysed according to their impact on the participation of women in science and research and on cultural changes on the funding practices of the FWF. The self-presentation of the FWF on its homepage and in annual reports, funding statistics, programme guidelines and principles of the FWF decision-making procedure are used for a critical analysis of evident improvements for female researchers and scientists.

With the establishment of a staff unit for gender issues, several measures to increase the awareness for gender equality in the organisation (awareness training, increasing share of women in boards and in the staff), to raise the share of female applicants (monitoring the share of women in grants, redesign of programmes) and to ensure fair and equal treatment of female and male applicants (gender equality standards for external and internal processes) were implemented. This concurred with a rising share of women among applicants and principal investigators. Because the FWF mainly funds basic research and not applied research there is hardly any direct impact on products, services or processes and economic benefit. However, the gender policy of the FWF might influence the general discourse about gender on research and with this the gender culture in research institutions.

Table 35 Case study 18: Case details

RRI dimension	RRI □	Citizen Participation □	Science Literacy □	Gender equality X
	Open Access □	R&I governance □	Ethics □	Other □
R&T field	Basic research			
Country	Austria			

2 Introduction

The Austrian Science Fund (FWF), Austria's central funding organisation for basic research, has anchored gender equality as a guiding principle of the organisation. The FWF implemented

Gender Mainstreaming processes and female promotion programmes to tackle structural disadvantages of women in science and research. The measures address gender equality in the three dimensions of female participation in research, structural changes of institutions and gender in content, although the priority lies still in the individual promotion of female researchers.

The purpose of the FWF is to strengthen science and research in Austria to develop Austria's human resources for science and research and to enhance the interactive effects of science and research with other areas of culture, economy and society. It was founded in 1967 on the basis of the Research Funding Act as an independent legal entity together with the Austrian Research Promotion Agency. In 2004, its legal entity (Research and Technology Funding Act) was amended in response to the Universities Act 2002 and the organisation of the FWF as well as ministries and members representing the interests of employers and employees. In 2005, the FWF established a Staff Unit for Gender Issues.

With a total of 211.4 million € grants the FWF financed 691 projects with 3,973 funded research personnel. Within the portfolio, stand-alone projects make up the largest part of grants, both according to the number of projects and the amount of money. START and Wittgenstein Award as well as the FWF Doctoral Programmes are intensive grands for long-term research with sufficient financial security. Programmes for career development for women in science and research, that address women at different stages of their career with the Hertha Firnberg Programme and the Elise Richter Programme and the PEEK Programme, account for about 6% of the total grants.

Table 36 Number of projects and research grant amounts (2014)

	Projects		Grants in 1.000 €	
Stand-Alone Projects	300	43%	90,8	43%
International Programmes	125	18%	27,2	13%
SFBs, NFNs	84	12%	31,1	15%
START and Wittgenstein Award	9	1%	10,7	5%
DKs	11	2%	24,8	12%
International Mobility	112	16%	14,1	7%
Career development for women	38	5%	9,9	5%
PEEK	8	1%	2,6	1%
Science Communciation Programme	4	1%	0,2	0%
	691	100%	211,4	100%

New approvals 2014. Source: FWF annual report 2014, p. 26-27.

With its grants the FWF can influence the performance of science and research especially in the university sector (85% of the total FWF funding amount goes to universities, where the FWF funding accounts a relative share to university's basic budget of 8%). The Guidelines and evaluation criteria of the FWF could influence female participation in science and research, the

institutional culture and the content of research. The goal of this case study is to identify the impact of the implemented measures for gender equality, respectively the gender criteria for the programmes according to its benefits for society, democracy and economy.

3 Methodology and data

The case study is based on desk research using several sources provided by the FWF, such as annual reports, funding statistics, programme guidelines and principles of the FWF decision-making procedure. This data is supplemented by analysis of the decision-making procedures.

The efforts and goals of gender mainstreaming in the institution as well as the guidelines and the principles of decision making are used as input for the promotion of gender equality. These intentions are reflected with the outcome according to female participation in grants and its connected social and economic benefits. Additionally, structural measures designed to initiate organisational or cultural changes are observed wherever there data exist.

4 Input level: RRI activity

Gender equality measures of the FWF aim to increase the share of women among Austrian's researchers to support its new research technology and innovation (RTI) strategy of ensuring that Austria attains a top international position in RTI by developing human resources. This includes efforts to ensure equal opportunities for men and women in research through equal representation in all sectors and all levels of RTI. In order to achieve this goal, the share of women will have to increase significantly in all positions and especially in higher research positions and technical disciplines that show an enormous lack of women.

The strategy to promote women in science and research through "women-only" grant programmes was supplemented by processes of gender mainstreaming, that means the systematic integration of a gender perspective in the planning and implementation of policies. Its development started with the establishment of the FWF's Staff Unit for Gender Issues in 2005 that reports directly to the FWF's management. Its initial objectives are

- to ensure the quality of data captured and to identify links in existing data;
- to increase the visibility of women in science and research;
- to enhance and expand career opportunities for women in science and research;
- to increase the number of women among principal investigators and in the FWF's decision-making bodies.

Consequently, gender mainstreaming tasks are related to monitoring and self-reflection processes on the one hand and to the development of strategies to promote women as the target group of grants and as members of the institution on the other hand.

Since 2007, gender issues in the field of research policy have been supported by national networking activities within the framework of the genderAG working group. This multi-organisation working group includes all funding agencies housed in the Haus der Forschung building (ACR, CDG, FFG, FWF and JR) and promotes exchanges and discussions on measures to enhance career opportunities and to promote equal opportunities for women. At the international level, a working group was established within the D-A-CH region (Germany – Austria – Switzerland).

Several measures were implemented to raise internal and external awareness of gender issues, like awareness training seminars for employees for the FWF and its decision-making bodies in 2009 or the adoption of a set of standards for equal treatment in 2010. These standards also extend to the FWF's external work, that is, research funding and the associated processes such as committee work, the promotion of junior researchers, programme design, peer review and decision making. In addition, processes within the organisation were also taken into consideration and defined (e.g. the FWF's HR activities).

The FWF was successful in increasing the share of women in the organisation. Except the Assembly of Delegates that decides on rules of procedures and elects the most influential members of the FWF, and the FWF board, that is responsible for deciding on funding for research projects and changes in the FWF’s funding programmes, the share of women exceeds the 40% mark.

Table 37 Share of women in the FWF

	Total	Women	Share of women
Supervisory board	9	4	44%
Assembly of Delegates	60	23	38%
FWF Management	5	3	60%
FWF Board	54	21	39%
Expert Juries and board	25	12	48%
Employees	99	67	68%
Total	252	120	53%

Source: FWF annual report 2014, p. 59.

The implementation of gender equality standards at the FWF fostered policy decision processes for objective assessment of all applications to ensure, that the gender distribution of grant recipients is in line with that of applicants received. One result is the revision of the FWF’s application requirements for grants and fellowships, as age limits have been eliminated and parental leave is now recognised in the calculation of a researcher's "academic age". The

application guidelines for grants and fellowships contain guidelines concerning gender equality in an Appendix on Notes and questions for FWF reviewers:

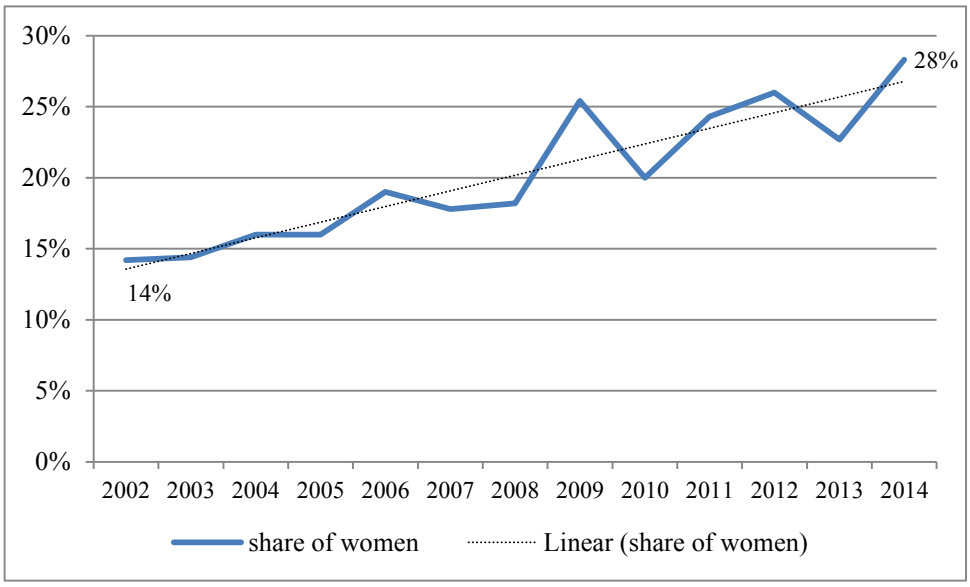
> *"In all of its programmes, the FWF actively supports equal opportunities and equal treatment. The review of an application must not put the applicant at a disadvantage for non-scientific/nonscholarly reasons such as age, gender, etc. For example, the assessment of research proposals should not be based on the applicants' actual age, but instead on the individual circumstances relating to the duration of their scientific/scholarly careers and previous research achievements. The FWF endeavours to ensure equal opportunities for all applicants and thus takes into consideration any unavoidable delays in the scientific/scholarly careers of applicants, such as gaps in publication activity or less time spent abroad (e.g. due to longer qualification periods, time spent raising children, long-term illness etc.)."*

In 2010, the FWF also implemented a self-reflection process according to the organisation's decision making processes and carried out a bibliometric analysis of FWF-funded projects.

5 Output and outcome level: impact and benefits

The share of women as principal investigators increased dramatically in the most programmes. For instance, the share of women in stand-alone projects doubled between 2002 and 2014.

Table 38 Share of women as principal investigators in funded stand-alone projects



Source: FWF annual reports 2005-2014.

Also, the share of applicants who requested funding from the FWF rose from 20.4% in 2005 to 31% in 2013. Nevertheless, between 1998 and 2008 the overall approval rate for stand-alone projects was lower for women than for men. The FWF explains this underrepresentation of

women in certain disciplines to family-related burdens during periods that are decisive to one's career, and to the higher proportion of unstable employment relationships. In 2014, the approval rate for female applicants for stand-alone projects (28.2%) exceeded those of men (25.7%). Even in total, the approval rates of women are slightly higher than those of men (29.0% vs. 28.1%).

But the rising share of women in grants concurred with a rising share of female researchers. Women are still underrepresented among applicants for stand-alone projects, international programmes, priority research programmes, START and Wittgenstein Awards as well as FWF doctoral programmes. Only in programmes supporting international mobility, arts-based research and in science and communication programmes, women represent more than 40% of applicants. However, with the exception of support of international mobility, all these programmes only fund a comparable small number of projects. The underrepresentation of women in general programmes is partly compensated by-women only programmes (e.g. stipend programmes for women working on their habilitation). In total, women represent 31% of applicants. Although women represent 31% of applicants, they only receive 28% of the grant amounts.

Table 39 FWF-funded projects by gender (2014)

	women	men	share of women
Stand-Alone Projects (incl. clinical research)	301	837	26%
International Programs	117	436	21%
Priority Research Programs (SFB, NFN)	13	80	14%
START and Wittgenstein Award	26	95	21%
FWF Doctoral Program (DK)	1	12	8%
International Mobility	130	179	42%
Career development for women	136		100%
Program for Arts Based Research (PEEK)	23	27	46%
Science Communication Programme	10	9	53%
Total	757	1.675	31%

Table 40 FWF grant amounts by gender (in mio €, 2014)

	women	men	share of women
Stand-Alone Projects (incl. clinical research)	92,1	256,3	26%
International Programs	30,7	107,8	22%
Priority Research Programs (SFB, NFN)	4,8	31	13%
START and Wittgenstein Award	32	115,6	22%
FWF Doctoral Program (DK)	2,9	33,2	8%
International Mobility	15,5	21,9	41%
Career development for women	34,3		100%
Program for Arts Based Research (PEEK)	7,9	8,7	48%
Science Communication Programme	0,5	0,4	56%
Total	220,7	574,9	28%

Source: FWF annual report 2014

About 4,000 people are working within stand-alone projects. During the last years, gender composition within the different categories remained stable. This applies to all levels of positions with the tendency of a higher share of women in less qualified positions.

Table 41 Staff working in stand-alone projects funded by FWF by gender (2009-2014)

	2009	2010	2011	2012	2013	2014
PostDoc	951	976	1.229	1.288	1.351	1.392
women	388	412	575	517	519	564
men	563	564	654	771	832	828
women in %	41%	42%	47%	40%	38%	41%
PraeDoc	1.619	1.683	1.771	1.935	1.967	1.955
women	671	710	745	819	839	835
men	948	973	1.026	1.116	1.128	1.120
women in %	41%	42%	42%	42%	43%	43%
Technical staff	134	122	137	173	170	158
women	95	82	98	118	123	121
men	39	40	39	55	47	37
women in %	71%	67%	72%	68%	72%	77%
Other staff	405	403	405	456	476	468
women	183	193	213	215	232	230
men	222	210	192	241	244	238
women in %	45%	48%	53%	47%	49%	49%
Total	3.109	3.184	3.542	3.852	3.964	3.973
women in %	43%	44%	46%	43%	43%	44%

Source: FWF monitoring (due date 31.12.)

The FWF supplemented "women-only" programmes with structural measures designed to initiate organisational or cultural change in the world of science, but the effects of these

initiatives cannot be measured simply by looking at female participation in funding. The relevance of the topic is among others visible in the self-reflexive process the FWF launched with a series of empirical studies to systematically analyse its decision-making procedures with regard to a gender bias. The analysis is being conducted partly by the FWF itself and partly with the support of independent experts, who include a research group from the ETH Zurich and the Max Planck Society Munich (Hans-Dieter Daniel, Rüdiger Mutz, Lutz Bornmann), the bibliometric research group at the Centre for Science and Technology Studies Leiden (CWTS) and a research team at the Institute for Research Information and Quality Assurance (IfQ). All the results are openly accessible and have been published as policy papers or in relevant international journals.

In this context, Christian Fischer and Falk Reckling (2010) analysed the probability of male or female applicants obtaining funding in stand-alone programmes (which represent about 60 % of all FWF grants). They found that women had a slightly lower chance of obtaining funding than men in the period from 1999 to 2008 (ibid. 35f). However, they could find no clear causal explanations for this result, since there were no indications that women faced a disadvantage in the peer review process as a result of their gender. Instead, there was a close correlation between approval rates and average review ratings. The actual field of research also had no direct effect. Fischer and Reckling found the lower success rate of women to be a consequence of a combination of several factors. On average, female applicants are three years younger than male applicants. They also account for a significantly larger share of independent applications than men. So while female applicants do not receive lower approval rates per se, the combination of more applications and lower age produced this negative effect.

Mutz et al. (2012) focused on the peer review process in the FWF application procedure. Their study also centred on stand-alone projects and analysed gender effects in peer reviews. The authors concluded that the final decision of the FWF board of trustees is affected neither by an applicant's gender nor by any correlation between the gender of an applicant and that of the reviewers. However, they did find a female reviewer salience effect, as approval probability decreased when there was gender parity or a female majority in the reviewer group. This effect was found mainly in the middle range of ratings, where the overall rating neither clearly supported nor opposed the funding of a proposal.

This self-reflexive process, which focused mainly on process quality (transparency, etc.), was continued in the development of equality standards for research funding. Published in 2010, these standards address structures and decision-making processes (e.g. gender know-how in decision-making bodies, programme design, review procedure). The FWF thus monitors the share of women at all stages of application procedures – from receipt of application to funding decision – to ensure that gender is not a bias factor in the assessment. In its decision-making bodies (FWF Board, FWF Executive Board), the organisation makes every effort to ensure that the gender distribution of grant recipients is in line with that of applications received.

In addition to these internal structural measures, the FWF not only supports female scientists via its "women-only" grant programmes, it also tries to change the general conditions in all of

its programmes and include supporting measures (like target quotas) wherever possible. Programme objectives and the ultimate design of FWF programmes are in line with this goal. The FWF's overall goal is to achieve gender balance in all its programmes. Its programmes are being redesigned on the basis of the analyses of shortcomings and needs and adapted to reflect evaluation results. For instance, target quotas for female participation are being introduced in its special research [Spezialforschungsbereiche] and doctoral programmes [Doktoratskollegs] : 30 % of researchers involved in a project should be female. Applicants are now also asked to elaborate on the gender dimension of their research projects. While neither of these criteria have been officially sanctioned as yet, the fact that applicants have to address these issues during the application process (submission, hearing) increases awareness. Cyclical evaluations serve to verify the actual effect of programmes in accordance with their relevant objectives. New and existing programmes are analysed accordingly and reviewed for their potential effects on gender equality. Measures have also been introduced to raise awareness and build up gender competence among FWF employees and international peer reviewers.

The FWF's gender equality standards also extend to its own internal processes (recruiting, remuneration, continuing education and training, working hours, organisational culture). For instance, the FWF aims to avoid any age, gender and/or ethnic bias in its own recruiting activities. On an organisational culture level, the FWF defines gender equality as a key management task and endeavours to ensure gender balance in the delegation of management responsibilities. The gender-sensitive use of language has also been implemented both internally and externally. With regard to the benefits, the results of the case may be summarised as follows:

5.1 Society

- There is no data available if and how a gender dimension in research content is considered. As the FWF mainly funds basic research and not applied research a direct impact on products, services or processes might not be assumed.
- However, the gender policy of the FWF might influence the general discourse about gender in research.

5.2 Democracy

- FWF interventions aim to increase female participation in funded research. An increase of female participation would also be a democratic benefit.

5.3 Economy

- As the FWF funds basic research there is no direct implementation of results in markets. Hence, economic effects may not be assessed.

6 Discussion

FWF interventions aim to increase female participation in funded research. Consequently, the share of women among applicants and researchers seems to be a relevant indicator. Unfortunately, the gender monitoring of the FWF did not show the expected development even though several policies are in place. This underlines the reservations already mentioned in the Gender Dimension report to use a single indicator like female participation.

7 References

Fischer, Christian; Reckling, Falk (2010), Factors Influencing Approval Probability in FWF Decision-Making Procedures, FWF Stand-Alone Projects Programme, 1999 to 2008, FWF discussion paper, Vienna. [download: http://www.fwf.ac.at/de/downloads/pdf/FWF-ApprovalProbability_P-99-08_15-12-2010.pdf]

FWF (2005-2015), Annual report, Vienna. [download: https://www.fwf.ac.at/en/about-the-fwf/publications/publication-types/10/publication-view/single/back/230/]

FWF (2010) Equal opportunities in research funding – Gender equality standards at the FWF, Vienna.

Mutz, Rüdiger; Bornmann, Lutz; Daniel, Hans-Dieter (2012), Does Gender Matter in Grant Peer Review? An Empirical Investigation Using the Example of the Austrian Science Fund, Zeitschrift für Psychologie 2012; Vol. 220(2):121-129 [download: http://www.fwf.ac.at/de/zur_diskussion/pdf/does_gender_matter_in_grant_peer_review.pdf]

Institute of Gender in Medicine at the Charité, University Medicine Berlin

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1 Case abstract

This case describes the Institute of Gender in Medicine (GiM) at the Charité University Medicine in Berlin. The institute was founded in 2003 with the aim to integrate gender aspects in medical research, particularly cardiovascular diseases. The institute was founded by Prof. Dr. Vera Regitz-Zagrosek[107] who has, since the beginning, been the head of the institute.

The GiM does not only conduct research in national and international context but is also engaged in teaching and education activities, development of guidelines and standards, networking and theme setting activities.

The case study is based on publicly available information - for example the institute's website -, one interview with the head of the GiM and further studies, such as literature on benefits of the (intensified) consideration of gender aspects[108] in medical research and practice. Thus, the information this case study is based on is primarily qualitative.

The benefits associated with the activities of the GiM are manifold: they relate to economic benefits (increased knowledge on improved diagnostics, drug development, therapies and consequently a better life expectancy), societal benefits (effects on education, health, quality of life, prevention), democratic benefits (more justice through the consideration of particular needs of 50% of the population), as well as scientific benefits (better suited theories, methods and models, evidence-based therapies).

Table 42 Case study 19: Case details

RRI dimension	RRI	Citizen Participation	Science Literacy	Gender equality
	□	□	□	X

107 Prof. Regitz-Zagrosek is also Deputy Director at Center for Cardiovascular Research at the Charité and Coordinator Berlin of the German Center Cardiovascular Research (DZHK)

108 In this text we use the term "gender" as generic term including differences according to biological factors (sex) as well as socio-cultural factors (gender). For a more exact differentiation see Regitz-Zagrosek 2012.

	Open Access	R&I governance	Ethics	Other
R&T field	Medicine, Health			
Country	Germany			

2 Introduction

The GiM started its work in October 2003, based on two professorships. In 2007, after four years of successful work and the respective evaluation results, the faculty council supported the foundation of an institute. The number of staff varies, depending on external grants. Given the large number of tasks and activities, the institute is comparatively small in terms of available personnel resources. The institute divides its activities into five fields: (1) Basic research, (2) Clinical research, (3) Guidelines, (4) Prevention research and Health care system, (5) Research on gender in graduate/postgraduate education.

In terms of the overall organisational structure, the institute employs a scientific advisory board (see below) and is regularly evaluated by external reviewers. The strong dependency on external grants and regular evaluations is a regular, often inhibiting, basic condition of the institute's work.

Main actors

Currently, the GiM is composed of the head of the institute, two post-docs and one technical assistant financed by institutional means. The remaining 25 researchers are financed by external grants.

The institute has a board of directors, with the Central Women and Equal Rights Representative as one of the members, and a scientific advisory board, consisting of representatives from universities, gender experts, medical associations, but also from companies.

Activity or instrument used to achieve RRI

The GiM dedicates the majority of its activities to the conduction of research. Additionally it is engaged in education and further training, the formulation of guidelines, networking at national as well as international level and in theme setting activities like the foundation of expert associations like the "Deutsche Gesellschaft für geschlechtspezifische Medizin e.V." (http://www.dgesgm.de/), respectively the "International Society for Gender in Medicine" (IGM) (http://www.isogem.com/).

Relevance for RRI

The GiM is a pioneer regarding the institutionalisation of gender in medicine in Germany, but also in Europe: besides the Karolinska Centre for Gender Medicine in Stockholm, it was the first

institution explicitly focused on gender aspects in basic and clinical medical research. Meanwhile, several years later, other countries started institutes or professorships engaging in gender medicine as well, for example the Medical University in Vienna (Gender Medicine Unit since 2010), the University of Innsbruck (which established a respective professorship in 2014) and the University of Maastricht.

3 Methodology and data

The methodology and data used for this case study are a personal interview with the head of the institute, which took place in January 2016 at the institute in Berlin (Charité) and was based on an interview guideline, and the in-depth analysis of numerous articles and further publications on (benefits of) gender aspects in medicine. As impacts of RRI activities can – due to the novelty of the concept and the respective activities – hardly be "measured" in a strict causal sense, the qualitative approach is justified.

4 Input level: RRI activity

The GiM focuses primarily on the gender equality area "gender aspects in research and innovation content", but also shows effects on other RRI dimensions like science education and a general shift in science towards more responsibility - asking questions like: "what are the impacts of research?", "who is the beneficiary?", - as well as the consideration of so-far neglected parts of society in research design and implementation.

Based on her own experience in applied medical research and practice in cardiology regarding a significantly worse diagnosis and treatment of women with heart diseases (see Regitz-Zagrosek 2012), the head of the institute promoted the establishment of a visible research group to contribute to an improvement of the situation at that time.

Actors or groups involved in the implementation phase were primarily the head of the institute and some colleagues and researchers. Direct support by the Charité was and is scarce if ever existent. Thus, the main challenge of the institute's work is a lack of basic funding and thus the requirement to dedicate a lot of time and efforts to the acquisition of external grants. As a consequence, less time is available for, for instance, engagement in policy-related expert groups, even if numerous invitations exist. As a result, the impact on policy-making remains limited.

The concrete activities at the GiM can be divided into four areas: (1) research, (2) medical education, (3) guidelines and (4) networking and dissemination activities.

4.1 Research

The core objective of the GiM is the systematic integration of gender aspects in (cardiovascular) research. The institute subdivides its research activities into (a) basic research, (b) clinical research, (c) prevention research and (d) research on gender medicine education.

Basic Research

The GiM conducts research at regional, national as well as international level, for example in the context of the current EU-funded project EUGenMed (http://www.eugenmed.eu/, since 2013) which aims to develop a "roadmap for implementation of Sex and Gender (S&G) in biomedicine and health research". The core objective of this project is the improvement on how to treat the major chronic diseases in Europe like heart failure, diabetes etc. Further EU projects were the already finished EU Integrated Project EUGeneHeart (2005-2010) and the FP7 project "RADical reduction of OXidative stress in cardiovascular diseases – ITN RADOX", which has run since 2013.

One of the first activities at the national level was the pilot project "Gender Medicine", funded by the German Ministry of Education and Research where the team investigated the impact of sex and gender on basic and applied medical research based on a thorough analysis of the available literature. The project resulted in a publicly accessible database.[109]

Further activities are several research projects funded by the German Research Foundation (DFG), for example the Research Group Myocardial Hypertrophy (FOR 1054, since 2008) or a project on gender differences in human aortic stenosis (2006-2009), and current collaboration with the German Centre for Cardiovascular Research (DZHK).

In terms of promoting young scientists, the GiM coordinated a DFG-funded graduate group on "Gender specific mechanisms of myocardial hypertrophy" (2004-2011), an activity which is followed-up by the initiative "Young CCR" at the Centre for Cardiovascular Research where master, PhD and MD students receive the opportunity to work on cardiovascular research.[110]

Clinical Research

The primary focus of the clinical research activities at GiM is cardiology, where they intensively cooperate with the German Heart Institute in Berlin and the German Competence Network "Heart Failure". In the latter case, the GiM was able to integrate its specific gender-sensitive point of view into the overall research activities (see, for example, Zugck et al. 2012). In a

[109] http://gender.charite.de/en/research/research_areas/basic_research/ppgm_basic_research/

[110] http://www.ccr.charite.de/en/about_us/graduate_course/

further project, funded by the Margarethe Ammo Foundation (2007-2010), the GiM investigated sex respectively gender differences in the case of heart transplantations, based on finding that there is a serious lack of knowledge regarding a specific heart disease which is far more frequent among women than among men. A further project, TP13 (Heart Failure, funded by German Federal Ministry for Education and Science), focuses on the influence of psychosocial factors like depression on recovery after coronary artery bypass surgery, differentiated according to gender.

The overall integration of gender aspects in applied clinical research, however, is challenging, as the readiness of the pharmaceutical industry to systematically consider gender aspects in their studies and/or integrate a substantial number of female study participants in clinical research is still limited (see Kim 2010, Kim et al. 2008), primarily due to high costs associated with a better gender balance. However, given the fact that adverse reaction to prescription drugs are much more frequent among women than men (Zopf et al. 2008, Martin et al. 1998), it is more than questionable why progress is so late in this field. Also regarding medication, there is still a lack of sensitivity, except from a few cases where the dosage is differently defined for men and women (see Anderson 2005).

Some recent developments have the potential to improve the current situation particularly through emphasizing a better target group definition. If such a target group orientation would become mandatory, according to the interviewee, it would become self-evident to involve female patients and subject groups in clinical research too.

Prevention research and health care system

At GiM, a lot of attention is given to prevention research where gender-related psychosocial and psychological determinants play a crucial role regarding recovery, clinical success and the wellbeing of the patients. The GiM analyses these factors primarily, in the fields of Cardiology and Pulmonology. Selected projects in this area are, for instance, a project on risk evaluation for cardiovascular diseases in Berlin. In this study, a representative sample of 1000 women in Berlin was asked about their self-estimation of cardiovascular risks. These results were compared with objective data for this risk. The main result of the study was a serious lack of reliable self-estimation particularly among the elderly women and the necessity to design more specific risk counselling and information campaigns in order to reach the affected target group more efficiently (see Oertelt-Prigione et. al. 2015).

There are some further projects conducted in the field of prevention research, for example:

- The Pilot Project Gender VWZ which aims to identify preventive behaviour, readiness for change and health literacy in a sample of the general urban population attending general/specialist practices.
- The HuSG project (2010-2012) which led to first mandatory training for practicing clinicians in an academic hospital in Germany as well as a number of materials still used today on how to manage partner violence and communicate with victims. Furthermore,

train the trainer seminars and *ad hoc* workshops still take place, raising awareness and competence about this issue.

- The project Watch-Protect-Prevent (WPP, 2014-2016) investigates the prevalence of sexual harassment in hospital personnel. The focus of this study is on the prevention of sexual harassment and the development of suitable workplace policies that can be adapted to different clinical settings.
- Based on the WPP project, a follow-up project funded by the Hans-Böckler-Stiftung (HBS) could be launched to develop a general concept for guidelines for the management of sexual harassment at the workplace (2015-2016).

4.2 Medical Education and Training

Besides research, another activity is improving medical education. The overall aim in this regard is to promote the mainstreaming of gender and sex differences in medical education in the sense that gender medicine becomes an integral part of the medical curriculum, in the form of elective but also mandatory courses. Through a broad integration of gender aspects into the medical curricula, so the expectation, the next generation of researchers and practitioners will be more sensible and trained to apply the existing gender knowledge into practice. In the end, this will lead to improved diagnosis, therapy and health care for women, but also for men (for instance, the so far underestimated risk for men to get osteoporosis.[111]

The activities in the field of gender-specific learning and education include different approaches. In 2012, for example, the institute developed a master module "Gender Medicine" [112], which aims to promote awareness and knowledge regarding gender-sensitive medicine. The teaching concept combines self-organised learning supported by mentoring with seminars and lectures that require personal attendance. It is also possible to use e-learning course material. This master module is based on a joint effort of the GiM and six partner universities who developed a first concept for Gender Medicine between 2009 and 2011.

The head of the GiM institute also coordinated the ERASMUS project EUGIM on a European level, in which a European Curriculum in Gender Medicine was developed.[113]

Furthermore, the GiM offers an elective course on "Gender-related Medicine", in order to accelerate the transfer of gender research (regarding differences in pathogenesis, clinical features, prognosis but also diagnostic and therapeutic options) into clinical practice. This

[111] http://genderedinnovations.stanford.edu/case-studies/osteoporosis.html

[112] Further master studies are offered on Health and Society (International Gender Studies Berlin) as well as Molecular Medicine

[113] http://gendermed.at/geschlechterforschung/eugim/workpackage-1.html

course involves a series of lectures as well as seminars where the attendees can work on particular topics. The course is case-oriented in order to ease the transfer into practice.

Finally, the GiM set up a project for the development of sex/gender-specific learning objectives in general medical education. The project aims to define gender-specific learning objectives for the educational activities at Charité addressing undergraduate students, based on international findings (see Ludwig et al. 2015). The overall objective of this activity was to improve research, diagnosis and treatment by systematically integrating gender perspectives into the curricula.

Further target groups like general practitioners, dentists, pharmacists and students of health sciences are addressed by training activities like the seminar on genders-sensitive medicine, which took place in 2013 and involved a workload of 75 hours, combining personal attendance and e-learning.

4.3 Guidelines

Especially in clinical research and practice, it is of crucial importance that the available guidelines consider differences between the two sexes systematically. In this regard, the head of the institute led a group that compiled the European guidelines "Management of Cardiovascular Diseases in Pregnancy".

However, medical guidelines typically foresee rather general recommendations and are mainly based on expert opinions, less on evidence-based treatments (Regitz-Zagrosek 2012). In practice it is a common observation that gender recommendations are not fully considered – also due to a lack of sanctions, for example the rejection of applications for approvals. Only the FDA (Federal Drug Administration) seems to be stricter and foresees a mandatory share of female study participants of 40%.

A different type of guideline will be developed by the GiM aiming at the better prevention of sexual harassment at the workplace, based on the results of the aforementioned prevention projects.

4.4 Networking and dissemination activities

The GiM organises numerous events, including large symposia on Gender Medicine, for example the Symposium Gender in Myocardial Hypertrophy or the Symposium GenderMedDB - both in February 2014 -, the International Congress for Gender Research in Medicine, respectively the 7th Annual Meeting of the International Society for Gender Medicine in September 2015, and also workshops and summer schools.

The foundation of science associations like the "Deutsche Gesellschaft für geschlechtspezifische Medizin e.V" respectively the "International Society for Gender in Medicine" (IGM) also serves the purpose of networking (see ESC 2011). The GiM plays a leading role in both associations.

A further relevant aspect for the agenda setting is the establishment of journals like Gender Medicine (available for 2004-2012) or Biology of Sex Differences (BioMed Central - Open Access Publisher.[114] In the latter case, the head of the institute is member of the editorial board.

5 Output and outcome level: impact and benefits

As described above, there are numerous tangible and intangible outputs like publications in peer-reviewed journals[115], the foundation of expert associations, the development of curricula, but also contributions to guidelines, awareness raising and agenda setting. Additionally, the effects on the science-making process itself are worth mentioning: broadening the perspectives through integration of gender aspects into the research design and thus orientating research towards users' needs improves the overall quality of medical research. Finally there are a number of positive societal impacts like improved awareness towards abuse among clinical practitioners, the shaping of suitable workplace environments, and the design of more suitable and effective prevention campaigns.

There is a wide range of affected actors, reaching from researchers, students, young scientists, faculty members and scientific communities within the research and innovation system, to clinical practitioners, patients and citizens within the overall society. The effect on policy-making bodies is, due to the above mentioned time restrictions, less strong than it could be if more basic funding would be available.

The effects occur not only on a national level (Germany), but also Europe-wide, as the GiM is very active in EU research projects and the development of guidelines and curricula also on a European level. Furthermore, the activities of the GiM not only affect research as such, but also medical education and training.

The noteworthy approach of the GiM has been, from its beginning, the strong benefit and user orientation of its research. However, in Germany as well as in other (European) countries, scientific excellence in medical research is still broadly defined by mechanism-oriented research, trying to causally explain a certain phenomenon. That means that the majority of medical research is undertaken in order to identify the underlying mechanisms for a certain disease or the mechanism for the effectiveness of a certain therapy. These approaches typically look at molecular mechanisms and sometimes miss to take societal factors into account. As long as this

[114] http://bsd.biomedcentral.com/

[115] For an overview see http://gender.charite.de/forschung/publikationen/

overall normative model of science does not change – and change is difficult to reach as long as the main actors, expert associations and funding organisations do not broaden their perspectives – the orientation towards user needs is hardly to be reached. However, as the interviewee pointed out, research which can only explain phenomena that occur in half of the population cannot be excellent.

6 Discussion

The importance of a better integration of gender aspects in medical research and innovation is undoubted (see Regitz-Zagrosek 2012, Regitz-Zagrosek / Seeland 2012, Legato 1998 / 2004, Stramba-Badiale et al. 2006, Lehmkuhl et al. 2012). The economic and social benefits are obvious if women – half of the population – receive more attention for their particular needs when developing and implementing pharmaceuticals, diagnostics and therapies. A sound consideration of gender aspects will lead to better knowledge, processes and products as well as an improved health system. For example, not only can life expectancy be increased, but also the quality of life when better medical diagnostics and treatments are available.

For methodological reasons it is difficult to "measure" a causal impact of the institute's work, but based on the numerous and diverse activities described above it is reasonable to assume a strong impact on the development of gender in medicine. And as the regular evaluations lead to steady positive assessments, the outputs and outcomes are obviously satisfactory.

The main challenge of this case study was that despite existing knowledge about the relevance of gender-sensitive research and practice in medicine, the situation is far from being developed in a way that concrete impacts can be identified on a quantitative basis. There are numerous well-documented examples of cost-saving when improving the health and well-being of 50% of the population[116], but experimental designs to prove causalities are – also for ethical reasons – unlikely to be established. A further hindrance is the complexity of the health sector: due to the number and diversity of the involved actors it is apparently difficult to implement gender medicine more extensively without clear regulatory requirements. However, the available literature and studies as well as insights gained through this case study deliver far more than anecdotal evidence.

[116] see the website on gendered innovations, http://genderedinnovations.stanford.edu/, but also single articles like Biermann et al. 2012

7 References

Andersion, Gail D (2005): Sex and Racial Differences in Pharmacological Response: Where Is the Evidence? Pharmacogenetics, Pharmacokinetics, and Pharmacodynamics. In: Journal of Women's Health, Vol, 14, No. 1.

Biermann, Janine et al. (2012): Economic burden of patients with various etiologies of chronic systolic heart failures analysed by resource use and costs. In: International Journal of Cardiology, Vol. 156, Issue 3, Pages 323-325.

European Society of Cardiology (eds.) (2011): ESC Guidelines on the management of cardiovascular diseases during pregnancy. In: European Heart Journal (2011) 32, 3147–3197.

Kendel F. et al. (2011): Gender differences in health-related quality of life after coronary bypass surgery: results from a 1-year follow-up in propensity-matched men and women. In: Psychosomatic Medicine, 73(3): 280-5#

Kim, Alison M. (2010): Sex bias in trials and treatment must end. In: Nature, Vol. 465, Opinion, p. 688-689.

Kim, Alison M. et al. (2008): Enrolment of women in National Heart, Lung, and Blood Institute-funded cardiovascular randomised controlled trials fails to meet current federal mandates for inclusion. In: Journal of the American College of Cardiology 52(8): 672-3.

Legato, Marianne J. (1998): Women's health: not for women only. In: International Journal of Fertility and Women's Medicine, 43(2): 65-72.

Legato, Marianne J. (Eds.) (2004): Principles of Gender-specific Medicine, Volume 1 and Volume 2, Elsevier Academic Press. San Diego.

Lehmkuhl E et al. (2012): Gender-specific predictors of early mortality after coronary artery bypass graft surgery. In: Clinical Research Cardiology, 101(9): 745-51.

Ludwig et al. (2015): A Successful Strategy to Integrate Sex and Gender Medicine into a Newly Developed Medical Curriculum. In: Journal of Women's Health, Vol. 24, No. 12.

Martin, Richard M. et al. (1998): Age and sex distribution of suspected adverse drug reactions to newly marketed drugs in general practice in England: analysis of 48 cohort studies. In: British Journal of Clinical Pharmacology, 46 (5), 505-11

Oertelt-Prigione, Sabine et al. (2012): Cardiovascular risk factor distribution and subjective risk estimation in urban women – the BEFRI Study: a randomised cross-sectional study. In: BMC Medicine (Open Access), 13:52, DOI 10.1186/s12916-015-0304-9

Regitz, Zagrosek, Vera (2012): Sex and gender differences in health. Science & Society Series on Sex and Science. In: EMBO reports. Vol.13, No. 7.

Regitz-Zagrosek Vera; Seeland, Ute (2012): Sex and gender differences in clinical medicine. Handbook Experimental Pharmacology 214, 3-22.

Stramba-Badiale, Marco et al. (2006). Cardiovascular diseases in women: a statement from the policy conference of the European Society of Cardiology. In: European Heart Journal 27, 944-1005, ESC report.

Zopf, Yurdagül et al. (2008): Women encounter ADRs more often than do men. In: European Journal of Clinical Pharmacology, 64 (10): 999-1004.

Zugck C et al. (2012): Implementation of pharmacotherapy guidelines in heart failure: experience from the German Competence Network Heart Failure. In: Clinical Research Cardiology, 101(4): 263-72.

http://gender.charite.de/en/research/, status 12th January 2016

http://gender.charite.de/en/institute/history/), status 12th January 2016

http://gender.charite.de/en/institute/team/, status 12th January 2016

http://gender.charite.de/forschung/publikationen/, status 12th January 2016

http://www.eugenmed.eu/, status 14th January 2016

http://genderedinnovations.stanford.edu/, status 16th January 2016

http://genderedinnovations.stanford.edu/case-studies/osteoporosis.html

http://www.dgesgm.de/, status 16th January 2016

http://www.isogem.com/, status 16th January 2016

The European Bioinformatics Institute (EMBL-EBI)

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1 Case abstract

This case is about the economic impact of the activities of the European Bioinformatics Institute (EMBL-EBI) in managing and providing open access to life-science data for the scientific research community. The EBI was established in 1992 and collates, curates and distributes life science data free of charge to researchers from its base in Hinxton, UK. EMBL-EBI also conducts basic research, as well as providing training and pre-competitive collaboration for public and private researchers. The online presence of EMBL-EBI was reviewed as well as all publicly available information. Of particular interest is a recent study of the economic impact of EMBL-EBI services. This study uses a variety of techniques to estimate the value and impact of EMBL-EBI services in monetary terms. The findings of this study are used as a proxy for the economic benefits of RRI activities on the Open Access dimension.

Table 43 Case study 20: Case details

RRI dimension	RRI X	Citizen Participation □	Science Literacy □	Gender equality □
	Open Access X	R&I governance □	Ethics □	Other □
R&T field	Molecular biology			
Country	European organisation. EMBL is based in Heidelberg, Hamburg, Grenoble, Monterotondo and Hinxton (EBI).			

1 Introduction

The case is based on the activities of the European Bioinformatics Institute (EMBL-EBI, henceforth EBI)[117], which is part of the European Molecular Biology Laboratory (EMBL)[118].

[117] http://www.ebi.ac.uk/

[118] http://www.embl.org/

EMBL is organised under the auspices of the European Molecular Biology Conference (EMBC)[119].

Founded in 1969, EMBC is an inter-governmental organisation comprising 27 Member States including most of the European Union and some of the neighbouring countries. The EMBC provides, through its General Programme, a framework for European co-operation in the field of molecular biology and closely related research areas. Molecular biology, as the fundamental basis of all life sciences, significantly impacts our daily lives.

The General Programme focuses primarily on the provision of training, teaching and research scholarships and on the establishment of programmes for courses, workshops and study meetings. Financial contributions from each Member State carry the General Programme. A subset of the EMBC countries funds the activities of EMBL.

EMBL is one of the world's leading research institutions, and Europe's flagship laboratory for the life sciences. The cornerstones of EMBL's mission are to: perform basic research in molecular biology; train scientists, students and visitors at all levels; offer vital services to scientists in the member states; develop new instruments and methods; and actively engage in technology transfer.[120]

The EBI was established in 1992 and is one of the five operative locations of the EMBL. Its core activity is to gather, curate and maintain a library of data resulting from life-science experiments, covering the full spectrum of molecular biology, which is supplied without financial cost to researchers (Beagrie and Houghton 2016, p.7).

At the European Bioinformatics Institute (EMBL-EBI), we help scientists realise the potential of 'big data' in biology, helping them exploit complex information to make discoveries that benefit mankind. We manage the world's public biological data and make it freely available to the scientific community via a range of services and tools, perform basic research and provide professional training in bioinformatics.[121]

The EBI Mission statement includes five core elements:

- To provide freely available data and bioinformatics services to all facets of the scientific community
- To contribute to the advancement of biology through basic investigator-driven research
- To provide advanced bioinformatics training to scientists at all levels
- To help disseminate cutting-edge technologies to industry

[119] http://embc.embo.org/

[120] http://www.embl.de/aboutus/general_information/)

[121] http://www.ebi.ac.uk/about

- To support, as an ELIXIR node, the coordination of biological data provision throughout Europe.[122]

The interest of this case study is primarily in the first element of the EBI Mission. The EBI is one of the most important providers of Open Data to the global life science.

We maintain the world's most comprehensive range of freely available and up-to-date molecular databases. Developed in collaboration with our colleagues worldwide, our databases and tools span the full range of molecular biology, from nucleotide sequences to full systems. Our services let scientists share data, perform complex queries and analyse the results in different ways. Users can work locally by downloading our data and software, or use our web services to access our resources programmatically. Our website serves millions of researchers, who are wet-lab and computational biologists in industry and academia working in all areas of the life sciences, from clinical biology to agri-food research.[123]

The core EBI databases are produced in collaboration with major life science organisations including the National Centre for Biotechnology Information (U.S.), the National Institute of Genetics (Japan), the Swiss Institute of Bioinformatics and the Welcome Trust Sanger Institute (UK) (Beagrie and Houghton 2016, p.7). The 'strategically most important databases are accompanied by comprehensive tools and training' (Beagrie and Houghton 2016, p.7), ensuring the value of the available Open Data by making it useable and exploitable by researchers and industry.

The EMBL-EBI case is relevant for RRI as it involves a demonstration of the open access dimension of RRI. A number of potential indicators of RRI could be applied to the depositing and accessing of datasets curated by EBI. EMBL-EBI has its own evaluation programme that could provide additional user perception and user information. The economic benefits accruing to both the research and innovation communities from Open Data have been the subject of a specific analysis that constitutes the major focus of this case study.

2 Methodology and data

The methodology for this case study is based on desk research. One data source was online documentation and publications hosted at the websites of EMBL and EMBL-EBI. A second source was the EBI Annual Scientific Report series of which the most recent edition relates to 2014. A third source was the consultant report produced by Charles Beagrie Ltd entitled 'The Value and

[122] http://www.ebi.ac.uk/about

[123] http://www.ebi.ac.uk/about

Impact of the European Bioinformatics Institute' in January 2016 (Beagrie and Houghton 2016). A fourth source was a case study of EMBL-EBI compiled as part of the EvaRIO project.[124]

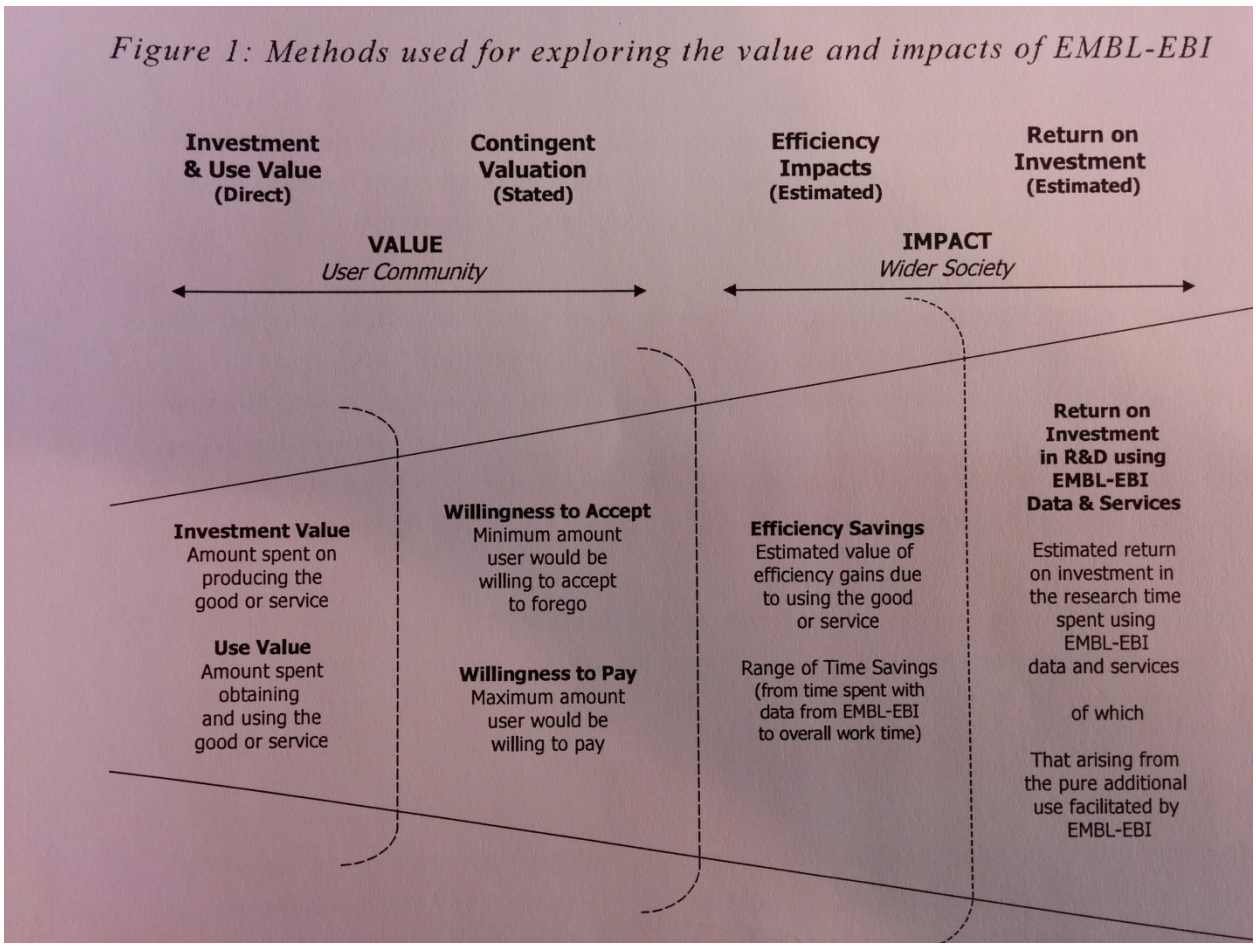
Measurement of RRI activity for openness can only be done at the input level, such as the number of open datasets made available, data requests, the amount of data downloaded, or the amount of time spent connected to the data platform. Data can also be easily obtained to show the number of unique IP addresses visiting EBI and the geographic location of users.

Data on the provision and access to data at EMBL-EBI has the advantage of being traceable over a relatively long time-series, although adjustments and improvements to the quality of data collected will have occurred during this period.

In terms of assessing the economic benefits of Open Data, a quite comprehensive study has been conducted utilizing a multi-method approach to capturing the 'economic value and impact of EMBL-EBI data and services' (Beagrie and Houghton 2016, p.11). It is not immediately clear to what extent methods for capturing the economic value of open data services can be used as a proxy for economic benefit as it is understood in the framework of MoRRI. There are likely to be some convergences and some inconsistencies between these approaches. In the EMBL-EBI study economic value refers largely to the value of the data services to the user community. Economic impact refers largely to the impact on the wider society (Beagrie and Houghton). In MoRRI terms, economic value may thus be thought of as directly capturing RRI inputs, whilst economic value refers to estimates of RRI outputs-outcomes-benefits. Overall, multiple quantitative and qualitative methods are used and explained in the valuation of EBI data services, which are summarised in Figure 1 below.

[124] http://evario.u-strasbg.fr/

Figure 7 Case study 20: Assessing the economic value and impact of EBI



Source: Beagrie and Houghton 2016, p.16.

In terms of indicator methodology and data, there are several measures of the user population and of data requests and access that can be considered potential indicators for the open access/open data dimension of RRI. Data sources that may be suitable for the development of input indicators of open data/open access are described in Section 3 of this case study.

With regard to indicators of RRI impacts and benefits for open data, the problems of time lag and attribution remain methodologically significant. Nevertheless, the estimations of the economic value summarised in Section 4 indicate the potential for outcome indicators of the open data/open access dimension of RRI. There is already increasing attention being paid to methodological and technical approaches to matching the use of open data to scientific

outputs[125] and to the downstream use of these outputs[126]. The potential for a range of valid outcome indicators of RRI on the open data dimension thus seems to be on the rise.

Data collection requires mainly quantitative capture of web-based information. There are technical challenges, but at least in the case on input indicators these seem relatively straightforward. In addition to such quantitative metrics, the potential of user-surveys to track evolution in access to, and use of, open data is apparent from the EMBL-EBI case. EBI conducts an annual user survey, which has the potential to also contribute to RRI indicator development, not least in the identification of critical factors that may require a monitoring framework.

3 Input level: RRI activity

The RRI related activities address open data access and use.

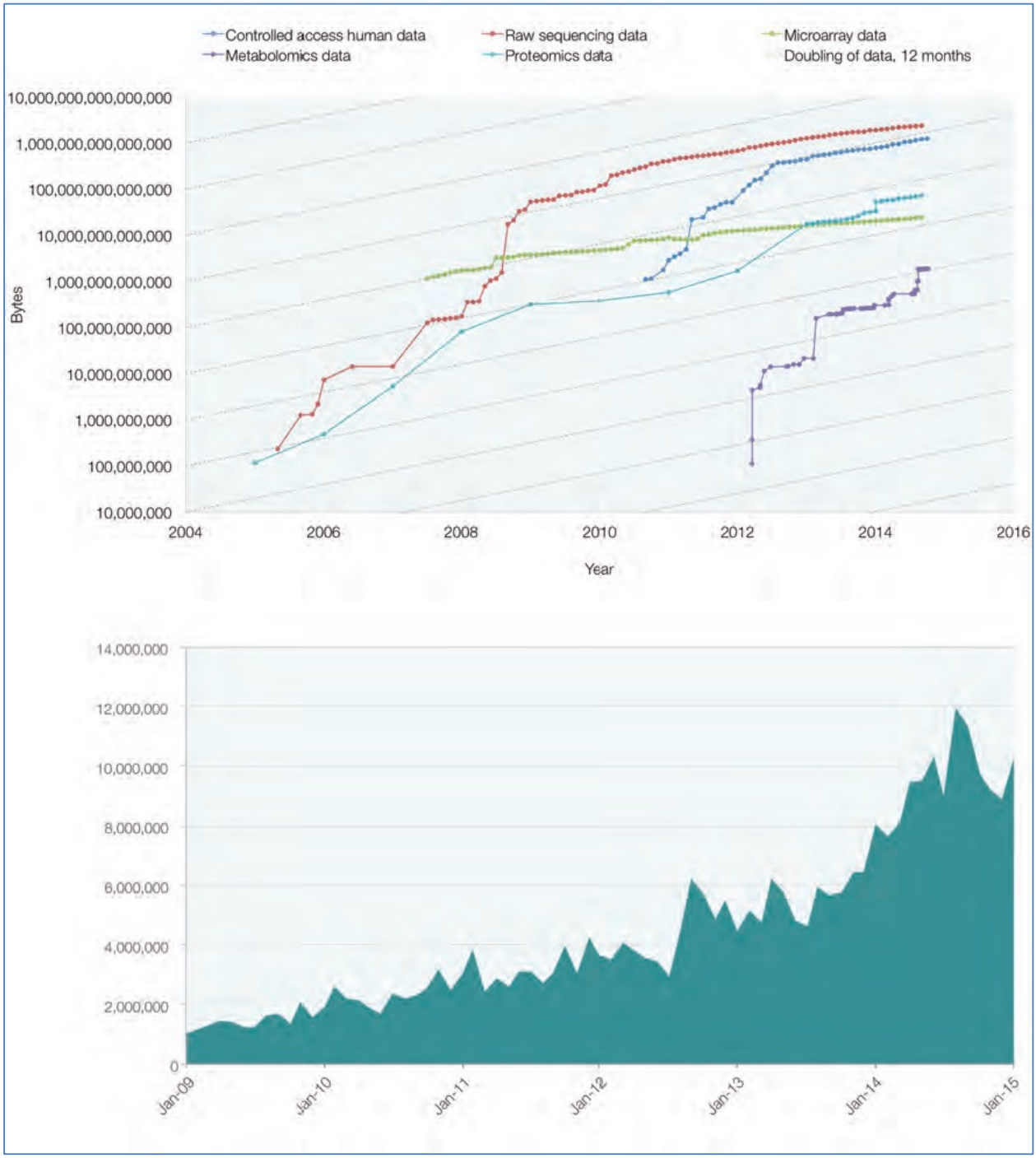
The data basis includes potential input indicators such as the aggregation of open data/datasets and potential output indicators such as the number of data requests or the number of data users. Process indicators such as training or documentation on using open data and the open data platform also appear potentially possible.

The most simple and direct indicators of open data access and use are data requests and volume of data available in the EBI repository. As Figure 2 shows, the volume of data in the repository (upper image) and the number of data requests (lower image) are on a consistent upward trajectory.

[125] https://www.jisc.ac.uk/rd/projects/research-data-metrics-for-usage

[126] http://www.projectcounter.org/

Figure 8 Case study 20: Growth of data platforms (upper) and data requests per day (lower)



Source: EMBL-EBI 2015, p.46.

In terms of the user population, data requests from around 11 million unique hosts were received in 2014 (EMBL-EBI 2015, p.46). An estimated 513 accesses/downloads per unique host were logged for this 12 month period – or around 5.5 billion data requests (Beagrie and Houghton 2016, p.20). However, it is not straightforward to calculate the exact user population. This due in part to the 'dynamic nature of IP addresses, the number of devices used by

individual users, and the multiple locations they use to access the internet' (Beagrie and Houghton 2016. p.19). These data are also complicated by whether the access includes using one or multiple of the EMBL-EBI data platforms. Combining the log data with data from the EMBL-EBI user survey, an estimate of around 88 million access and use events was calculated on the basis of an estimated user population of 198,000 (Beagrie and Houghton 2016, p.21). The EMBL-EBI User Survey recorded a figure of 547 accesses/downloads per user for the year (Beagrie and Houghton 2016. p.21-2). Triangulating these different numbers, Beagrie and Houghton estimated that, on average, each of the 198,000 users make use of EBi services 445 times per year.

These data provide potential for the development of input indicators of open data.

Additional possibilities could be developed with a better understanding of the role EMBL-EBI open data plays in the total work programme of individual researchers, research groups, RPOs, projects or programmes. Delineating how many hours per week, out of a total working week, were spent using open data platforms or downloaded data could be the basis of a metric for indicator development. Survey or logbook methods would be needed to develop such a metric.

Another potential source of metrics could be data related to the use of explanation and commentary regarding datasets/platforms and/or the availability and take-up of specialised training in how to use the facilities. In the EMBL-EBI case training is an extensive activity, including for PhDs, researchers, staff and industry. Online training in 2014 was reported to have almost 6,000 registered users, double that in 2013 (EMBL-EBI 2015, p.40). Training has grown in line with the expanding demand for EMBL-EBI data and services, 'from a handful of workshops in 2007 to a full programme with face-to-face courses reaching more than 7000 people at 200 sites globally and an online resource reaching 100,000 professionals in 2013 (EvaRIO 2013). Data sources suitable for creating metrics may potentially also be combined with user survey outcomes to design innovative indicators.

Datasets incorporated into the platforms could also potentially be monitored in terms of the project, institution, country or region that produced these data. Clearly, there would be technical issues regarding the provenance of datasets that were collected by international teams or consortia, but a protocol for attribution could nonetheless be designed.

In terms of the level at which the RRI activity can be monitored through data collections the online environment provides potentially different levels of aggregation that could be captured. These include organisation/institution and country levels. Monitoring at these levels could be broadly focused on either contribution to open data resources or on use of open data resources.

4 Output and outcome level: impact and benefits

In terms of the impact and benefits of the open data RRI activity, interpreting economic outcomes or benefits will depend importantly on how the beneficiaries of the activity are

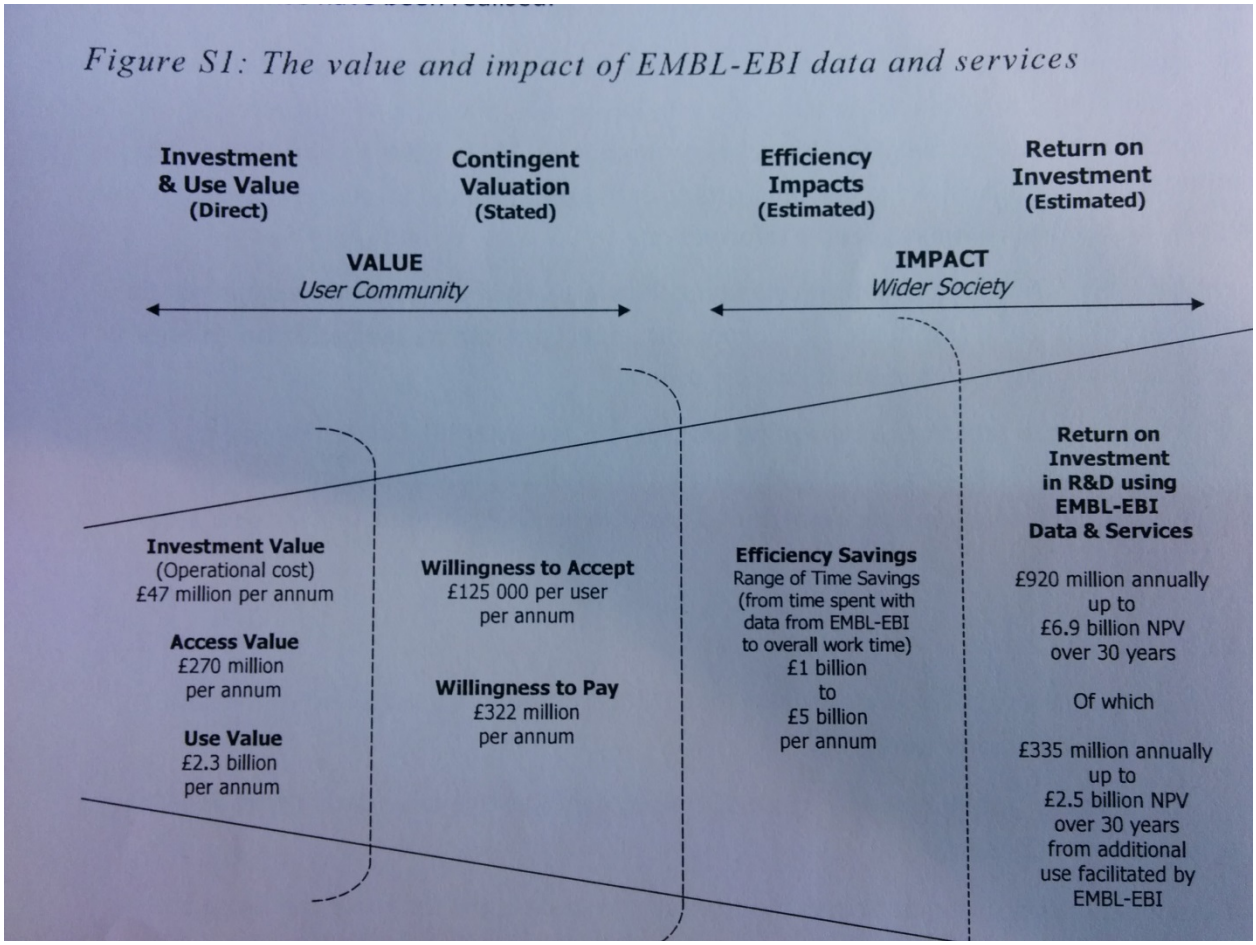
defined. The consultant report on the value and impact of the EBI divides beneficiaries into two broad classes: the 'user community' and 'wider society' (Beagrie and Houghton 2016).

Economic benefits accruing to these two classes are then calculated using a range of different methodologies in this consultant report. These include:

- Investment and use value - referring to users attribution of how much the good or service is worth to them
- Contingent valuation – referring to giving monetary values to non-market goods and services based on user preferences
- Efficiency impacts – referring to the costs and time-loss saved by users from not having to created or collect the data resource themselves
- Return on investment – referring to the benefits (modified Solow-Swan model) accruing from the use of the open data and associated services (Beagrie and Houghton 2016, p.14-17).

These methods are applied to different dimensions of the assessment of the value of the EMBL-EBI data and services. The data basis of these calculations combines user surveys, research infrastructure metrics and interviews designed to appreciate 'pathways to impact' (Beagrie and Houghton 2016, pp.12-14). The results are summarised in Figure 3.

Figure 9 Case study 20: Assessment of the economic value and impact of EBI



The results of the assessment assign highly significant economic value accruing to the research user community from access and use of EMBL-EBI data services. The downstream impact on the wider community is also highly significant, including the additional return on investment in R&D that can be attributed to EBI.

The EvaRIO case study includes two assessments of the direct effects of using EMBL-EBI data and services, with one large firm and one SME. The large firm reported benefits including:

- 15-20 patent applications in 5 years that could not have been submitted without data provided by EBI;
- 20 million Euros (minimum expenses) of activities dependent on EMBL-EBI services in 2013;
- An estimated 150 million euros economic benefit since entering the EMBL-EBI Industry programme;
- One co-funded PhD and two publications (EvaRIO 2013, pp.4-5).

The SME reported benefits including:

- 350,000-500,000 euros in activities dependent on EMBL-EBI services in first half 2012;
- One third of data used in drug design to commercial client obtained from EBI;

- One patent and two publications from EMBL-EBI data (EvaRIO 2013, p.5).

The economic benefits accruing to individual firms do not lend themselves easily to monitoring metrics. Nevertheless, standard indicators of publications and patents that are based entirely or in part may be useful proxies for such impact, as there seems to be connections between economic returns and such outputs in the cases observed.

The numbers of EMBL-EBI co-publications with multiple affiliations of authors has grown steadily over the period 1996-2012 (EvaRIO 2013, p.20) as has the proportion of co-authored papers with multiple affiliations as a percentage of total EBI publications. The geographic distribution of co-publication activity is global, while co-publication with industry has doubled between 2004 and 2012 (EvaRIO 2013, p 22, 24.). The potential for metrics based on the distribution of open data based publications appears relatively straightforward and could potentially be developed into an output/outcome indicator.

Some attention would need to be paid to the way of interpreting and metricizing those activities that directly use EMBL-EBI resources and those activities that are part of collaborating with EMBL-EBI. Both involve open data access and use, but the extent to which those activities are directly or 'privately' beneficial in economic terms may vary.

In terms of the level at which the RRI activity can be monitored through data collections, the estimation of economic impacts of open data repositories such as EBI can be approached at the user/firm level, whilst such benefits can also be attributed to regional/national levels to some degree.

5 Discussion

It would likely be premature to try to associate specific economic benefits too directly as resulting from the outcomes of open data use. At this descriptive level, the multiple data sources and methods applied suggest that metrics that can underpin input-output indicators for the Open Data dimension of RRI. An analytical approach would next need to be taken to assess whether there are options for designing indicators with the degree of coverage that could be useful for a monitoring task. It seems clear that input-output metrics of Open Data initiatives can be constructed in terms of volumes of data, data usage and user communities. Intuitively such metrics would centre on the log data, user surveys, etc. from particular repositories. While a quite detailed picture could be drawn of these open data activities and their value to clients, the question of national or other bases of comparison for a monitoring framework seems somewhat problematic, with the possible exception of the provenance of datasets and instructions for use that are included into the platform.

In terms of metrics that can quantify, in monetary values, the economic impacts or benefits of open data, the case study includes a range of methods. The collection of user survey data seems critical in this regard, as assessing the cost to users, or willingness to pay of individual

firms or other entities, will be linked to their specific R&D and/or product-market strategy and will therefore be contingent on this strategy and management approach.

Analysing the proportion of open data used in conjunction with proprietary data appears to be one potentially useful metric for assessing the contribution to open data to firm revenue or turnover. If one quarter of the data used to develop a product or drug design that is licenced for example, then a proxy measure of economic outcome could be one quarter of the turnover associated with this product or drug design.

6 References

Beagrie, Neil and John Houghton (2016): The Value and Impact of the European Bioinformatics Institute, Full Report, January, Charles Beagrie Ltd., accessed 15/02/2016: http://www.beagrie.com/static/resource/EBI-impact-report.pdf

EMBL website: http://www.embl.org/

EMBL programme 2012-2016: https://www.embl.de/aboutus/communication_outreach/publications/downloads/programme12-16.pdf

EMBL-EBI website: http://www.ebi.ac.uk/

EMBL-EBI Annual Scientific Report, various years

EvaRIO (2013) EvaRIO Case Study: WMBL-EBI, December, accessed 15/02/2016: http://evario.u-strasbg.fr/uploads/autres-docs-BETA/EvaRIO_CAse_Study_EMBL-EBI.pdf

Promoting Citizen Science at the ETH Zurich

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1 Abstract

ETH Zurich (ETH), established in 1855 and one of the leading HEIs in the world for technology and natural sciences, has been sensitive to the dimensions of RRI, even though the term RRI itself was not explicitly used in any documents. ETH applies the principles of gender equality, sustainability and ethics, while maintaining an open information policy early on. It has recently adopted a citizen science policy triggered by a workshop organised by the Institute of Molecular Systems Biology (IMSB), Department of Biology, in November 2015, which instigated an ambitious CS project, including the adoption of voluntary standards for Citizen Science but most importantly paving the way for the creation of a competence centre together with the neighbouring University of Zurich. Together, the two organisations have over 40.000 students and this is a community sufficiently large to test new ideas and share experiences.

The CS competence centre is an innovative idea, since in general until now the international experience is that citizen science projects are usually either funded by external sources (explicitly requiring research organisations to involve citizens for educational purposes) or are simply adopting the methodology of research teams that find it appropriate for their goals (implicit/occasional use of CS).The competence centre is not yet operational, but funds have been earmarked and the key ideas are coordination activities and suggestions for new ideas and policies regarding citizen science, project funding and operating an Open Lab, which will involve citizens. Areas expected to be involved include physics astronomy and star observation, health and transport.

Table 44 Case study 21: Case details

RRI dimension	RRI □	Citizen Participation x	Science Literacy □	Gender equality x
	Open Access x	R&I governance □	Ethics x	Other □
R&T field	Academic research, HEI			
Country	Switzerland			

2 Introduction

ETH Zurich (ETH), established in 1855 is one of the leading HEIs in the world for technology and natural sciences, ranking 20th in the Academic Ranking of World Universities[127]. It is a large university, which enrols 18,500 students from over 110 countries, including 4,000 doctoral students.

ETH has been sensitive to the dimensions of RRI, even though the term RRI itself was not explicitly used in any documents. Alongside the general principles of knowledge and practical skills, the mission statement of ETH addresses the understanding of ethical and cultural values so that "upon completing their studies, they [its students] will be not only highly qualified professional people but also responsible members of society"[128]. In compliance with the Personnel Ordinance of the Federal Institutes of Technology, ETH applies the principles of gender equality and maintains an open information policy[129].

ETH pioneers new concepts and in this spirit, the notion of citizen science has attracted the attention of several departments and the administration at the same time. After a period of investigation and gathering knowledge from global sources, the administration has decided to join forces with the University of Zurich and promote a concept where the universities would play a central role not only in terms of research responsibility but also of governance and funding of citizen science projects. Funding has been ensured and the implementation of the new approach is in progress.

3 Methodology and data

The case study is based on internet research, employing documents listed in the references and an extensive interview with the Vice Rector, Prof. Günther.

The target of this case study was to identify original policy ideas for the promotion of citizen science. Input in that sense has been the pre-history and the building blocks for the adoption of a systematic citizen science programme, which is quite innovative.

[127] http://www.shanghairanking.com/World-University-Rankings-2015/Switzerland.html

[128] https://www.ethz.ch/en/the-eth-zurich/portrait/self-image-and-values/mission-statement.html

[129] http://www.equal.ethz.ch/about/legal_aspects/index_EN

4 Input level: RRI activity

The explicit involvement of ETH with **citizen science** started with an international conference organised in Zurich in 2015 with world-class international speakers. The joint benefit of improving science itself and educating society came out very clearly in this conference. It included both, the benefit for research and the educational aspect for the general public. The benefits of involving citizens in scientific research were stressed, supporting the view that CS can lead to very high-quality research and not to lower quality results, as was sometimes argued. The learning dimension was not neglected; it seems more relevant for Europe than elsewhere, because countries wish to keep their leadership in education.

A workshop was then organised by the Institute of Molecular Systems Biology (IMSB), Department of Biology in November 2015 where two research papers were analysed, namely *Citizen Science: New ways for research policy advice paper*[130] and *Standards for citizen science: Principles and guidelines for citizen science projects at universities and other research institutions*[131]. The IMSB was founded in 2005 for the study of Systems Biology. It employs nine people as professional staff (principal investigators) and four people at support staff level. Citizen science is also included in the academic curriculum of the IMSB through the course Science and Society and Research Ethics[132], taught in the spring semester. The course is based on academic literature on the roles and responsibilities of the modern scientist and the social and ethical aspects of scientific research.

The results of the workshop triggered the CS policy approach of ETH, as described below.

The CS project, however, is not independent of the overall sensitivity of ETH in RRI. The university has been a pioneer and is by now an established player in various dimensions of RRI, having explicit policies in the following areas:

- **Gender equality** is a topic of particular interest for ETH since 1991, when the point of contact for women was created. The point of contact evolved into the Office of Equal Opportunities for Women and Men in 1993 and has been offering its services under the name of Equal! since 2008[133]. ETH has established a gender strategy, which encourages

[130] http://www.imsb.ethz.ch/content/dam/ethz/special-interest/biol/imsb/imsb-dam/events/citizenscience_data/additional_content/citizen_science_policy_advice_paper.pdf

[131] http://www.imsb.ethz.ch/content/dam/ethz/special-interest/biol/imsb/imsb-dam/events/citizenscience_data/additional_content/standards_for_citizen_science.pdf

[132] http://www.vvz.ethz.ch/lerneinheitPre.do?semkez=2015S&lerneinheitId=97710&lang=en

[133] http://www.equal.ethz.ch/about/history/index_EN

participation of women in all fields of research and across all academic levels, recognising them as a source of research innovation at an international level[134]. In 2010, ETH published its first Gender Monitoring Report, which provided information on gender equality for students, research staff and professors at ETH, distinguished by degree and by department. The report also provided gender equality statistics on its grants programme[135]. The 2011/2012 Report was enhanced with gender statistics on new professor appointments at the assistant, full and associate professorship levels, as well as on gender statistics for technical and administrative leadership positions[136]. The 2012/2013 Report was enhanced with information on discrimination issues at work, as identified by two additional surveys[137]. The 2013/2014 Report provided comparative gender statistics of ETH with other university members of the International Alliance of Research Universities (IARU)[138]. The 2014/2015 Report was enhanced with gender information about assistant professors[139].

In spring 2014, the Board of Directors of ETH decided for the drafting of a Gender Action Plan (GAP) in four distinct areas: careers and career development in the academic area, integration of gender-specific aspects in research and teaching, facilitation of work/life balance, and prevention and combat of sexual harassment and discrimination. The plan aims to increase women participation at all academic career levels[140]. In the summer of 2014, all 16 departments of ETH Zurich submitted either a report or a relatively detailed strategy on the implementation of GAP[141]. At the professor level, additional professorships for excellent female scientists are offered; in the period 2013-2016 it is recommended that on average two additional professorships per year

134 http://www.equal.ethz.ch/gender_strategie/index_EN

135 http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2009/index_EN

136 http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2011/index_EN

137 http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2012/index_EN

138 http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2013/index_EN

139 http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2014/index_EN

140 http://www.equal.ethz.ch/gender_strategie/gender_action_plan/index_EN

141 http://www.equal.ethz.ch/gender_strategie/gender_action_plan/umsetzung/index_EN

for women should be created by direct appointment procedure[142]. ETH welcomed three visiting professorships on Gender, Science & Technology in 2011, 2012 and 2014[143].

- In the area of **sustainability**, ETH established a hub, ETH Sustainability, in 2008 for the assurance of the development of sustainability activities at ETH and their promotion both within and outside the university. ETH sustainability reports directly to the President of ETH and is led by a steering committee composed of eight ETH professors including the chairperson[144].

  Sustainability activities in the period 2009-2011 included[145]:

  - The establishment of a Summer School in Ethiopia in 2010 with the participation of 18 ETH students and 36 students of the Ethiopian Institute of Architecture, Building, Construction and City Development for collaboration in architectural projects;
  - The establishment of a second Summer School with the participation of 30 students from 18 countries and 18 different disciplines for the implementation of sustainability projects. In total 12 students participated from ETH, 6 students from the ETH partner universities of Yale, MIT, National University of Singapore and the Australian National University and 12 students from other leading universities worldwide;
  - The establishment of a seed sustainability platform in 2010, which promoted collaboration between academia and the industry. In total, about 22 projects were handled by the platform, with the participation of 4 students from ETH and 1 student from University of Zurich;
  - The coordination of sustainability activities in international alliances and networks (Alliance for Global Sustainability, ISCN/Gulf Network, IARY/IDEA League Network);
  - The initiation of dialogue on sustainability issues through the setting up of TV broadcasts on climate and energy, the establishment of a climate blog in 2009 and the launch of climate campaigns. In total, 2,000 guests participated in the live TV broadcasts on climate and energy. About 20 ETH professors contributed to the

142 http://www.equal.ethz.ch/gender_science_technology/gastprofessur/index_EN

143 http://www.equal.ethz.ch/gender_science_technology/index_EN

144 https://www.ethz.ch/en/the-eth-zurich/sustainability/eth-sustainability.html

145 ETH Sustaunability Rueckblick 2009-2011

climate blog, more than 20 prominent guests from the economic and political sector, as well as ETH students. More than 230 questions were answered and more than 4,300 comments were registered in the areas of climate research, environmental change, energy and mobility, housing and urban development, and nutrition and agriculture in the north and in the south. The blog accommodated about 5,000 visitors per week and about 2-3 new questions each week were raised;

- The establishment of the project ecoworks, in cooperation with the department Safety Health Environment SGU and the Science City project for the enhancement of collaboration between students and employees in the area of CO2 emissions reduction. In the context of this initiative, two workshops took place in 2008 and 2010, in which 158 people participated and presented 29 project ideas and one film. Out of these project ideas, 8 projects were implemented (5 from 2008 and 3 from 2010).

- ETH also prioritises an **open dialogue** with general public through public guided tours, exhibitions[146] and the Science City project. The latter is a science programme designed for everyone free of charge, with the objective of enhancing collaboration in important sustainability issues.

- In the area of **open access**, ETH adopted an open access policy in 2008, encouraging its staff/students to publish their academic work freely on the institutional repository ETH E-Collection[147], provided there are no legal restrictions. ETH E-Collection provides access to over 27,000 individual documents published by authors from ETH[148].

- In the area of **governance/ethics**, the executive board of ETH approved the *Guidelines for Research Integrity and Good Scientific Practice at ETH Zurich*[149], which were enforced in 2008.

  In addition, an ethics commission was established in 2014 for the safeguard of research ethics at ETH. The scope of the ethics commission covers all kinds of research (clinical,

[146] https://www.ethz.ch/en/industry-and-society/dialogue-with-the-general-public.html

[147] http://e-collection.library.ethz.ch/index.php?&lang=en

[148] http://e-collection.library.ethz.ch/about.php?subnav=about_1

[149] https://rechtssammlung.sp.ethz.ch/default.aspx

non-clinical) involving human subjects. The Cantonal Ethics Committee (CEC) must evaluate all studies that fall within the scope of the ethics commission[150].

A trusted intermediary is available to offer researchers at ETH Zurich advice, support and mediation with respect to research integrity and good scientific practice[151].

5 Output and outcome level: impact and benefits

The citizen science workshop held at the IMSB triggered a discussion that attracted the interest of the board of ETH and led to the adoption of a new approach towards CS. The following two outputs were achieved:

- the discussion of CS Standards,
- paving the way for the creation of a competence centre.

5.1 Adoption of standards or not

A paper with *Standards for Citizen Science* was presented and discussed in detail in the workshop. It included principles and guidelines for CS projects at universities and other research institutions. The principles suggested included:

1. Excellence all the way: Citizen science projects must adhere to general international standards of science.

2. Participation all the way: Citizen science projects should aim to develop an active and productive participation of citizens' scientists in all the different phases of the research project.

3. Clear motivation: The goal of a citizen science project must be clearly and realistically stated.

4. Openness and diversity: Citizen science projects should be open to anyone.

5. Transparency: Citizen science projects must operate in a fully transparent way.

6. Maintaining public and personal interest: Research institutions should ensure that public investments into citizen science are spent effectively and efficiently and empower citizens and institutions to explore new ways for science.

[150] https://www.ethz.ch/services/de/organisation/gremien-gruppen-kommissionen/ethikkommission.html

[151] https://www.ethz.ch/en/research/ethics-and-animal-welfare.html

7. Sustainability: Research institutions and their researchers should provide access for citizens to their research projects, including to e-infrastructures. The research institutions and researchers should ensure the continuity in project support and the dissemination of knowledge and support participants who want to continue and develop their knowledge. The development and maintenance of the community of citizen scientists should have high priority.

8. Education and training: Citizen science projects shall contribute to education and training of scholars and citizens alike.

Guidelines were taken from state-of-the-art papers and referred to recruitment and training of citizen scientists, governance, quality control, ethical oversight, sustainability, intellectual property rights and acknowledgement, costs, health, safety, security and environment. Furthermore, it was suggested that the research institutions and their researchers must provide mechanisms to implement these standards safeguarding a low administrative burden. The relevant stakeholder organisations regularly assess the relevance and applicability of these standards and, whenever appropriate, propose and decide upon needed amendments.

The discussion led to the conclusion that CS differs considerably between disciplines, hence adopting standards might be counterproductive and the decision was to adopt a policy advice paper rather than strict standards. A draft paper with suggestions and recommendations is being produced and is expected to be finalised and adopted in April 2016. In a pragmatic way the paper addresses recruitment, participation, organisation, rewards and incentives. It addresses explicitly, through ideas and examples, the communities involved in CS, namely research institutions, governments and funding organisations[152].

5.2 Institutional initiatives: An in-house competence centre

The direct output of the initial thinking was the idea to create a competence centre for citizen science in Zurich, as a joint project. The discussions and workshops have led to the proposal to link with the University of Zurich and establish a joint competence centre on citizen science, which would allow the two HEIs to experiment with ideas and a governance scheme. Together the two organisations have over 40,000 students and this is a community sufficiently large to test new ideas and share experiences.

The CS competence centre is an innovative idea, since in general until now the international experience is that citizen science projects are usually either funded by external sources (explicitly requiring research organisations to involve citizens for educational purposes) or are simply adopting the methodology of research teams that find it appropriate for their goals

[152] http://www.imsb.ethz.ch/news-and-events/events/citizenscienceworkshop/presentations.html

(implicit/occasional use of CS). As both HEIs in Zurich are major players in education, they decided to *experiment* explicitly with citizen science and identify ways to best use the untapped potential, which is often considered less acceptable by scientists. The nature of the experimentation is that there are no costs and benefits assessed in advance; it is more the knowledge to be gained from the experiment that counts.

The competence centre is not yet operational but funds have been earmarked and the key ideas are:

- The centre will be able to coordinate activities and propose new ideas and policies regarding citizen science;
- It will dispose of a budget, which will fund projects in citizen science following applications by institutes and research teams of the two universities;
- An Open Lab will be operated, in the context of the centre, which will involve citizens.

The centre will start operating with one manager and the necessary staff to deal with the first proposals. It will tap the expertise of the ETH Internal Research Commission for the skills necessary for a peer review process to select proposals. The competence centre is expected to slowly build up its own competences and be directly linked to the Ethics Department. The centre will be endowed with a budget of 0.5 million Swiss Francs (practically 0.5 million Euros) per year for the first four years, at the end of which the centre will be evaluated. The funds will be used to cover the costs of the centre and to fund the most promising projects. International state-of-the-art science will be the main criterion for project selection.

At an initial overview the projects that have demonstrated interest include the following:

- Physics astronomy and star observation: search and reporting can be made by citizens.
- Health: personalised medicine (possibility to have access to a large population committed to the HEIs, like ETH's alumni network).
- Transport: how students move by bike.

Among the targets of the competence centre will be its role for Open Science, in the sense that it will act as a data warehouse. It has been observed that open science is often not providing full access to the data; however, citizen science connected with open access to the data will lead to more research and publications.

Overall, the main target of the centre is to create experience in a promising area for which there is little management knowledge. It is in line with the ETH philosophy that when a new area is investigated there may be very interesting outcomes but there may be no outcome as well. The driver is that citizen science is neglected and snubbed. The main output will be better

knowledge of this field. Connected to that is the reputation and better visibility of the ETH and the University of Zurich as investigating new avenues.

In the starting period, careful steps are needed to build confidence. This is why at the beginning only public organisations are to be involved. It is better, when trying to promote new ideas, to select less sensitive issues and partners because at the start of each idea any mishappening can bury the idea and its whole effect.

Among the expectations is a better connection of international research (need of traceable smaller communities e.g. ETH with Cambridge) and new ways to treat data (big data algorithms).

More data and the plan of the CC will be available in April.

6 Discussion

The case study is of particular interest for several reasons:

1. ETH Zurich is one of the leading universities globally and adopted principles and policies for several RRI dimensions relatively early, in particular concerning gender issues, open access and sustainability. In 2015, it added the notion of citizen science with preparatory workshops and has then adopted the concept of CS. While all dimensions of RRI are present, the term RRI itself is not used.
2. The process leading to the adoption of an explicit CS policy by the ETH started with the initiative of one institute, an example of a bottom up approach, which was then expanded at the university level.
3. A further important aspect in this process is the decision to join forces with the University of Zurich, which facilitates the creation of a momentum and increases the scope of the project. The idea of local partnerships of networked institutions to promote the concept of RRI may be of interest for further recommendations.
4. Citizen science generates a lot of interest but receives limited funding from outside universities. The ETH initiative to dedicate a multi-annual budget to test the role of a competence centre as an institutionalised policy is particularly interesting and the experiment will lead to important insights into new institutional setups.
5. In this spirit, it is also interesting to note that ETH and the University of Zurich are not interested in quantifying the return of their investment in terms of money but much more in the lessons they will derive for governance, research and educational benefits.

7 References

Academic Ranking of World Universities. Academic Ranking of World Universities 2015. Retrieved from http://www.shanghairanking.com/World-University-Rankings-2015/Switzerland.html

ETH Zurich. (2014, February). Mission statement. Retrieved from https://www.ethz.ch/en/the-eth-zurich/portrait/self-image-and-values/mission-statement.html

ETH Zurich. (2011, October 3). Legal Basis. Retrieved from http://www.equal.ethz.ch/about/legal_aspects/index_EN

ETH Zurich. (2011, October 3). History. Retrieved from http://www.equal.ethz.ch/about/history/index_EN

ETH Zurich. (2014, June 10). Gender Strategy. Retrieved from http://www.equal.ethz.ch/gender_strategie/index_EN

ETH Zurich. (2011, December 6). 2009/10 Gender Monitoring. Retrieved from http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2009/index_EN

ETH Zurich. (2012, November 19). 2011/12 Gender Monitoring. Retrieved from http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2011/index_EN

ETH Zurich. (2013, October 24). 2012/13 Gender-Monitoring. Retrieved from http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2012/index_EN

ETH Zurich. (2014, November 18). 2013/14 Gender-Monitoring. Retrieved from http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2013/index_EN

ETH Zurich. (2016. January 18). 2014/15 Gender Monitoring. Retrieved from http://www.equal.ethz.ch/gender_monitoring/gender_monitoring_2014/index_EN

ETH Zurich. (2014, August 18). Gender Action Plan. Retrieved from http://www.equal.ethz.ch/gender_strategie/gender_action_plan/index_EN

ETH Zurich. (2016, March 15). Realization of the Gender Action Plan. Retrieved from http://www.equal.ethz.ch/gender_strategie/gender_action_plan/umsetzung/index_EN

ETH Zurich. (2014, November 25). Visiting Professorships. Retrieved from http://www.equal.ethz.ch/gender_science_technology/gastprofessur/index_EN

ETH Zurich. (2013, August 8). Gender Science & Technology. Retrieved from http://www.equal.ethz.ch/gender_science_technology/index_EN

ETH Zurich. ETH Sustainability Office. Retrieved from https://www.ethz.ch/en/the-eth-zurich/sustainability/eth-sustainability.html

ETH Zurich, (2011). ETH Sustainability: Rückblick 2009-2011. *ETH Zurich*

ETH Zurich. Industry & society. Dialogue with the general public. Retrieved from https://www.ethz.ch/en/industry-and-society/dialogue-with-the-general-public.html

E-collection ETH Institutional Repository. (2016). Retrieved from http://e-collection.library.ethz.ch/about.php?subnav=about_1

ETH Zurich. Services & Ressourcen. Ethikkommission. Retrieved from https://www.ethz.ch/services/de/organisation/gremien-gruppen-kommissionen/ethikkommission.html

ETH Zurich. Ethics and animal welfare. Retrieved from https://www.ethz.ch/en/research/ethics-and-animal-welfare.html

ETH Zurich. (2016). Citizen Science: New ways for research, Policy Advice Paper. *ETH Zurich.* Retrieved from http://www.imsb.ethz.ch/content/dam/ethz/special-interest/biol/imsb/imsb-dam/events/citizenscience_data/additional_content/citizen_science_policy_advice_paper.pdf

ETH Zurich. (2015). Standards for citizen science, Principles and guidelines for citizens science projects at universities and other research institutions. *ETH Zurich.* Retrieved from http://www.imsb.ethz.ch/content/dam/ethz/special-interest/biol/imsb/imsb-dam/events/citizenscience_data/additional_content/standards_for_citizen_science.pdf

ETH Zurich. Institute of Molecular Systems Biology. (2016, March) Additional Material. Retrieved from http://www.imsb.ethz.ch/news-and-events/events/citizenscienceworkshop/presentations.html

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Annex

Table 45 EU projects screened in the first round

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
01	SET-ROUTES	Pan-European women ambassador programme bringing female role models to schools and universities to stimulate and mobilise girls and young women for studies and careers in SET.	No	It is a networking / ambassador programme that has not the purpose of assessing the wider impact of its activities on R&I. In general, impacts of such programs are hard to assess (e.g. long-term effects on scientific awareness or career paths).	GE
02	SHE FIGURES	Statistics and Indicators on Gender Equality in Science.	No	The project offers data and analysis regarding the number, distribution and situation of women in science and research, but it does not analyse the impact (effects/benefits) of gender in-/equality on R&I per se.	GE
03	WiST	Women in Innovation, Science and Technology working group.	Yes	WiST conducted several in-depth studies working together with industry partners. Thereby, it was a platform to promote gender diversity in science and technology areas within business and industry (and in a later round: HEIs). On the one hand, it analysed the representation of women in different areas of and positions in R&D in business, industry and HEIs. On the other hand, it also analysed certain effects, including	GE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				benefits, of gender diversity in R&D. For example, an analysis was conducted that used econometric modelling to show how research performance is affected by gender diversity in R&D teams.[153]	
04	EPWS	European platform of Women scientists	Possible	The EPWS is a network of networks that tries to bring together and start exchange between different national/international organizations with the purpose of promoting women in science. Currently it works on voluntary basis. Its activities range from the organization of conferences, to statistical analysis of the representation of women in R&D to networking means. It also collects different studies and data regarding women in science. The given empirical evidences and analyses seem to focus on the representation of women and on measures/policies to promote women in science, but a closer look at the individual studies and results might reveal analysis of impacts in different areas.	GE
05	WHIST	Women's careers hitting the	No	WHIST conducted pilot experiments with a participatory approach	GE, PE

[153] Turner, L. (2009): Gender Diversity and Performance. International Journal of Innovation and Sustainable Development Vol. 4, 2/3, 123-134.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		target: gender management in scientific and technological research.		to promote gender diversity in three scientific organizations. These experiments were monitored and evaluated. It was analysed, "how and under what conditions" certain measures to promote women in science can have an impact on gender diversity. Based on the results, WHIST also produced guidelines on gender diversity in science and technology organizations. In WHIST, the impacts of certain gender diversity measures on gender equality were measured. Thus, it might be a case that illustrates the democratic impact of RRI measures (Gender). [154]	
06	TANDEMplusIDEA	Establishment of an international strategic development between leading European technical universities with the aim of increasing the number of	Yes	"The […] objective of the project was to increase the number of female professors by supporting the careers of a number of high potential young female scientists […]" (Technopolis 2012: 18). Besides conceptualization and implementation of a mentoring programme, an evaluation of its impact was conducted. Effects of the program on the participants' career paths and other related	GE

[154] WHIST (2011): Guidelines on Gender Diversity in S&T Organisations. http://www.reteparioppportunita.it/Rete_Pari_Opportunita/UserFiles/whist/whist_gl_def_ok_28112011.pdf; accessed 10 March 2015. Further material: cordis.europa.eu/project/rcn/91101_en.html.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		female professors in natural science and engineering. (Coordination Action)		issues are described. Although such programs tend to have long-term effects, there are first indicators in the projects evaluation. The project also produced a model of good practice. Positive effects on women's careers in science and more gender equality in this area could be seen as in social and democratic terms. Thus, including this project as a case might reveal benefits of RRI in this respect.[155]	
07	SHEMERA	Euro-Mediterranean research cooperation on gender and science: SHE Euro-Mediterranean Research Area.	No	Objective of the project is to collect data and existing statistics on women in science in Mediterranean countries (similar to SHE-FIGURES). Furthermore, it tried to create a network of stakeholders involved in women and science activities and policymaking. The project does not primarily focus on the impact that certain factors have, but is rather descriptive.	GE

[155] TANDEMplusIDEA (2010): Final Report. // Leicht-Scholten, Carmen/ Breuer, Elke/ Tulodetzki, Nathalie/ Wolffram, Andrea (Hrsg.) (2011): Going Diverse: Innovative Answers to Future Challenges. Gender and Diversity Perspectives in Science, Technology and Business. Opladen: Budrich UniPress.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
08	TWIST	Towards Women in Science and Technology.	No	TWIST was a support action that designed and implemented various activities and exhibitions in science centres. Thereby they tried to draw attention to gender stereotypes and challenge them. Thus, interest of girls in science and research should be furthered. The project produced different guidelines for science centres and museums as well as school teachers, conducted gender days (in science centres and museums), an interactive exhibition, and an online test to self-assess gender bias towards science and research. TWIST did not examine or evaluate the impact of their measures on research and innovation or in other areas.	GE
09	GENIS LAB	The Gender in Science and Technology LAB.	No	GENIS LAB is a support action that tries to improve the working conditions and career opportunities of women in science and research by implementing certain organizational tools to raise gender awareness (in six institutions).	GE
10	GENSET	Increasing Capacity for Implementing Gender Action Plans in Science.	Possible	GenSET was a support action that wanted to "raise awareness and build capacities for the incorporation of gender knowledge and gender mainstreaming expertise into science institutions" (Technopolis 2012: 31). Furthermore, it wanted to "propose a new understanding of the impact of the gender dimension on the	GE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				quality of research" (ibid). Although the project produced "large-scale outputs" in terms of involvement of different stakeholders and science institutions, agreement to a memorandum of understanding by many stakeholders, facilitation of dialogue etc. it does not produce evidence on the impact of gender measures on RI. This project might be a starting point for a new case study to assess the effect of the measures taken by different institutions.	
11	PRESCIENT	Privacy and emerging technologies.	No	The project dealt with privacy and ethical issues of emerging technologies. It redefined the concept of privacy and made five case studies on ethical and social aspects of different new technologies (RFID, biometrics, genome sequencing, human enhancement, new surveillance technologies) with regards to privacy. The cases identify and discuss different privacy issues and the legal framework in place to deal with them. The project then developed an assessment method for privacy and ethical issues of emerging technologies. The impact of the project efforts, results or the effects of an implementation of the proposed framework are not monitored or evaluated. And the case studies do not provide empirical evidence for the benefits of RRI considerations into the innovation process.	ET

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
12	EPOCH	Ethics in Public Policy Making: The Case of Human Enhancement.	No	The EPOCH project investigated the role of ethics in the governance of science and technology with a focus on human enhancement. It developed strategic recommendations for dealing with normative issues of technologies and innovation, but no evaluation of its impact has been done. Thus, it is not suitable as case for further examination.	ET
13	ETHICSWEB	Inter-connected European Information and Documentation System for Ethics and Science: European Ethics Documentation Centre.	No	The projects' objective was to build a database that contains information on ethics and science (literature, laws, regulations, projects, events, news, etc.). This should foster information and engagement of the public and initiate public debate. There is no information whether or not this goal could be accomplished or on the positive effects of this project on R&I in general.	ET
14	EURECNET	European Research Ethics Committees Network.	No	EURECNET built the infrastructure for a network of research ethics committees (REC) across Europe. They wanted to promote awareness of the different practices, mutual exchange between these committees, and to collect and evaluate existing training materials for REC members. The project was no research project. There is no evaluation if the training materials provided are used or if they have a positive	ET

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				effect of R&I in practice.	
15	GeneBanC	Genetic bio and databanking: confidentiality and protection of data. Towards a European harmonization and policy.	Yes	GeneBanC was a research project that investigated privacy and confidentiality issues, the existing regulatory framework, ethical and policy issues, and governance aspects regarding biobanks. The project provides descriptions and analysis of biobanks including factors for success and failure, a mapping and comparison of legal frameworks for biobanks, and an analysis of the issue of confidentiality. Furthermore, they analysed the impacts of funding arrangements on ethics and governance. Thus, GeneBanC could be a suitable case study.[156]	ET
16	GEST	Global Ethics in Science and Technology.	Possible	GEST investigated the role of ethics in science and technology policy and policy making in Europe as well as in China and India, which are - besides the USA - the most important partners in S&T for Europe. It wanted to develop policy recommendations as a	ET PE

[156] Dierickx, K.; Borry, P. (Ed.): New Challenges for Biobanks: Ethics, Law and Governance. Antwerp/Oxford/Portland: intersentia.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				collaborative roadmap. In three case studies (food technologies, nanotechnologies, synthetic biology) that are based on desk research, the project wanted to explore how policymaking is determined by societal factors and especially ethical considerations and values and how public participation is institutionalized in different contexts. Furthermore, the discourses on the different technologies in the countries under investigation are analysed and compared. The project did not produce new empirical data and resorts to the analysis of existing research and policy documents. It mainly looks at how ethical considerations and values influence S&T policy making and development, but the analysis of the impact of certain measures to include ethics is marginal. The first overview showed that there is a lot of information on different attempts of participation and the inclusion of ethics in policymaking, but few on the wider benefits of them. However,	

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				further analysis of the output materials might provide insights into benefits especially of participatory measures. [157]	
17	NANOCAP	Nanotechnology Capacity Building NGOs	No	The project researched the environmental, occupational health and safety risks as well as ethical aspects of nanotechnology by facilitating organized discussions between NGOs, trade unions, academic researchers and further stakeholders. The different participant groups should be enabled to formulate an own position on nanotechnology. Besides the position paper of the NGOs and trade unions, project publications mainly deal with describing and assessing different nanotechnologies. The project also developed and published policy recommendation on how to address health, safety and environmental issues of nanotechnology. No systematic evaluation had been conducted on the impact of the measures taken on different areas. The project provides little	ET

[157] Results can be found in an open accessible book: Ladikas, M. Chaturvedi, S. Zhao, Y.; Stemerding, D. (Ed. 2015): Science and Technology Governance and Ethics. A Global Perspective from Europe, India and China. Springer.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				information about the effects including benefits of different ethics-measures and thus is not suitable as case study.	
18	NanoCode	A multi-stakeholder dialogue providing inputs to implement the European Code of Conduct for Nanosciences & Nanotechnologies research.	No	The project aimed at developing a framework that should promote the implementation of the European code of conduct for responsible research and development in the fields of nanoscience and nanotechnologies. Therefore, the code of conduct and other related measures and practice were analysed, a stakeholder consultation conducted, and an assessment tool (CodeMeter) created. The CodeMeter should enable stakeholders to assess their compliance with the code of conduct. Furthermore, a MasterPlan, a concept to support integration via sanctions and incentives, was produced. The effects of the CodeMeter or MasterPlan were not evaluated and measured. Thus, the project does not provide information on the impact of such measures and is not a suitable case.	ET
19	PATS	Privacy Awareness Through Security Branding.	No	The PATS project wanted to raise privacy awareness in different areas, including government agencies and private companies, by developing security brand indicators. At first, they mapped the field of civil security actors in different countries, analysed the privacy awareness of different actors and their symbolic	ET

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				representation of privacy awareness.[158]	
20	NANOPLAT	Nanoplat: Development of a Platform for Deliberative Processes on Nanotechnology in the European Consumer Market.	Yes	NANOPLAT was a support action that evaluated deliberative processes on nanotechnology in Europe and itself developed a platform to facilitate science based and deliberative stakeholder dialogues. Thereby, they not only identified involved organizations, methods, and purposes but also the results of the deliberative processes, which they categorize into direct and tangible or indirect and intangible. From the first review, it is not clear if the project produced empirically grounded assessments of the impact of the different deliberation processes (in all or at least some of the analysed cases). Nonetheless, it seems a suitable project for an in-depth review, because of its focus on the results/outputs/impacts of instruments and approaches towards a better participation of different stakeholders in the field of R&I. [159]	PE

[158] Guagnin, D.; Hempel, L.; Ilten, C.; Kroener, I.; Neyland, D.; Postigo, H. (2012): Managing Privacy through Accountability. Palgrave-Macmillan. // www.pats-project.eu; accessed 10 March 2015.

[159] Strandbakken, P.; Scholl, G.; Stø, E. (2012): Consumers and Nanotechnology. Deliberative Processes and Methodologies. CRC Press.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
21	EUIMA	Take-up activities by universities of specific guidelines and recommendations to implement their modernization agenda.	Possible	The EUIMA support action addressed the issues of sustainable funding, with a focus on the implementation of full costing models, and of further developing assessment tools for university research, in order to better considering diversity in their orientation and working mode (especially collaborative research). Project outputs were an Assessment Tool for University-Business Research Partnerships They worked on these topics by conducting case studies and stakeholder workshops. Though the project has an empirical basis and analysed the impacts of the conduct of collaborative projects (e.g. through reported impacts in surveys) it is not yet clear if it fits into the research focus of MoRRI, because both, the input side (Are assessment tools a research governance instrument?) and outcome side (e.g., development of networks or of the institution itself, …) are not fully in line with the RRI dimensions (OA, PE, GE, SLSE, ET) and areas of benefits (economic, democratic, societal benefits) identified in MoRRI.	Research governance
22	GAP2	GAP2 - Bridging the gap between science, stakeholders and policy	Yes	GAP2 (MML; follow-on project to the GAP project) wanted to promote dialogue between fishermen, scientists and policy makers in order to develop innovations for sustainable fisheries.	PE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		makers. Phase 2: Integration of evidence-based knowledge and its application to science and management of fisheries and the marine environment.		They tried to made research and innovation more inclusive and open to societal stakeholder and evaluated the impact of this participatory approach. In the project, 13 empirically grounded case studies were conducted on different topics (in the field of fisheries) in different countries. There is a short summary of each case study and scientific papers on several of them. Although not all of them seem to be relevant to the topic of RRI, there are several explicitly dedicated to technical innovations and their impacts in the field of fisheries. Therefore, and because they cover a field that is not much covered by most of the other EC funded projects under consideration, GAP2 could be a possible case resp. provide several cases for further analysis.[160]	
23	NECOBELAC	Network of collaboration between Europe and Latin American Caribbean countries to spread know-how in	Possible	The project wanted to improve scientific writing, to promote open access publication, and encourage cooperation between Europe and Latin American Caribbean countries. Therefore, it implemented a "train-the-trainer" strategy, conducting courses	SLSE OA

[160] http://gap2.eu/; accessed 14 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		scientific writing and provide the best tools to exploit open access information in public health.		for scientists in the participating countries. After the courses took place, participants had to fill out an online survey. The obtained data was then used to assess the impact of the courses. There are empirical results that show how the activities of the project had an impact on open access publishing activities or on the construction of OA institutional repositories. However, the project does not ask about the socio-economic or democratic impacts itself; thus it might only be a case if open access itself is seen as a democratic impact.	
24	PACITA	Parliaments and Civil Society in Technology Assessment.	No	The PACITA project aimed at promoting knowledge based policy making on science, technology and innovation issues by means of different parliamentary TA practices. It documented and analysed existing parliamentary TA practices, conducted training activities (summer schools, practitioners meetings) and parliamentary TA debates. It also set up example three projects (Public Health Genomics, Ageing society, and Sustainable Consumption) to exemplify the methodologies of expert bases methods, stakeholder involvement, and citizen consultation.	PE ET
25	SIAMPI	Social Impact Assessment Methods for research and	Possible (Data	SIAMPI developed a method to assess the social impact of research. Therefore, it conducted literature review, developed an	

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		funding instruments through the study of Productive Interactions between science and society.	assessment necessary)	analytical framework, and conducted several case studies in the areas of health care research, ICT, nanotechnology, as well as social science and humanities. The project was concerned with research in general and not particularly responsible research. A closer look into the cases is necessary to assess if they analysed research activities that include RRI measures (gender, participation, etc.) and if the impact of these were analysed too.	
26	SOAP	Study of Open Access Publishing.	No	The project collected and analysed data on open access publishing in science. It looked at the share of open access articles compared to traditionally published articles in different science fields and also analysed believes, attitudes and practices of researcher towards open access publishing. The project provides statistics and data about open access (in 2009), but did not analyse the impacts of open access on society, democracy or the economy. Thus, it is not a suitable case for MoRRI.	OA
27	ULAB	European Laboratory for modelling the Technical Research University of Tomorrow	No	In ULAB five technical universities from across Europe work together to develop university policies for research, valorisation, entrepreneurship and outreach. They do so by exchange of existing best practices, conducting pilot experiments. These pilot experiments were assessed regarding the impact of best practice	-

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				implementation on research quality (excellence). The impact of the developed best practice guidelines on other universities was not evaluated.	
28	CRÊPE	Co-operative Research on Environmental Problems in Europe.	Possible (data assessment necessary)	The project brought together civil society organizations (CSOs) and researchers in order to conduct research on environmental issues in agriculture. In CREPE several case studies were conducted together with the CSOs[161]. The overall characteristics and output of this cooperative research processes were described and assessed in a separate report. However, from the first scan it is not clear if the reports analyse and empirically underpin the impact of such a participatory approach in diverse areas (research quality, etc.).	PE
29	2WAYS	Two WAYS for Communicating European Research about Life Sciences	Maybe	The 2WAYS project developed and implemented new interactive science presentations for a lay audience on still active scientific research. They also conducted a survey on the impact of these	SLSE

[161] http://crepeweb.net/?page_id=339; accessed 24 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		with Science Festivals & Science Centres/Museums, Science Parliaments & Impact Survey.		presentations on the audience of science festivals (questionnaires for visitors) and conducted other events (science parliaments, final event). However, there is little information online available and further research is needed to obtain documentation. Only then it is possible to assess, if the project is usable as a case for MoRRI	
30	LINDAU NOBEL	58th Meeting of Nobel Laureates at Lindau in 2008	No	Non-call projects that brought together Nobel Laureates and young researchers from different countries for sharing their knowledge, discussions and networking. A wide and interdisciplinary range of scientific topics were covered in meetings, panels and lectures. The impacts on participants and especially the positive effects on the careers of young researchers have not been evaluated.	SLSE
31	PERARES	Public Engagement with Research and Research Engagement with Society	Maybe	PERARES wants to strengthen public engagement in research, involving researchers and Civil Society Organisations in the formulation of research agendas and processes. Development and piloting of different formats like a transnational web portal for dialogues or science shops in several countries. There is no data available on possible impacts or the sustainability of those measurements and it would have to be collected.	PE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
32	PLACES	Platform of Local Authorities and Cities Engaged in Science	Maybe	Network (and online platform) of organisations like science centres, museums, festivals, local authority administration resp. policy makers, or regions and cities, to promote cooperation in their science communication activities. A cooperation of policymaking and science communication should be established in the long-term and changes in public structures and attitudes towards societal science discussions and citizen participation on local and regional level should be implemented. Local Action Plans and City Partnerships could prove material for case studies, but data is not available in this project. The project also developed an impact assessment toolkit (http://www.openplaces.eu/resources/places/80649).	PE
33	SISOB	An Observatorium for Science in Society based in Social Models	Maybe	Goal of SISOB was to develop a tool (in form of open source software) for policy makers and funding agencies to identify research with high social impact worthy of support. In order to use those tools and validate the methods, three case studies were conducted about researcher mobility, knowledge sharing and peer reviewing processes. The tool might be interesting to use in other case studies.	Governance
34	ESCITY	Europe Science and the City: Promoting Scientific Culture	Yes	Preceding project of PLACES, ESCITY tried to promote the integration of science culture in society on a local authority's	PE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		at local level		level. Traditional science communication activities (e.g. science fairs, public lectures) were carried out and local government representatives were invited to attend. The project wanted to establish a European community for those local and regional governments and social researchers as a place of exchanging information and best practice. Case studies were carried out in order to compile examples of best practice, also a guideline was developed addressing local governments on how science cultures can be enhanced in cities. The case studies gathered 38 cases "benchmarking […] regional and local policies aimed at engaging citizens, especially those ones developed by cultural departments, paying special attention to those raising young people's interest in science and women's role in its development". Those had to already be carried out so it was possible to get data allowing their assessment.	
35	ESOF	EuroScience Open Forum 2010	No	"ESOF – EuroScience Open Forum – is the biennial pan-European meeting dedicated to scientific research and innovation. At ESOF meetings leading scientists, researchers, young researchers, business people, entrepreneurs and innovators, policy makers, science and technology communicators and the general public from all over Europe discuss new discoveries and debate the direction that research is taking in the sciences, humanities and	PE (partly)

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				social sciences."	
36	ACUMEN	Academic Careers Understood through Measurement and Norms	No	ACUMEN "aimed at understanding the ways in which researchers are evaluated by their peers and by institutions, and at assessing how the science system can be improved and enhanced." A new set of criteria and guidelines for good evaluation practices was developed. No formal mechanisms were implemented for evaluating the impacts of benefits of the project. There is a report about gender Effects on evaluation indicators though.	GE (partly)
37	ECB	European Coordinating Body in Maths, Science and Technology Education (ECB)	Yes	The ECB set out to strengthen the link between science education (STEM – Science, Technology, Engineering, Mathematics) and science technology careers within the industry and by that help closing a future gap of jobs and professionals. Multimedia tools and guidelines for best practice and innovation in teaching and teacher training were developed in order to attract young people to those fields. The project conducted an evaluation of the impacts on children's attitudes and could therefore be used for a case study.	SLSE
38	ESTABLISH	European Science and Technology in Action Building Links with Industry, Schools	No	ENCOURAGE set out to "encourage, disseminate and promote the use of inquiry-based education (IBE) for secondary level students (12-18)". Teaching and education material has been developed	SLSE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		and Home		for students as well as for teachers across 16 different science sectors. Multiple stakeholders have been involved in this. No impact has been evaluated.	
39	EUCYS 2011	European Union Contest for Young Scientists 2011	No	EUCYS is a yearly held contest that shall promote scientific exchange amongst young researchers in Europe and guide them into future careers in science and technology. The impact on the participants has not been evaluated.	SLSE
40	FIBONACCI	Large scale dissemination of inquiry based science and mathematics education	Maybe	FIBONACCI takes on the effort of previous projects to disseminate IBSME (inquiry-based science and mathematics education methods) on a local level and wants to "design, test and formalize a process for disseminating" IBSME in primary and secondary education throughout Europe in order to enhance scientific literacy from an early age and to reinforce scientific careers. Guidelines and other materials have been developed; the dissemination builds on 12 Reference Centres in Europe. The project could be used as a starting point for a case study.	SLSE
41	PRIMAS	Promoting inquiry in mathematics and science education across Europe	Yes	PRIMAS' goal is to promote the "use of inquiry-based learning (IBL) within science and mathematics education" in order to enable and improve the experiences of students with STEM subjects. For that purpose, teaching material, teacher education,	SLSE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				classroom guidelines have been developed and disseminated throughout Europe. Multiple stakeholders have been involved in this process. In order to measure the impact of the project, summative and formative evaluations have been conducted in which data was collected and national activities were monitored and case studied. Material is not available on website and would have to be asked for.	
42	S-TEAM	Science Teacher Education Advanced Methods	No	S-TEAM focuses on developing best practices in science education by combining existing research in order to stimulate learning in science. As optimal approach was identified the inquiry-based science teaching (IBST), which emphasizes own exploration of scientific problems. Three stakeholder groups were targeted in disseminating the outcome: policymakers, teachers and teacher educators. Some evaluation has been conducted on a national level, but impact has not been evaluated.	SLSE
43	SIS CATALYST	Children as Change Agents for the future of Science in Society	No	SiS CATALYST has the ambition to make children change agents in the relationship of science and society. The access to higher education should be based on the child's abilities whereas momentarily it lies more on cultural variables. Different measures and steps were taken for that. Impact measurement was one work package of the project, material and results of which cannot	SLSE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				be found on the internet and would have to be researched. Additional information for a case study would have to be gathered.	
44	UPDATE	Understanding and Providing a Developmental Approach to Technology Education.	No	UPDATE wanted to improve and promote "science and technology teaching in Europe in order to make technology more attractive to young people." For that purpose, it focused on a young age, namely early childhood and primary education, to spark interest and abilities. The project examined possible reason for high dropout rates of girls in technology education, designed new teaching materials and education methods and on the long run mobilize young people for future careers in engineering and technology. Pilot studies were conducted in order to gather expertise, but no benefits of RRI were touched in those.	SLSE
45	ALACs	Promotion of Participation and Citizenship in Europe through the ALACs of Transparency International	No	The project focuses on Advocacy and Legal Advice Centres set up by Transparency International. Those provide "free and confidential advice and support to witnesses and victims of corruption" and were "analysed and enhanced across Europe in order to generate better scientific knowledge and best practice models of civil society activities" in anti-corruption. Since the project does not focus or account for corruption in research and innovation specifically, it is of no use for case studies.	PE ET

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46	CIVI.NET	The capacity of CSOs and their networks in community based environmental management	No	CIVI.NET chose for case study regions in Brazil and Costa Rica were communities successfully faced the "challenge of reorganizing the management of natural resources as a result of environmental changes and degradation". Those successful and sustainable community-based approaches were analysed and transferred to other communities with similar challenges. The outcome is disseminated in different measurements: guidelines, training and publications. Since the project deals with environmental challenges of communities, it is not suitable for case studies of benefits of RRI.	PE
47	COMBIOSERVE	Assessing the effectiveness of community-based management for biocultural diversity conservation.	No	COMBIOSERVE wanted to "develop new scientific and technological knowledge that can help in understanding and characterizing locally developed forms of community conservation", community-based resource management and conflict resolution strategies. For that goal it focused on four field sites in South and Central America, where conditions and principles of success were identified, involving local researchers. Since benefits of RRI are not part of the project, it is unsuitable as a case study.	PE
48	GEOFAIR	GeoTraceability Fair Trade	No	The project aimed at creating improved, standardized information on Fait Trade activities in form of an online tool. Greater	PE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
	TRADE			transparency about the producers for the customer and bringing them closer together was goal of that tool. Since CSOs play a key role in Fair Trade, the project linked them with research performers. Though the involvement of CSOs shows the dimension of participation/civil engagement, no data concerning the long-term the benefits has been collected and thus a case study would be hard to conduct.	
49	COMET-LA	Community-based Management of Environmental challenges in Latin America	No	The project set out to identify "sustainable community-based governance models for the management of natural resources that could be used in different social-ecological systems in a context of climate change and increasing competition for the use of these resources". In a participatory learning-area, the community-based management of natural resources were analysed and best practices identified under the involvement of different stakeholders, amongst them CSOs. Three case studies were conducted in Mexico, Colombia and Argentina, but the subject is again not the benefits of RRI.	PE
50	COBRA	Coordination of Biological & Chemical IT Research Activities	No	COBRA dealt with the "emerging field of biological and chemical information technologies". Background challenges and motivating factors were described, different approaches to its realization were introduced, possible impacts imagined and it was illustrated	-

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				in five case studies of suitable projects. No benefits of RRI were part of the project.	
51	PANGEO	Enabling access to geological information in support of GMES	Maybe	PANGEO project developed a free and open access portal on which the different targeted user groups (local authority planners and regulators; national geological surveys and institutes; policy makers; general public; commercial sector) can get geohazard information for 52 participating towns and cities in Europe. In order to do so the project gathered and interpreted a range of data and information on geological processes. For a better promotion and dissemination of the portal, case studies of user have been conducted, studying the benefits and value of the end product. The material is not available on their homepage, but might prove interesting for a case study on open access.	OA
52	PASSO	Participatory Assessment of Sustainable Development indicators on good governance from the Civil Society perspective	No	PASSO aimed at developing "a set of effective, coherent and useful indicators of good governance that take better account of the perspective of civil society and that can be used in Europe to support the monitoring of sustainable development". Civil society representatives were involved in a participatory process that led to a governance framework and a set of 30 indicators. No case studies were conducted in the project.	PE

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
53	CIT-PART	Impact of Citizen Participation on Decision-Making in a Knowledge Intensive Policy Field.	Yes	The project studied the impact of PTA and TA on policy-making in various European countries, the EC, the OECD and the Vatican and furthermore the potential impact of citizen participation on EU-level on the example of xenotransplantation. Case studies were conducted about the examined countries and xenotransplantation policies, which could provide information about the Dimension Participation in those countries.	PE
54	TECHCLINIC SST	Setting-up of effective Technological Clinics to address real knowledge needs of Surface Transport.	No	The project set out to change the attitudes of young people towards the surface transport industry. In this sector, shortages of qualified personnel exist while there is a high level of unemployment in most EU countries. TECHCLINIC SST wanted to close this gap in motivating young people to choose education in this sector. For that purpose, technology clinics and scientific cafés were established in different countries, directly involving students with the industry. It does not seem as though benefits were surveyed, but the existing material is very scarce.	SLSE
Explicit RRI projects					
55	Res-AGorA	Responsible Research and Innovation in a Distributed Anticipatory Governance	Yes	The Res-AGorA project aims at developing a comprehensive governance framework for RRI. Therefore, theoretical reflection, empirical work, and stakeholder engagement are conducted.	RRI

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		Frame. A Constructive Socio-Normative Approach.		Approximately 30 case studies form the core of the project; these are concerned with existing practices in different scientific and policy fields that support or prevent RRI. Furthermore, a monitoring of RRI activities in 16 European countries is being conducted. The case studies are quite diverse; they differ in terms of technology field (nanotechnology, fracking, synthetic biology, biofuels, etc.) as well as research focus (on methods of technology assessment, research infrastructures, standardization, etc.). Though not all of the case studies provide evidence of the benefits of RRI (but in some cases rather the negative effects of "non-RRI") there are several case studies that could be useful for identifying benefits of RRI.[162]	
56	PROGRESS	Towards a European normative model for	Possible future	PROGRESS wants to develop and implement a normative model for RRI drawing on existing constitutional values as normative	ET

[162] The Res-AGorA project is still active until the end of January 2016; not all case studies are finalized and accessible yet. http://www.res-agora.eu; accessed 24 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		Responsible Research and Innovation globally, using constitutional values as a driver to inform societal desirability.	case	basis. In that, PROGRESS analyses and compares science funding strategies in different countries (including Europe, the USA; China, Japan, etc.). In the project, three case studies have been conducted in the fields of Synthetic Biology, Nanotechnology, and ICT. However, the case studies only give an overview and evaluation of ethical challenges regarding the different technologies or innovations, but not on the impact of implementing RRI. In the future, the PROGRESS project including its impact in different areas might be analysed as an example of RRI practice itself.[163]	
57	Responsibility	Global Model and Observatory for International Responsible Research and Innovation Coordination.	Yes	RESPONSIBILITY is developing a stakeholder network to adopt and diffuse a common concept of RRI between different stakeholders in the EU and worldwide. Therefore, it wants to produce policy recommendations and guidelines (a model and tool for cooperation) as well as a so-called "Observatory", which collects and holds available RRI related materials (policy	RRI

[163] http://www.progressproject.eu/; accessed 24 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
				documents, case studies, articles, etc.) The project also initially produced 21 case studies for their case study collection (as well as a reusable case study template) focusing on different RRI issues in various contexts and technology fields. These (might) provide valuable insights into effects and benefits of RRI.[164]	
58	GREAT	Governance for Responsible Innovation.	Possible future case	The GREAT project analysed five research projects that worked on ageing and care for older people, care for the environment, and public service for citizens and businesses. In their cases, they focused on (1) if and how the funding programme (EC) had certain requirements with regards to RRI, and (2) what ethical challenges the projects had to face. In the future, the impact of the project, as an instrument of promoting RRI, can be analysed.[165]	RRI (ET)

[164] http://responsibility-rri.eu/; accessed 24 March 2015.

[165] http://www.great-project.eu/; accessed 24 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
59	RRI Tools	RRI Tools. Fostering Responsible Research and Innovation.	Possible future case	The RRI Tools project wants to develop a toolkit (training materials, best practices, guidelines, etc.) that can be used in order to promote RRI. For production and dissemination of this toolkit, a consortium and RRI Hubs covering 30 countries have been set up. At a later stage of the project, the impact of this toolkit will be evaluated. However, at the moment (March 2015) there are not many results yet, since the project just recently started (2014). At a later point in time, it might be useful to re-assess the project as a case for MoRRI.[166]	RRI
60	Responsible-Industry	Responsible-Industry	Yes	The Responsible Industry project produced several case studies[167] that deal with concrete innovations, how they were developed, how RRI aspects were considered in the development process and what impact this had.[168]	RRI

[166] http://www.rri-tools.eu/; accessed 24 March 2015.

[167] Case studies were produced by researchers outside the project; there was an open call for competition on case studies that demonstrate how RRI can be implemented and what impacts RRI has. Webpage: www.responsible-industry.eu/; accessed 20 March 2015.

[168] http://www.responsible-industry.eu/; accessed 24 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
61	NERRI	Neuro-Enhancement responsible research and innovation.	Possible future case	NERRI wants to introduce the concept of RRI in the field of neuro enhancement and to model a governance framework for this purpose. It does so by facilitating a broad societal discussion, including stakeholder involvement and different mobilization and mutual learning activities. In the future, the impacts of the RRI activities in NERRI could be analysed, but at the moment, there are no results on their wider impacts.[169]	ET PE
62	SYNERGENE	Responsible Research and Innovation in Synthetic Biology.	Possible future case	SYNERGENE is a mobilization and mutual learning action, which aims at promoting RRI in synthetic biology by conducting a dialogue between different stakeholders on the benefits and risks of synthetic biology. In the future, the impact of the activities in the project could be analysed, but at the moment, there are no results on the wider impacts of this RRI promoting project.	ET PE
63	irresistible	Engaging the Young with	Possible	The irresistible project wants to design activities to support	SLSE

[169] http://www.nerri.eu/; accessed 24 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		Responsible Research and Innovation.	future case	participation of students and the public in RRI processes. In the project, science education.[170] In the future, the impact of the activities in the project could be analysed, but at the moment, there are no results on the wider impacts of this RRI promoting project.	PE
64	PARRISE	Promoting Attainment of Responsible Research & Innovation in Science Education.	Possible future case	PARRISE promotes RRI in the field of primary and secondary education. The project collects and distributes best practices in different countries and develops a framework for socio-scientific inquiry-based learning. Thus, the project wants to promote democratic citizenship. Later, they want to evaluate the use and success of the developed materials and framework.[171] The project just started in 2014 and there are not many results yet. However, in the future the project itself might be a case for MoRRI.	SLSE
65	SATORI	Stakeholders acting together	Possible	SATORI wants to develop a framework for ethical impact	ET

[170] http://www.irresistible-project.eu/index.php/en/; accessed 24 March 2015.

[171] http://www.parrise.eu/; accessed 27 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
		on the ethical impact assessment of Research and Innovation.	future case	assessment of research and innovation. To this end, relevant projects and stakeholders, effects of globalization on R&I, and other related issues are identified and analysed. Furthermore, there will be collaborations with different stakeholders in order to bring in a variety of perspectives. Two SATORI workpackages deal with risk-benefit analysis and measuring impacts of ethics assessments. However, the project just started in 2014 and the respective deliverables are not finished yet.[172]	
66	NanoDiode	Developing Innovative Outreach and Dialogue on responsible nanotechnologies in EU civil society.	Possible future case	NanoDiode establishes a coordinated programme for outreach and dialogue to support governance of nanotechnology. Therefore, stakeholder engagement and dialogue are promoted by different activities (idea competitions, surveys and interviews, stakeholder dialogues, establishment of user committees, scientific education, etc.).[173] The project itself	SLSE PE

[172] http://satoriproject.eu/; accessed 27 March 2015.

[173] http://www.nanodiode.eu/; accessed 27 March 2015.

ID	Acronym	Name	Possible Case?	Argumentation	Dimension
67	CONSIDER	Civil Society Organisations in Designing Research Governance	Yes	CONSIDER aimed to examine SCO participation in research. For that, it surveyed all FP7 projects and did case studies for more than 30 relevant projects, from which a model of participation was developed. In a further step, guidelines for stakeholders were developed, on how to involve representatives from CSOs into research. The case studies looked into dynamics of participation in research and the characteristics of participating CSOs. Impacts of the case study projects have been examined, which makes CONSIDER a good source for potential case studies in MORRI.	PE