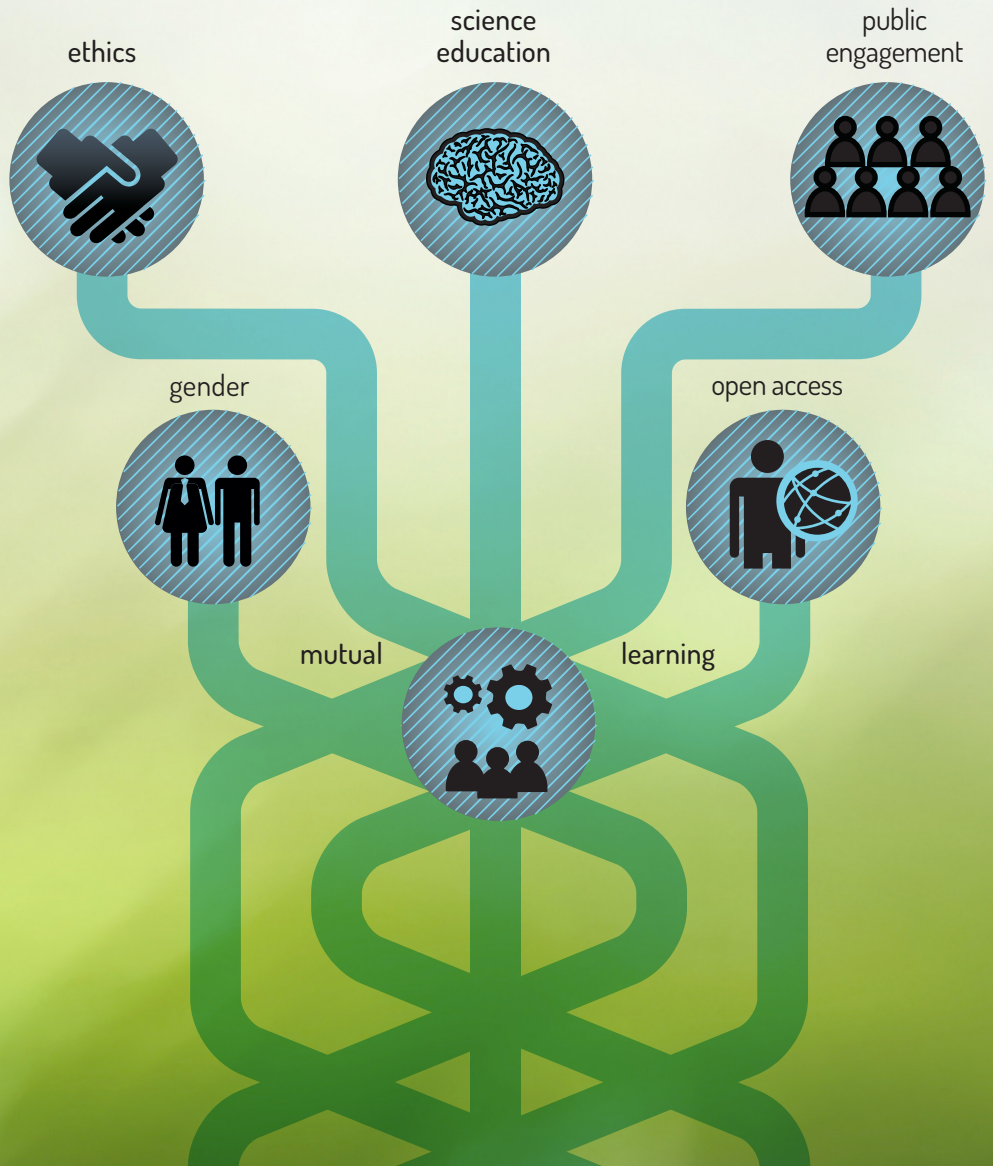
JERRI

JOINING EFFORTS FOR RESPONSIBLE RESEARCH AND INNOVATION

Fraunhofer implementation report

Deliverable D6.1



JERRI – Joining Efforts for Responsible Research and Innovation

Deliverable D6.1

Fraunhofer implementation report

Project Name	Joining Efforts for Responsible Research and Innovation (JERRI)
Project No.	709747
Project Type	Coordination and Support Action
Project Duration	01.06.2016 – 31.05.2019 (36 months)
Project Coordinator	Philine Warnke, Fraunhofer ISI
Funded under	Horizon 2020, Science with and for Society SwafS
Work Package	WP6: Implementation Process at Fraunhofer
Dissemination Level	Public
Planned Date	Month 34 (March 2019)
Actual Submission	24.04.2019
Version	Draft Version
Authors	Philine Warnke, Andreas Röß with contributions from: Anne Spitzley, Michaela Friedrich (Fraunhofer IAO), Tina Klages, Andrea Wuchner, Martin Maga (Fraunhofer IRB), Jürgen Bertling and Venkat Aryan (Fraunhofer UMSICHT)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 709747.

TABLE OF CONTENTS

EXECUTIVE SUMMARY **4**

1 Function of the Report in the JERRI Context **5**

2 Conceptual Background **6**

3 Pilot Implementation **7**

3.1 Ethics 7

3.1.1. Starting point: Long-term goals and pilot activities 7

3.1.2. Description of the pilot activity implementations 9

3.1.3. Lessons learned 15

3.2 Gender Equality 18

3.2.1. Starting point: Long-term goals and pilot activities 18

3.2.2. Description of the pilot activity implementations 20

3.2.3. Lessons learned 28

3.3 Societal Engagement 30

3.3.1. Starting point: JERRI long-term goals and Pilot activities 30

3.3.2. Description of the pilot activity implementations 36

3.3.3. Lessons learned 43

3.4 Open Access 45

3.4.1. Starting point: JERRI long-term goals and pilot activities 45

3.4.2. Description of the pilot activity implementations 47

3.4.3. Lessons learned 57

4 Analysis and Conclusion **61**

ABBREVIATIONS **66**

REFERENCES **67**

ANNEX I (ETHICS) **69**

ANNEX II (GENDER) **76**

ANNEX III (OPEN ACCESS) **87**

EXECUTIVE SUMMARY

For us in JERRI responsible research and innovation (RRI) means creating impact together with society that is socially desirable and ethically acceptable. JERRI was an organisational learning process that enabled us at Fraunhofer to strengthen our RRI capacities. In the process we set out from four distinctive RRI domains (gender equality, ethics, societal engagement, open access) but ended up with an integrated notion of RRI where organisational reflexivity becomes the key enabler across all dimensions. Now at the end of JERRI we have developed and implemented the following concrete RRI capacities at Fraunhofer:

- A process for identification of ethically relevant issues within strategic research programs,
- A workshop format enabling R&I teams to systematically reflect on ethical aspects of their research,
- A toolbox providing easy access to good practice examples for advancing gender equality in research organisations,
- A brochure with inspiring stories from colleagues who pave the way for more gender equality through adopting new working models,
- A guideline for identifying relevant gender aspects in research proposals,
- An infrastructure for a repository providing open access to research data,
- Six business models for creating value through open science approaches,
- Fact sheets supporting Fraunhofer researchers and their industry partners in integrating Open Access and Open Data into contract negotiations,
- A communication strategy for deepening institutionalisation of Open Access,
- Citizen Cafe as a format in which societal needs can be put forth to science,
- A format for a public debate with actors from academia and civil society on a topic of high public attention.

These capacities are now available in Fraunhofer and have the potential to initiate wider transition towards the long-term visions we had developed in the beginning of the process. In line with the JERRI theoretical framework of “deep institutionalisation” (Randles 2017) the key factors determining the deep institutionalisation trajectories of RRI practices are: The existence of change agents, the prevalence of concepts that reach across domains (boundary objects) and the positioning of the new narratives vis a vis the dominant institutional logics. The continuation of the change process also depends on developments in the overall research and innovation landscape. Especially relevant factors are: The dominant notions of research and innovation excellence, reward structures and incentives, evidence for successful RRI applications and integration of RRI competencies into university curricula.

1 Function of the Report in the JERRI Context

The EU project 'Joining Efforts for Responsible Research and Innovation' (JERRI) aimed at a deep RRI transition process within the two largest European Research and Technology Organizations (RTO's), the German Fraunhofer-Gesellschaft and the Netherlands Organizations for Applied Scientific Research (TNO). The process featured an intense mutual learning between these two organizations, a wider circle of RTOs and stakeholders. In essence, this transition process consists of three main elements:

(1) The development of organizational long-term goals regarding RRI (WP 2 & 3) and identification of pilot activities to initiate change towards these goals.

(2) The analysis of the conditions of organizational change, which included the development of an theoretical framework (WP1), a bilateral and international exchange and reflection upon good practices between RTOs (WP 8,9,10) and the identification of barriers and enablers on our way to organizational transition. All these findings were used as inputs for the long-term transition roadmaps (action plans) (WP 4 & 5), in which we outlined what steps have to be taken after the JERRI project has ended in order to fulfil our long-term goals and deeply embed RRI practices into the organizational *DNA*.

(3) The actual implementation of the selected pilot activities.

This report is dedicated to the third element, the pilot implementation at the Fraunhofer-Gesellschaft. Accordingly, it documents the pilot activities and summarizes the lessons learned from the implementation process. In addition, the products arising from the activities such as guidelines, fact sheets, brochures are provided in the Annexes of the report. We hope that our experiences and insights will be helpful for other organisations and in particular, other RTOs, who may wish to engage in similar change processes. When reading this report it is important to note, that we see the pilots not as an end in itself but as starting points for the subsequent transition process towards our long-term goals as visualised in Figure 1 below.

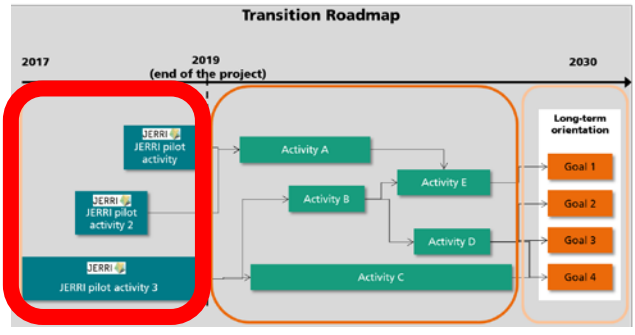
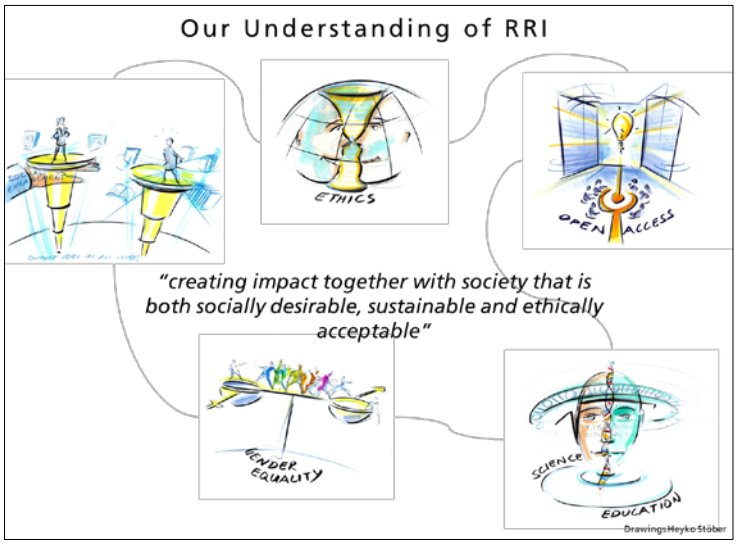


Figure 1: JERRI Framework (the red frame indicating the focus of this report)

A dedicated second report (Deliverable D6.2) will review the long-term goals and the necessary steps for further RRI institutionalization beyond the project duration in the light of the pilot experience.

2 Conceptual Background

In JERRI, we have adopted the concept of “deep institutionalisation” to conceptualise our journey towards an organisation that pioneers “science with and for society” by deeply embedding practices of reflexivity, anticipation and responsiveness into our daily routines and organisational culture. As a starting point for our change process, we have addressed the “dimensions” featuring prominently in the European Commission’s official definition of RRI: Ethics, open science, gender equality, societal engagement/ science education. These domains have proved highly useful inroads into the change process but in the course of the process we came across a number of interfaces resulting in a more holistic understanding of RRI as the “ability to create impact together with society that is socially desirable and ethically acceptable” which is also shared with TNO. This ability is at the core of all the dimensions but also extends to other activities within our organisation.



The theoretical framework of deep institutionalisation (Randles 2017) provides us with valuable lenses for understanding our change process. Firstly, it tells us to differentiate between three analytical levels, we need to consider for understanding organizational change in general and the deep institutionalisation of RRI practices in particular.

I. Interorganisational & environment level: The level of institutional logics within the organisation’s environment and interorganisational relations, for example nation state policies and its effect on organisations
II. Intraorganisational level: The ability of the organisation to cope with different institutional logics, organisational cultures, missions and goals.
III. Actor level: institutional entrepreneurs and their performance as change agents.

Secondly, it has alerted us to the potential tensions of a change process where new narratives and institutional logics compete with established ones especially in large multi-purpose organisations such as Fraunhofer and the risk of shallow institutionalisation patterns as well as responsibility overload. This has brought to the forefront key aspects such as the importance of change agents, the key role of leadership not only on the top but also on mid management level and the need to align old and new narratives and logics. Also, we have learned to pay attention to the degree of overflow of concepts across the organisation as a measure of institutionalisation. All these notions helped us to make sense of our experience and will therefore be evoked when analysing the pilot implementation experience.

3 Pilot Implementation

In this chapter, we present the results of the implementation process dimension by dimension. In each section, we first give an overview of the long-term goals and subsequent choice of pilot activities, which are documented in depth elsewhere (Teufel, Röß 2017). We then report in detail the implementation activities and the experience of the process.

3.1 Ethics

3.1.1. Starting point: Long-term goals and pilot activities

Within an applied research organization like Fraunhofer, we understand ethics more in a consequential or utilitarian tradition than in the deontological tradition of Kant. From this perspective the ethical question of 'what to do' is guided by a normative position, that weighs up the results, or more precisely the risks and benefits of R&I actions related to third parties like society as a whole or specific societal groups. This understanding of ethics evaluates the outcome of research and innovation actions by their fitting with the values and demands of society and is therefore in line with the overall understanding of RRI (Lindner et al. 2016). It is important to note that this conceptualisation of ethics as anticipatory impact reflection goes far beyond a notion of ethics as compliance with ethical guidelines and regulation when conducting research such as e.g. in research with human subjects or animal testing which is well established in many RTOs including Fraunhofer.

As described in detail in a previous report (Teufel, Röß 2017) the ethics dimension was kicked-off with a visioning workshop where the following elements of a long-term vision for Fraunhofer were emphasised:

- **Responsibility**:
  - Besides technological developments, Fraunhofer addresses societal, ecological and economic implications (“thinking mid- and long-term”).
  - Fraunhofer integrates and lives up to ethical responsibility.
- **Enabling:**
  - Fraunhofer staff is enabled (in terms of ‘competences’) to live up to ‘ethics’.
- **Value pluralism:**
  - Fraunhofer creates and supports an open, constructive and respectful culture of dealing with conflicts, e.g. via clearing agents, consultancy services, etc.
- **Dealing with conflicts:**
  - Fraunhofer actively deals with different moral concepts.

The following three pilot activities were assessed as most promising for initiating change towards these goals and therefore selected for implementation within JERRI:

(1) **Ethical screening and consultancy for project proposals of the internal research programmes**. This activity aims to foster institutionalisation of responsibility orientation by integrating a reflection of ethical aspects and societal impacts into the set-up of Fraunhofer’s internally funded strategic research projects. This activity has two core elements. Firstly, screening the proposals for such projects for ethical issues and secondly supporting project leaders in reflecting on these ethical aspects and addressing them in the research design. The internally funded strategic projects were seen as a highly promising entry point for initiating change across the organisation due to their high visibility within Fraunhofer and the strong cooperation of diverse institutes within these projects.

We reckoned, that the implementation of this pilot activity allows the organisation to anticipate and address possible Fraunhofer wide research & technology trends and related ethical issues in a very early stage. In addition, it has the potential to build competences and awareness at the level of team leaders on a mid-level leadership who are important potential change agents according to our theoretical framework.

(2) **Multiplying orientational knowledge about the societal impact of R&I by integrating ethical competences into qualification programmes for Fraunhofer staff**. By integrating an ethical module within existing staff qualification programmes, this

pilot aims to sensitize Fraunhofer researchers to the ethical dimensions and societal implications of R&I and to build competences in recognizing and addressing such issues.

(3) The third chosen pilot activity was **to set-up and test of a discussion format on one application field with particular ethical relevance**

3.1.2. Description of the pilot activity implementations

1. Ethical screening and consultancy for project proposals in the internal research programmes.

This pilot activity consist of the two elements, the ethical screening of the project proposals and the consultancy part for project leaders. For both activities, we had to define criteria for identifying ethically relevant research projects in a systematic and transparent manner. Therefore, the first step within this pilot activity was to establish a guideline for the assessment of the ethical relevance of a research proposal. This guideline contains (1) our general understanding of ethics in applied research, (2) the criteria of what makes a certain project ethically relevant and (3) the key normative principles for different fields of technology (e.g. medical technology, information and communication technology etc.). Although from an ethical perspective every project does have normative implications and has discussion potential, we decided to classify those projects to be relevant which are directly related to human beings and which have the potential to transform established social practices, expectations and value systems. As we got to this definition, the next step was to concretise this definition for specific technology domains. Therefore, we undertook a systematic literature analysis of the ethical discourse within different fields of technology. We found a very useful heuristic in (Grunwald 2013), which provides specific ethical principles for different technology domains including the societal context in which the technologies are used.

Based on this we could now relate the project proposals of the internal funding programme to the different fields of technologies and their normative principles. This enabled us to not only to decide whether a project proposal is relevant in ethical terms or not, but also to communicate which normative principle needs to be more considered or integrated into the project. Once we established a first draft of the ethical guideline, it was necessary to evaluate and test it in order to see if the developed heuristic is useable for the screening of the specific Fraunhofer projects. The first application of the ethical guideline was carried out in 2017 on project proposals from the previous and the ongoing year. The test confirmed our heuristic in two ways. First, the concept largely covered all the different research fields of the submitted proposals. Secondly, the test showed that the relevant normative principles of the literature could be applied to the project

proposals. In addition, we noticed that three different reviewers arrived at similar conclusions regarding ethically relevant aspects in the proposals when using the guideline. Thus, the testing phase indicated that the ethical guideline could serve as a robust and transparent tool for screening purposes. Nevertheless, because the internal research programs focus on the development of emerging technologies and innovations, the ethical guideline should be updated in regular intervals. At the moment, the ethics team of JERRI discusses how to manage such an ongoing improvement in order to ensure the usefulness of the tool after JERRI has ended. In total, during the JERRI duration the JERRI team reviewed 192 proposals in three batches. We documented the results and are going to transmit an assessment of the findings and a recommendation for further proceeding to the Fraunhofer board of directors.

In addition to monitoring ethical aspects of the internally funded projects, the second goal of the pilot was to provide ethical support for successfully submitted project proposals. We carried out the consultancy for the first time in 2018. Based on the previous ethical screening process, we choose three project proposals that successfully passed the first stage of a two-stage selection process. We offered the ethical consultancy to the project leaders on a voluntary basis. We tried to reach the project leaders through the argument that such an ethical consultancy would increase the prospect of success to pass the second stage of the selection process, enhance the quality of the research outcomes, and improve the chances for successful market entry and societal uptake. Although there was no official need to accept such an ethical consultancy, all three contacted project leaders were willing to exchange with us. The conversations with each of the project leaders took about one hour and were held via telephone conference or in one case face-to-face. Because the basis for the previous screening was only a short project proposal, the first part of each conversation was dedicated to getting a more detailed picture of the project content. In some cases, ethical concerns about the project could be dispelled at this early stage. After the concept of the project and the planned working steps was clarified, we discussed the ethical aspects we found during the screening and also how the project concept could address these issues by e.g. integrating underrepresented stakeholders/users or including consortium partners with ethical expertise. The results of these consultations were different.

In one case, the project leaders argued that other project partners already addressed the ethical aspects pointed out by us. Therefore, it was not necessary from their perspective to integrate new consortium partners or explicit ethical work packages. But as a positive result of the conversation, the project leader confirmed to integrate our ethical concerns into the extended version of the proposal. Another success within this case was that the project leaders stated that they also see the need to further examine ethical questions within this research area. Furthermore, the project leaders shared our

opinion that the ethical aspects of that particular kind of research field should be discussed in a broader way. They jointly agreed on our suggestion that in the case that this research area will be further deepened at the Fraunhofer society, there should be a joint discussion of all Fraunhofer institutes that work in this research area.

The second case was slightly different. Also here, the project leader agreed on our ethical concerns, but at the same time argued that one of their project partners could address these aspects in principle. Another topic of this consultancy was the question of financing additional resources for an extra work package. The timing was critical, because the period between the first stage and the second stage of the selection process covers only a few weeks (also this period usually fall into the summer holiday season). Therefore, for further examining the ethical aspects for the larger proposal (second stage) was not possible anymore at this time.

In general, we feel that the ethical consultancy was successful because in principle all project leaders confirmed the ethical aspects we had identified. However, our ambitions to integrate ethical reflection into the actual project design met some resistance. This experience raised important questions that allow us to better tailor the institutionalisation of the ethical consultancy after JERRI has ended.

As a result of the successful test of the procedure in JERRI the JERRI team will make a formal recommendation to the Fraunhofer board to continue the screening and counselling process in the strategic research programmes beyond the JERRI duration. Actors involved in the management of the strategic programme support this initiative.

Below, in section 3.1.3, we will discuss this experience and our lessons learned in more detail.

2. Multiplying orientational knowledge on research ethics in the research management qualification programme 'Forschungsmanager'

As stated above one of our long-term goals within the ethics dimension was to enable Fraunhofer staff to live up to ethics, meaning that ethical reflection become a part of research practice at Fraunhofer. In addition, our research about barriers and enablers (D4.1) showed that the lack of competences and awareness is a main challenge of implementing RRI not only in ethics, but across all RRI dimensions. Dedicating a pilot activity to competence building and awareness raising is therefore very reasonable. The initial idea was to develop a discussion format that has two functions: to strengthen the competence and awareness about ethical aspects among Fraunhofer staff, and to deal with ethical questions within a project / project team by showing how to discuss ethical aspects in a systematic way. Therefore, this discussion format can be used in two

different contexts: on the one side within Fraunhofer qualification programs (for example within the introductory course for new employees or for researchers in management/leadership positions) and on the other side as a tool to constructively and systematically deal with ethical implications on the level of a research group/project. We expect that in the second context our debate format will help to increase the benefits of R&I for the society or the future user by enabling researchers to reflect and anticipate normative aspects and the different moral viewpoints of a pluralistic society. In addition, it will also support the research team to identify and address moral conflicts inside the team and help to decide whether a research contract should be accepted or not or else how it could be approached to make it acceptable. In order to be useable in both contexts, especially in already existing qualification programs that have of course also other learning contents beside ethics, the format should not exceed a certain timeframe. Therefore, we set the format to a three hours minimum. However, of course this timeframe can be adapted, especially within the context of a practice tool, depending on the number of aspects or the seriousness of the moral conflict addressed.

The reflection format itself was developed at the beginning of 2018 and was first tested and applied at the alumni meeting of the 'Forschungsmanager' in July 2018. 'Forschungsmanager' is the title of a relatively new Fraunhofer qualification programme, which is conducted annually. The purpose of this qualification programme is to prepare scientific staff and also administrative staff for leading positions. Qualification programs such as 'Forschungsmanager' does also have the advantage that it assembles very diverse participants from different Fraunhofer institutes with very different research domains. Therefore, an ethics module in this Fraunhofer wide qualification programs does not only multiply ethical knowledge but will also raise the awareness for ethics in the whole organisation.

Following (Brand 2015) ethical competence involves four lines of reflection:

1. Perception (descriptive: What is the case?)
2. Evaluate (What should be the case? Discussion of the underlying norms & values and moral attitudes of the participants (including one's own))
3. Judging (weighing up the reasons in favour of a particular measure, weighing up the various normative principles)
4. Action (which options for action are there and which should be taken?)

For our ethical module/discussion format, we dedicated separate working steps to each of these elements.[1] To be of practical assistance it is important that such an ethical module starts with a concrete problem from research practice instead of discussing

[1] Annex I provides a more detailed account of the process.

research ethics in general. Therefore, the discussion format opens with a short introduction of a researcher, who is familiar with the selected research field. The expertise of one researcher helps to identify normative problems within this research field/project. After this **introduction**, the rest of the participants are encouraged to discuss other normative problems from their point of view with the topic owner. The task moderator collects all identified ethical problems.

The ***second working step*** aims at widening the horizon of the moral perspective. To this end, participants are invited to articulate their own moral viewpoint and/or anticipating moral evaluation of other societal groups. For anticipating other moral viewpoints the group members could for example ask themselves how the purpose of this research project would be evaluated from a certain religious, political standpoint or by a certain societal group (e. g. persons with special needs, minorities etc.). This second working step has two goals. One is to identify internal moral conflicts within the research group and to become aware of the moral concerns of the different group members. The second one is to anticipate other moral viewpoints in order to get a better understanding of how the project could be received by stakeholders, users and affected citizens.



Figure 2: Illustration of step 2 reflection of diverse standpoints

Working step 3 is dedicated to reflecting upon the moral opinions collected from step 1 & 2. For this purpose, the participants use a template that lists the main normative principles for the specific field of technology.[2] Based on that list, the participants decide (in groups of two) which of these principles are relevant for the specific research project

[2] The full template is provided in Annex I

and what are associated potential dangers and benefits. After that, the group discusses the results and decides which of the mentioned ethical aspects should be further processed. As a result of working step 2 & 3, the discussion group now has a list of the relevant ethical issues of the research project and related societal impacts.

On the basis of this list, the discussion group decides in **working step 4** how to deal with these normative aspects. At first the group should find an answer to the question, whether they will continue with the project, respectively to accept the research assignment or not on the basis of the insights from step 3. In case the group decides to go on with the project, the next question is how to foster the perceived positive and minimise the perceived negative implications from the R&I activity. In other words how to balance the risks and benefits of the research outcomes. In this step the team should discuss concrete measures to realize alternative ways of conducting the research project including rethinking the team composition. This discussion is supported with a set of possible measures emerging from the JERRI analysis such as involvement of ethics experts or social scientists, integration of users, affected groups and stakeholder involvement.



Figure 3: Framework for step 4 and 5 (six ethical principles selected by group)

Ideally, the concept offers the following benefits:

- anticipating diverse moral viewpoints in relation to one specific research field/project
- identifying and discussing moral conflicts within a research team

- reflecting about these moral viewpoints and evaluating research projects on the basis of the ethical discourse
- weighing of risks and opportunities and discussing solutions for ethical problems within the research team

The format was carried out for three different topics situated in medical technology, artificial intelligence and defence/security. All three groups arrived at workable solutions for their topic. The feedback from participants was overwhelmingly positive. Participants saw the potential for the format to underpin new research perspectives and ethical business development. As an example, it was proposed to offer similar formats to industry clients who are also often struggling with ethical concerns. As a result from the JERRI experience, Fraunhofer management requested that the reflection format would be integrated into the eight strategic initiatives of Fraunhofer and will finance the implementation through the strategic initiatives' research budget.

3.1.3. Lessons learned

After describing the implementation of the pilot activities, in the following section we want to reflect on this process and share some lessons learned. Again, we would like to discuss each pilot activity separately.

1. Ethical screening and consultancy for project proposals in the internal research programmes.

Like outlined above, the ethical screening program had two aims: (1) to monitor internally funded projects regarding their ethical relevance and report the results to the managers of the internal funding programs and (2) to support project leaders in addressing the ethical challenge of their research projects.

In the long-term by targeting this highly visible and competitive program we aim at advancing ethical competencies and awareness across the organisation.

Concerning the first part of the pilot activity, we received a lot of positive feedback several times when we presented our ethical guideline at workshops or other work meetings. The feedback shows that there is a great demand for orientational knowledge regarding research ethics among Fraunhofer staff. To us this reaction confirmed the usefulness of our approach. This feedback encouraged us also in our ambition to further develop the ethical guideline after JERRI has finished. This is also reasonable because designing it was quite a long-term and iterative process. During the developing process we had several consultations with Fraunhofer colleagues on questions like how abstract such an ethical guideline should be or how many and which normative aspects should be

included. In other words, the greatest challenge in developing such a guideline, which is not just to inform in general about research ethics but rather to be of practical help for concrete research areas/projects, is to **manage different expectations**. Different expectations relating to the ethical guideline occurred in two ways. On the one side, there were different opinions and recommendations about the scope of the ethical guideline, meaning the level of abstraction on which the questions and normative principles should be formulated and the range and numbers of normative principles that should be included. In the end, we are planning to solve this challenge by developing ethical guidelines for different target groups: One only for staff, which do not have any competences in ethics yet and one for the managers of the internal funding programme. The second time we faced different expectations was during the internal communication of the ethical guideline. When we planned how the ethical guideline should be communicated internally, the unit that manages the internal funding programme raised the concern that the ethical guideline could be misunderstood as another criterion for funding and that applicants may complain about it. Although the ethical guideline aimed to support project leaders during the proposal writing process and beyond, we were told to be very careful in communicating the guideline. Therefore, the second difficulty was about **how to communicate appropriately our ethical activities** in order to **avoid misunderstandings**.

When it comes to the second working part of the ethical screening - the consultancy for project leaders and their proposals - we also faced some difficulties. As outlined before, in general we encountered a very open-minded atmosphere among Fraunhofer researchers when it comes to the topic of ethics in research. Nevertheless, when it came down to integrate ethical aspects into the research practice or ongoing projects we encountered some hesitations. During our consultancies, the project leaders mentioned several arguments. One reason for their reservations is that most researchers especially in highly regulated fields such as medical research perceive ethics as following accepted guidelines in their field similar to research integrity. Especially in applied research, the teams often rely for that on their university partners and their well-established procedures such as e.g. approval by ethics commissions. So there is a feeling that ethics is already well addressed. At the same time, the RRI and JERRI notion of ethics as a proactive reflection of impact that underpins the excellence of the research process and its outcomes is new to most researchers. Therefore, the challenge was twofold: Defeating a traditional understanding of ethics (as something which mostly forbids specific practices) and secondly, to overcome the general reservations against new research practices.

Another critical factor is the availability of resources. So far, there is only little willingness to spend parts of the budget for further ethical reflection, for example in form of additional

ethical work packages, the integration of users or specific societal groups etc. This willingness increases as soon as such an ethical work package gets extra funding. This behaviour follows directly from landscape pressures. Under the present circumstances and in particular in an RTO context economic success and competiveness are important assessment criteria for research teams. Accordingly, there is little openness for new approaches with seemingly additional costs.

Following from these barriers the question arises how to convince project leaders to engage in this new kind of research practices. Here it is very difficult and crucial to find the right balance between challenging and reassuring communication strategies. This is especially challenging in cases like JERRI where the ethics team with its primarily social science competence directly engages with group leaders who are at the same time top-level experts in their field so there is a substantial imbalance in authority. In sum, the big **challenge is to create a constructive conversation atmosphere** during the consultancy. This can be realised much better through joint reflection processes like in pilot 2 than in direct counselling situations or else in a peer to peer discussion with the management group. Another consequence is that domain specific ethical expertise is required at Fraunhofer. Both conclusions will be submitted to the Fraunhofer board as a result from the JERRI experience.

2. Multiplying orientational knowledge on research ethics in the research management qualification programme 'Forschungsmanager'

The purpose of the discussion format is not only to be a kind of general introduction to 'ethics in research' but in fact to be useable as a practical tool for concrete research projects and their normative aspects. Therefore, it is necessary to equip such a format with two things: a concrete research project and the respective ethical principles of the field of technology where this research project is located. One important experience is that this preparation requires quite a long **preparation time**. In case the discussion format is used as a module of a qualification programme or in the context of a workshop it is necessary to win several participants in advance, who are willing to present a certain research topic / research field. Only based on a concrete topic the discussion format can be of practical help for researchers. For the preparation of the alumni meeting of the 'Forschungsmanager' we asked all participants in advance, who wants to present his/her particular research field. After getting some replies, we discussed bilaterally with the researchers their specific topic in advance of the workshop. This exchange was necessary to narrow the topic and to find an agreement about which normative principles are relevant to discuss the topic in ethical terms. Based on these selected normative principles, we developed a template for the workshop that lists these abstract principles and explains them by giving examples (see ANNEX I). Also here we made the

experience at the workshop that there are **different levels of ethical knowledge among the researchers**. While for some the principles were clear and translating them to the specific context of the discussed research projects was straightforward, for others the ethical terminology and principles were too abstract. This experience again illustrates the fact that there are **different expectations regarding what the concept should accomplish**. For some, such tools should provide a kind of checklists, while others want to dive deeper into ethical consideration. Therefore, it is **nearly impossible to develop ethical guidelines or other tools that will satisfy every requirement and meet every expectation**. Nevertheless, to manage these diverse expectations the facilitation skills and sound ethical knowledge of the moderator are very important. It is the challenging task of the moderator to deal with these different levels of knowledge and to help with understanding problems through translating ethical terminologies into an everyday language.

Another important lesson we learned from the workshop is the importance of **ensuring a constructive discussion atmosphere**. Therefore, we identified several success factors. Like mentioned before, it is essential that the **discussion moderator has sufficient ethical knowledge or at least a background in the social sciences or the humanities**. Furthermore, in order to have constructive discussion atmosphere it is **important to mediate between different positions**. That does not mean necessarily to solve every moral controversy, but to **identify dogmatic positions, trying to translate between them** as far as possible and to **continue with the discussion in case of dissent**.

3.2 Gender Equality

3.2.1. Starting point: Long-term goals and pilot activities

For the gender dimension, the following three **pilot activities** had been previously selected (Teufel, Röß 2017, p. 23ff.):

1. **Gender Diversity Toolbox**: The existing Toolbox from the previous EU funded project STAGES contains good practical examples on the topic of equal opportunities. It shall be further developed, opened up and internationalized.
2. **Role models at Fraunhofer**: Role models (people who work for the Fraunhofer-Gesellschaft and who have found an individual way to reconcile work and private life) should be identified and interviewed. The results are integrated into the Gender Diversity Toolbox and an electronic booklet should be designed.

3. **Gender in research content consciousness**: The identification and (further) development of existing checklists and case examples dealing with gender in research content should serve to generate more attention for the (possible) relevance of gender aspects in research content. The prepared case studies and checklists were to be communicated via the Gender Diversity Toolbox.

The expected impact was (Teufel, Röß 2017, p. 30ff):

1. **Gender Diversity Toolbox**: Permanent provision of orientational knowledge on how to best deal with gender-related issues in different, concrete situations; directly accessible for other RTOs.

2. **Role models at Fraunhofer**: Motivation and enabling of all actors affected to live up to gender equality and diversity.

3. **Gender in research content consciousness**: Awareness raising and development of individual capabilities.

The goals agreed for the gender dimension and addressed in different ways by the three pilot activities are shown in the following figure.

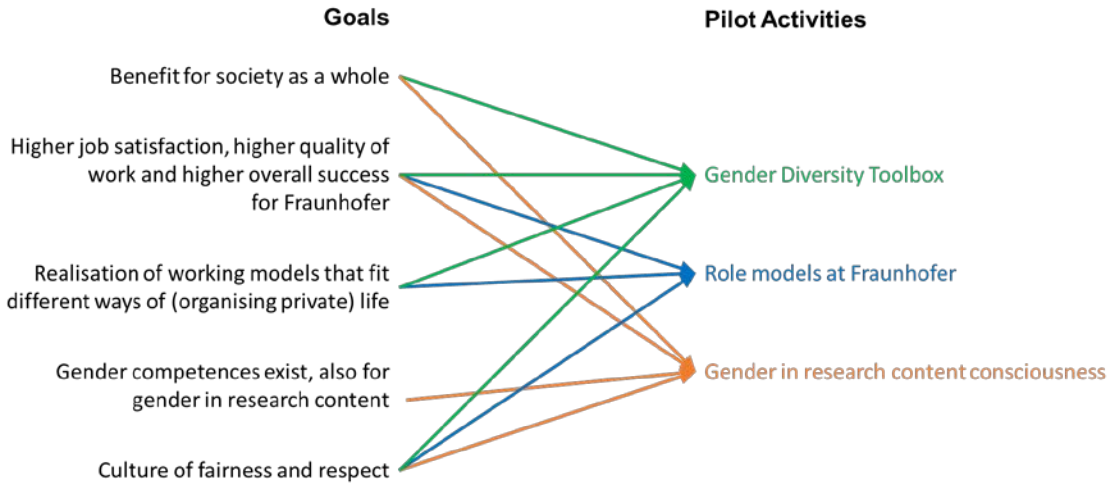


Figure 4: Relationship of goals and pilots in the gender dimension

3.2.2. Description of the pilot activity implementations

In the following section, we describe the work processes for the realization of the pilot activities as well as the results so far, separately for each pilot activity. The full outcomes are provided in Annex II.

1. **Gender Diversity Toolbox**

In the EU-funded project STAGES – Structural Transformation to Achieve Gender Equality in Science (Grant Agreement No. 289051, 2011-2015), the Fraunhofer IAO had already set up, in German language, an internet-based toolbox with practical examples for how to foster equal opportunities from various Fraunhofer institutes. This toolbox was to be redesigned. The following revisions were planned:

- Setting up a new domain (www.gender-diversity-toolbox.de)
- Redesign of the website in German and English
- Revise the previous toolbox entries and translate all entries into English
- Obtaining the consent of the authors for the revised toolbox entries
- Marketing to increase awareness of the toolbox among other research organisations
- Continuous maintenance of the Toolbox: Acquiring and setting up new toolbox entries

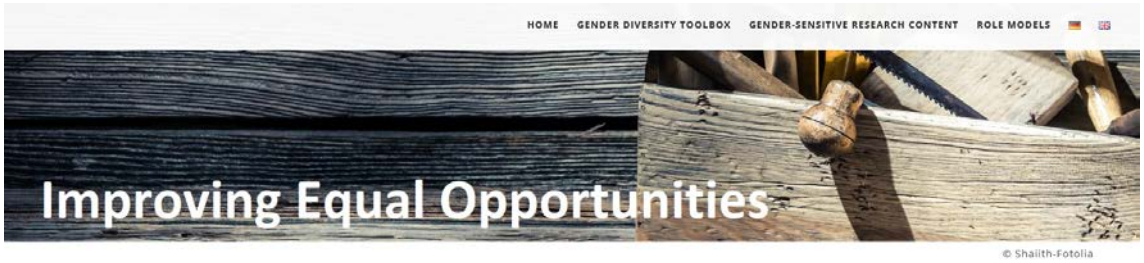


Figure 5: Screenshot of the english start page of www.gender-diversity-toolbox.de

First, we reserved the URL wwww.gender-diversity-toolbox.de and developed a concept for what content we wanted to make available on the website and in what way. This concept initially included a home page, the toolbox itself with the practical examples, information on how research organisations can participate in the toolbox, further FAQs on the toolbox, links to other toolboxes, information on the JERRI project, contact details, imprint, and publishing notes.

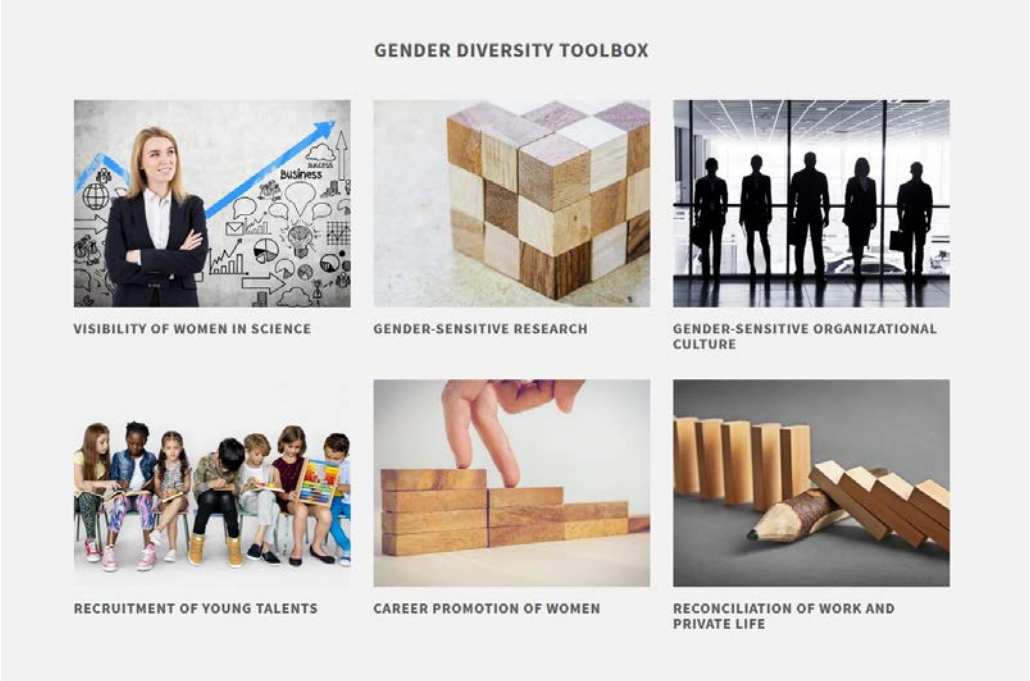


Figure 6: Screenshot Gender Diversity Toolbox categories

In addition, we selected appropriate images for the website. Next, we looked at all existing practice examples and sent them to the contact persons who had submitted them, asking them to revise the practice examples if necessary and allowing us to post the practice examples in the new toolbox. It took several months for us to receive the feedback. In the end, we received feedback on 38 practical examples (out of 44).

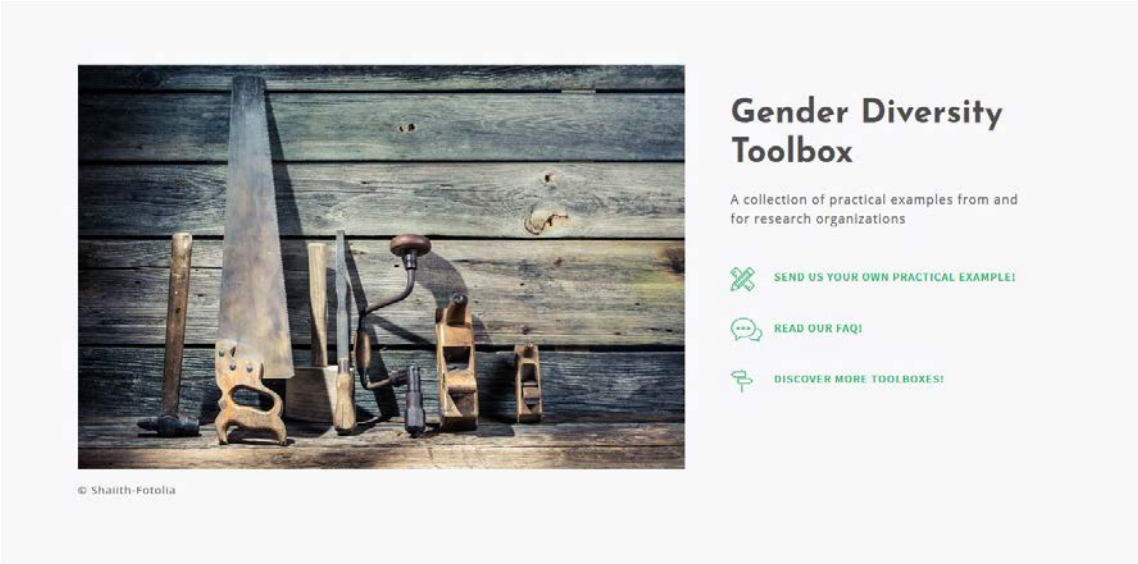


Figure 7: Screenshot Gender Diversity Toolbox

At the same time, the website was being set up. The website went online in December 2017 and has been continuously updated and expanded ever since. In spring 2018, we launched a major marketing campaign by e-mail in which we informed personal contacts and equal opportunities contact persons at research organisations about the website and the possibility of submitting practical examples for the toolbox. A second marketing campaign followed in autumn 2018, in which we drew the attention of participants at the STEMM Equality Congress (Amsterdam, 11-12 October 2018), where we exhibited a poster on our pilot activities, to our toolbox. We received nine new practical examples from external research organisations. Unlike originally planned, we not only used the website to present the toolbox, but also expanded it and added the anonymised role models, checklists and case studies on gender in research content. We also used the website to find further role models and practical examples.

Results

- Homepage www.gender-diversity-toolbox.de with the main parts: Gender Diversity Toolbox, Gender-sensitive research content, role models
- Submission form for new practical examples
- Fill-out manual for practical examples
- Bookmarks for marketing purposes

2. **Role models at Fraunhofer**

The aim of this pilot activity was to find and present role models. In order to be suitable as a role model, the people should work for the Fraunhofer-Gesellschaft and have found

an individual way to reconcile work and private life. In addition, the person should cover at least one of the following categories: Part-time work, job sharing, breaking the classroom culture, early return to parental leave, equal sharing of childcare between mother and father, or caring for relatives.

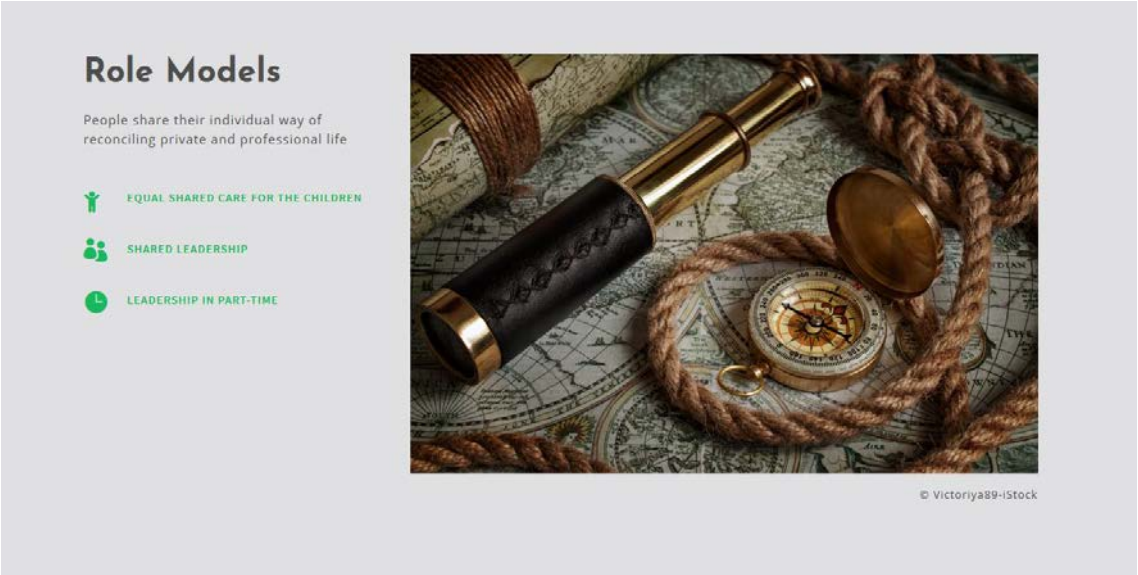


Figure 8: Screenshot Role Models at www.gender-diversity-toolbox.de

Due to the decentralized structure of the Fraunhofer-Gesellschaft there is no database of all employees of the Fraunhofer-Gesellschaft in which we could have searched for suitable persons. In addition, such a search would not be possible for privacy reasons. Because of that, the search for suitable persons had to be done through personal contacts and through word of mouth propaganda. It was therefore assumed that the search for suitable people holds the greatest potential for the failure of the activity.

For the search, two ways were chosen. On the one hand through the Diversity Officer of the Fraunhofer Headquarters. We hoped to get in contact with persons who were previously available for interviews, image campaigns and the like. Unfortunately, no suitable people could be found via this way.

The second way was via the Equal Opportunities Officer[3] of the Fraunhofer-Gesellschaft. These Equal Opportunities Officers and their Deputies exist at each institute. The Equal

3 The Fraunhofer-Gesellschaft has an elected Central Equal Opportunity Officer. Her task is to contribute to the preservation and production of equal opportunity for all employees. At the level of the institute, the Central Equal Opportunities Officer is represented by one Equal Opportunities Officer and one Deputy Commissioner. At most institutes, the Equal Opportunity Officer is elected by the staff. At some institutes, the Equal Opportunity Officer is appointed. The term of office is 4 years. The Equal Opportunity Officer is exempted from her main duties for the Office 8 hours a week.

Opportunity Officers are usually very well networked in their institute and have many personal contacts. Therefore, we asked them to establish contact with suitable people. The result far exceeded our expectations. The second way we were given enough contacts, so that we could choose in the end, which people we want to interview. Due to the interesting and diverse contacts 14 people (4 men and 10 women) were interviewed instead of the planned 3 to 5 people.

For the conduct of the interviews, we developed an interview guide, which was adapted according to the personal situation of the interview partner. We tested the questionnaire in a pre-test and slightly adjusted it based on the results of the pre-test.

The interviews took place at the workplace of the interviewed persons. The talks lasted about two hours each. We were positively impressed by the openness with which the people also talked about very personal issues and about problems. The willingness to let colleagues participate in their own lives with their ups and downs, was very impressing.

Based on the interviews, a portrait was made. This portrait was subsequently voted on with the interviewed persons. Only after release by the persons the portrait was taken over into the booklet. Through photos of the interviewed persons, the brochure is particularly lively and appealing. The result is an authentic and varied brochure.

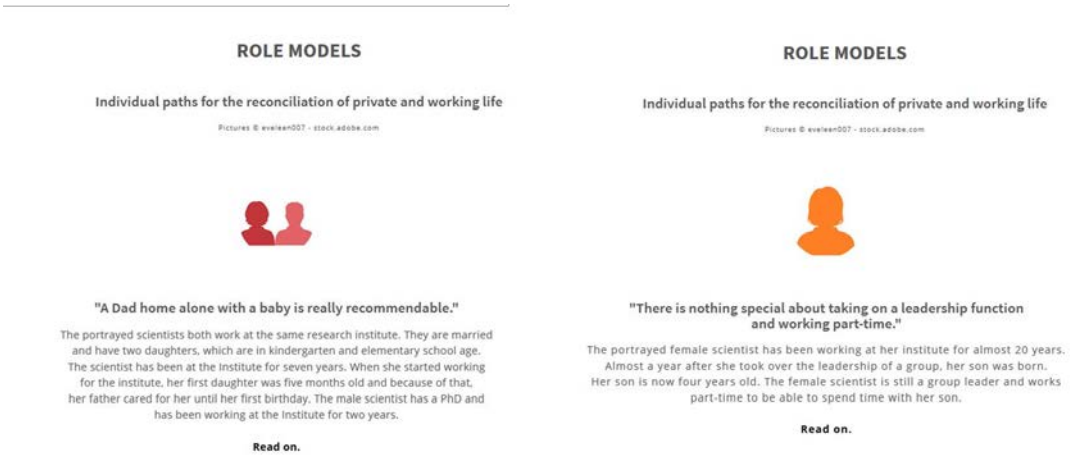


Figure 9: 2 Examples of role model portraits

In order to achieve a broad impact in the Fraunhofer-Gesellschaft, the brochure should be distributed to every employee. Unfortunately, the e-mail distribution list with all employees is reserved for particularly important communications from the Executive Board. Therefore, we had to find other ways to reach as many employees as possible. Due to the great success in the search for suitable interview candidates, we again chose the way through the Equal Opportunity Officers. They sent the brochure to all employees

via the e-mail distributor of their own institute. Besides the brochure was advertised on the start page of the Fraunhofer-wide intranet. In addition, the brochure and the link to the download was published in the Fraunhofer employee magazine.

The great response suggests that many employees of the Fraunhofer-Gesellschaft know the brochure and rate it as extremely positive.

Originally we had planned to publish the brochure in a digital version only. After the digital brochure was very well received and people often requested a printed version we decided to add a printed version. The printed brochure was distributed at the annual meeting of the Equal Opportunities Officers. They can now be obtained from the Equal Opportunity Officer at every institute.

In order to share an even wider circle of successful portraits, the portraits are displayed anonymously on the website www.gender-diversity-toolbox.de. The portraits on the website should be supplemented by external role models. For this purpose, a form and an interview guide for external role models were developed and posted on the website.

The search for external role models as well as the call with the request to volunteer as a role model has so far remained unsuccessful. Either the stories of the people are already prepared very well elsewhere and publicly available or the people are not ready to publish their story (even anonymously) on the Internet.

Results:

- Digital booklet: “Equal Opportunities in researchers' everyday work - Individual paths for the reconciliation of private and working life” in German and English
- Printed Booklet in German
- Anonymous portraits on www.gender-diversity-toolbox.de

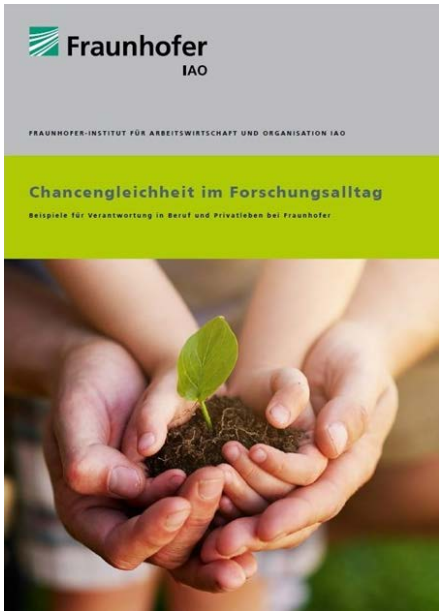


Figure 10: Printed Booklet in German

3. **Gender in research content consciousness**

Our objectives in this pilot activity were the following:

- Research of already existing and (possibly) tested checklists
- Preparation and provision of checklists on the website www.gender-diversity-toolbox.de
- Research of case studies
- Preparation and provision of the case studies on the website www.gender-diversity-toolbox.de

The compilation of case studies and checklists should serve to generate more attention for the (possible) relevance of gender aspects in research content. We started an extensive Internet and literature search and identified various projects (including EU-funded projects), initiatives, networks and research societies that had already dealt with gender-conscious research content and had drawn up checklists or case studies.

We want to name particularly important sources (projects) here:

- The “Gendered Innovations” project which was initiated in July 2009 at Stanford University. In January 2011, the European Commission set up an expert group for two years on “innovation through gender” to develop the gender dimension in EU-European research and innovation. The aim of the Gender Innovations project was to provide scientists and technicians with appropriate methods for the analysis of sex and gender.
- The project “Gender in EU-funded Research: Toolkit and Training” which was completed in 2012, developed a toolkit and training program. Both provide the research community with practical guidelines to integrate gender aspects into research.
- The aim of the project “Gender Aspects in Research” (funded by the Federal Ministry of Education and Research in Germany) was to develop knowledge bases and methodologies for the consideration of gender aspects in the research and development process in the field of application-oriented research. Among others, a guide to identifying gender aspects in research was developed.

We categorised the research results, produced summaries and explanations and posted them on the website.

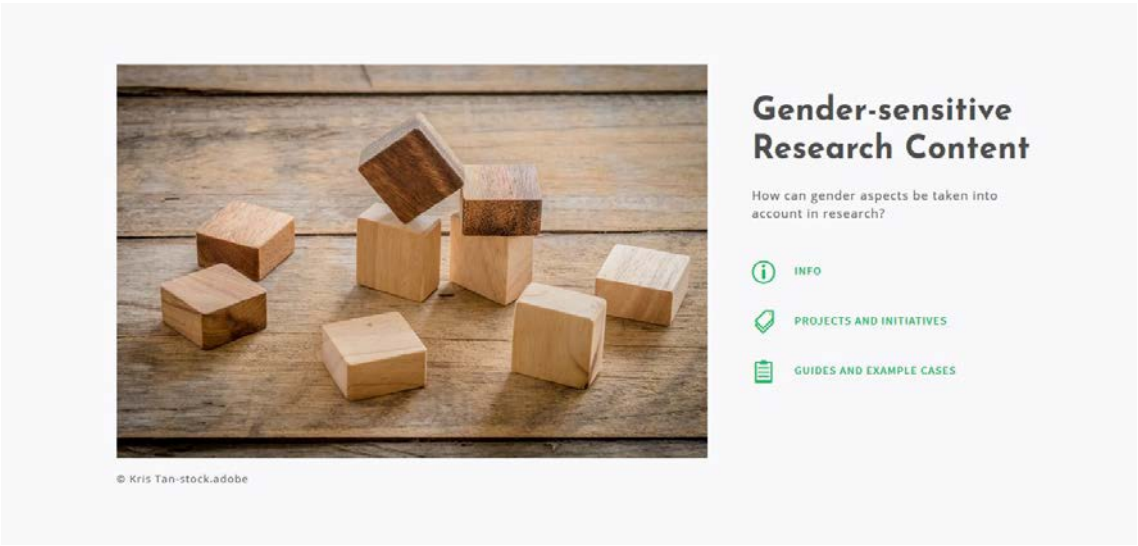


Figure 11: Screenshot Gender-sensitive Research Content

In February 2018, a JERRI workshop was held in Stuttgart for the Dimension Gender under the title "Ways to sustainably establish gender-sensitive research and innovation at Fraunhofer". Among other things, the participants discussed what could be enablers for gender-sensitive research at Fraunhofer. This gave rise to the idea of developing a short, manageable guideline for Fraunhofer on gender aspects in research content.



Figure 12: Guideline on Gender in Research Content (PDF document)

In a one-hour IAO-internal workshop in July 2018 with 5 interested colleagues, it was discussed how such a guideline should be structured and what benefits it would have. It turned out that the participants were of the opinion that another guideline was not a solution, but that the topic first had to reach people's minds. Nevertheless, in the course of 2018 we developed such an internal Fraunhofer guideline. It is available in German and English.

Results

- Internal Fraunhofer Guideline: “Gender in Research Content”
- Collection of case studies and checklists on www.gender-diversity-toolbox.de

3.2.3. Lessons learned

An overarching challenge, which occupied us during the entire project duration, lies in the project structure. The Fraunhofer IAO as project partner wanted to bring about changes for the entire Fraunhofer-Gesellschaft in accordance with the project objectives. Due to the large number of institutes and the decentralized structure, however, it is only possible to a very limited extent to bring about Fraunhofer-wide changes from a single institute, even on a voluntary basis. It would have been easier if the Fraunhofer headquarters had also been a project partner in the gender dimension. However, this was not possible due to the working structures of the headquarters. As project team members, we were dependent on cooperation with suitable people from the headquarters. This worked differently well.

In the following section, we describe the lessons learned in each pilot activity.

- **Gender Diversity Toolbox**

Based on the experiences from the EU project STAGES we knew what we wanted to do differently and better. This included above all that the Gender Diversity Toolbox should be accessible without password protection in order to ensure easy use. As a result, the practical examples had to be anonymised. In addition, all practical examples should not only be available in German, but also in English, so that the content can be used internationally. For this reason, we were dependent on the permission of all contact persons (these were, above all, Fraunhofer Equal Opportunities Officers), from whom we already had practical examples, to continue to use the practical examples with the changes mentioned. It was quite time-consuming and we had to remind the contact persons several times to answer us. But thanks to the good cooperation of the Equal Opportunities Officers, we received a lot of consent.

We learned, however, that keeping the toolbox entries up to date was a great deal of effort. And it is also difficult to find suitable people and motivate them to provide new practical examples for the toolbox. Marketing campaigns with non-personalized e-mails hardly received a response. We were more successful when we were able to establish personal contacts at the STEMM Equality Congress in Amsterdam and invite these people to provide a practical example by e-mail.

Due to the free access to the toolbox without password protection, we lacked the overview of who is actually using the toolbox and how often. If we had used a web analysis tool, we could at least have a rough overview of its use.

Originally, the homepage www.gender-diversity-toolbox.de was only intended for the actual toolbox. However, we also wanted to make our other results from the JERRI project accessible. Since these could not be converted into the format of a practical example, we added further categories to the homepage, namely "Gender-sensitive research content" and "roles models".

- **Role models at Fraunhofer**

After the publication of the booklet "Equal Opportunities in researchers' everyday work" we received numerous reactions from colleagues. The portraits have been read with great interest and have since contributed to the fact that colleagues are willing to go their own way in reconciling work and private life.

The great success of this pilot activity would not have been possible without two groups of people: on the one hand the Equal Opportunity Officers and on the other the role models.

Without the dedication and commitment of Equal Opportunity Officers, we would have failed to find role models. Since there is no infrastructure at the Fraunhofer-Gesellschaft to find suitable people, we were only able to identify them with the help of personal contacts and the networks of equal opportunities officers.

Only through the willingness of role models to tell their very personal and private stories for colleagues, authentic and interesting portraits have emerged. We were very impressed by the openness with which the role models also talked about very private issues, such as breastfeeding in the workplace.

Crucial to the success of this pilot activity was the engagement of individuals who care about the topic. In addition, it was particularly helpful to be able to fall back on a group that makes an effort on the topic by office.

- **Gender in research content consciousness**

The research on already existing case studies, checklists and guidelines on the topic of Gender in Research Content showed that there were already several projects on this topic in the past. Obviously, the results and findings were not continued, so that most of the material found was already about 10 years old. The question arose why this is so. We prepared the material we had identified and linked it on the homepage www.gender-diversity-toolbox.de, so that one now finds there a lot of easily accessible and well structured information. However, our own experiences, e.g. through discussions in the various workshops, show that the existence of checklists and guidelines alone does not bring about any change. Our impression is that they are not applied because they either do not fit the concrete projects you want to check, or because the potential users are not aware of the relevance or they cannot implement the instructions.

When we drafted our own guideline for Fraunhofer, we were faced with the challenge that the guideline should on the one hand provide very concrete assistance, but on the other hand also fit in with a large number of projects and research topics. We also received feedback that a guideline alone was not helpful. Rather, researchers need to be sensitized to the fact that gender aspects can be relevant to all research topics, i.e. can lead to new findings and improve research. We believe that the topic of gender in research content requires much more research work. In JERRI, it was just one of many topics. Therefore, we could not really do justice to it.

3.3 Societal Engagement

3.3.1. Starting point: JERRI long-term goals and Pilot activities

The overarching goal when designing pilot activities for societal engagement (SE) at UMSICHT was to enhance public engagement in the Fraunhofer society beyond traditional practises that typically entail: (a) educational objectives (usually involving science communication), and (b) public relations objectives (pre-empting potential risks and value failures of innovation outcomes). The principal aim was therefore to develop a functioning platform for the collective framing and deliberation of research and development (R&D) challenges with a spectrum of societal actors and therewith incorporating their social, environmental and ethical values and beliefs into the practise of science. In other words to institutionalise SE measures to achieve an inclusive, reflexive and participatory innovation.

It was realised earlier on that, for a successful implementation and long-term sustainability of any SE format or platform, besides healthy participation, it is particularly important that scientists and engineers perceive as well as derive value from any deliberative engagement with the wider society, and do not find it as an additional burden to their already challenging fields of work. Insofar, it is vital to integrate both scientific and non-scientific actors at various hierarchical levels early on during the conceptual, and design stages of the planned societal engagement formats. Hence, several formal and informal workshops were conducted at UMSICHT involving both internal actors and external experts as a means to understand societal needs from an external counsel, as well as collectively reflect and design a SE format that is indeed truly inclusive and enables unfettered participation.

The **first workshop** aimed at analysing the status-quo by comprehending the current institutional logics or dominant narratives for SE within scientific projects at UMSICHT. In addition, it also entailed mapping of presently employed tools, formats and medium at UMSICHT to reach out to the wider society. The workshop involved both scientific and non-scientific staff. Figure shows a synthesis of current SE activities at UMSICHT that can be classified into four following types:

1. Dissemination
2. Communication
3. Consultation & exchange
4. Collaboration

It became apparent that UMSICHT already has a long history of engaging citizens in a range of scientific topics and science discourse in general, using various engagement formats albeit at grassroots (driven by interest of tiny number of actors) level.

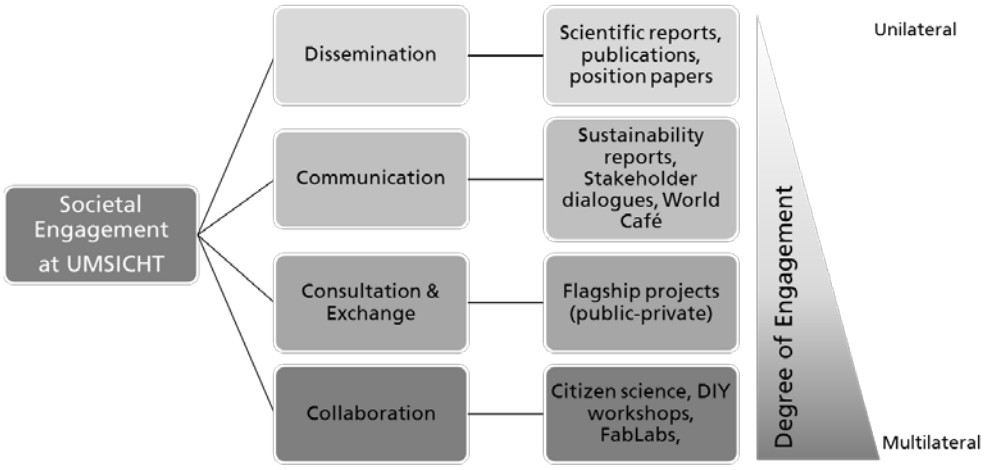


Figure 13: Synthesis of current engagement formats

However, it was also evident that, the institute has far less experience in systematically engaging with citizens and civil society organization in everyday R&D projects and embedding them to enable participatory innovation. In specific, one key issue was the varying connotations and interpretations as to what SE in science is. The understandings among scientists ranged from science communication, citizen involvement in data sensing, stakeholder dialogues and policy consulting. Likewise the raison d'être for SE ranged from personal beliefs, legitimacy gaining and risk management to attracting public funding and attaining market goals through technology acceptance. In some cases, it was viewed as an additional administrative burden or even as hindrance to scientific freedom and neutrality.

This workshop also aided in the identification of key stakeholders based on the resulting classification – dominant stakeholders, affected stakeholders and dormant stakeholders. The diversity of the stakeholder groups invited for some of the future workshops based on the above identified classification is shown in Table 1. The stakeholder identification was conducted based the following guiding questions:

1. Which stakeholder groups have an influence on Societal Engagement practices at Fraunhofer (“Dominant stakeholders”)?
2. Which stakeholder groups are or will be affected (positively or negatively) by Societal Engagement practices at Fraunhofer (“Affected stakeholders”)?
3. Which additional stakeholder groups may gain influence or legitimate claims on key dimension practices in the future (“Dormant stakeholders”)?

Table 1: Invited stakeholder affiliation for goal setting and deliberation workshops

Internal stakeholders	External stakeholders
▪ Scientific staff ▪ Business developer ▪ Public relations ▪ Knowledge organisation and information manager	▪ Policy maker ▪ Public funding agency ▪ Local chamber of commerce ▪ Environmental protection group ▪ National news media ▪ Local theatre ▪ A multinational company ▪ A foundation trust

The **second workshop** was more operational and content driven, in the sense the logistics of designing and conducting various types of low-threshold high-impact SE formats were conceived and analysed in detail.

Figure 14 shows the range of ideas that emerged from this workshop. Some of the key ideas for SE pilots that emerged from this workshop were realised during the course of the project.

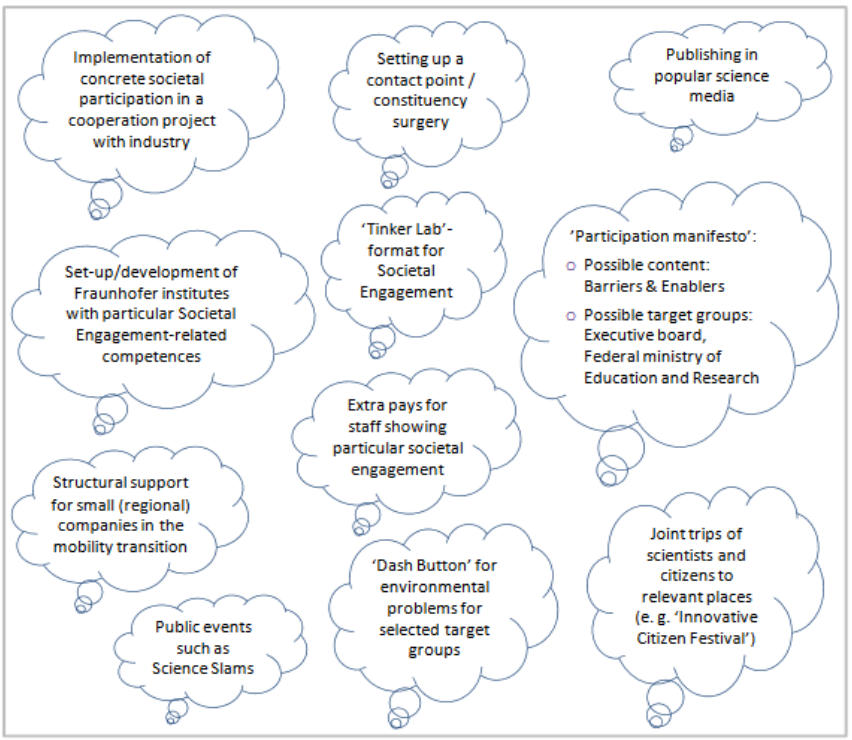


Figure 14: Brainstorming of ideas for SE pilots with internal and external stakeholders

For the SE dimension, the following four **pilot activities** were initially conceived following the workshop (Warnke et al. 2018, p. 42):

- **Citizen's office**: a series of citizens' meeting in which societal needs can be put forth to science
- **Fraunhofer Debates**: a public debate with actors from academia and civil society on a topic of high public attention
- **Stakeholder Avatar**: an algorithm that will systematically browse the World Wide Web for relevant social interests
- **UMSICHT Dash Button:** a software-based solution to enable sustained citizen engagement in environmentally relevant scientific topics on a continuous basis

However, after intense deliberations only the »Citizen's office« and »Fraunhofer debates« were chosen as viable pilot formats. The »Stakeholder avatar« and the »UMSICHT dash button« were excluded for the following reason. Bearing in mind that the goal of the pilots is not just the integration of RRI-measures within UMSICHT, but to scale-up or roll out to all remaining 71 Fraunhofer institutes, it was indeed important to design a format that is less resource-intensive and easily adoptable by the other Fraunhofer institutes. In light of the introduction of general data protection regulation (GDPR) in the EU in May 2018, it was decided that these two formats could be both commercially and technically unfavorable, as they require dedicated IT resources and privacy protocols in place in order to handle public data, which could now be classified as sensitive private data under GDPR.

When conceptualising the two chosen pilots, it was important that the activities remain as a decentralised bottom-up undertakings managed by motivated actors rather than a top-down SE strategy. In doing so, several short-term decisions despite being ambitious enough, can be execute in a semi-formalised fashion. Furthermore, unlike traditional approach of pre-selecting certain group that show affinity to scientific research and development the goal development processes had to extend beyond persistent organisational boundaries by involving a diverse group of external stakeholders. Equally important was the necessity to capture diverse individual understandings of SE amongst scientists within the organisation during the goals development and design phases.

Finally, it was also recognised that for a meaningful organisational change to occur, the developed goals must have an ambitions vision with a long-term trajectory. Although the range of the activities carried out within JERRI will be time bound, the pilots must nonetheless address the wider objectives to support the envisaged organisational change. Likewise, in order to attain a high level of SE across other Fraunhofer institutes, the developed formats should have a certain level of operational flexibility and degree of freedom, wherein respective Fraunhofer institutes can adapt the pilot formats according to their longstanding experience and regional stakeholder topology.

One of the common criticism of SE in science is that the scientists are often unclear about their goals and the expected outcomes. This indeed plays a huge role in selecting or developing the appropriate process to facilitate an effective outcome oriented engagement (Powell and Colin 2009). As such, the following methodology was used when conducting the pilots (see Figure 15). Starting with the clear definition of SE goals under a broader SE vision along with a self-declared participation manifesto as a gesture of renewed commitment. The manifesto was based five values – sustainability, transparency, radical inclusion, deliberation and capacity building.

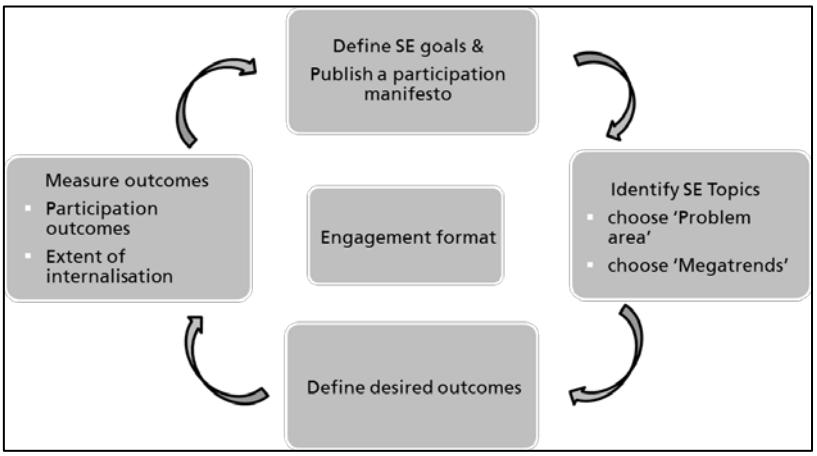


Figure 15: Methodology – SE in JERRI

As an outcome of this workshop, a set of long-term goals outlined in the form of a vision was developed by the participating actors (see Table 2), which contributed to a participation manifesto (see Figure 16). Mid-way through the pilot phase a **third workshop** was conducted with Fraunhofer project (JERRI) partners to evaluate the state of pilots implementation, to identify existing barriers for SE based on the pilot phase, and to develop a 2030 transition roadmap for Fraunhofer wide implementation of the SE pilot. Some of the key findings are presented in detail in section 3.5.

Table 2: Vision of long-term goals for Societal Engagement

- A culture of participation is deeply institutionalised in Fraunhofer:
  - by agenda setting, wherein 30% of research is defined through and with societal participation
  - by participation in ongoing research projects
  - by enabling public debates on science and technology
- Fraunhofer is a permanent contact point for citizens, also in 'physical ' terms
- Fraunhofer provides resources and space for participation
- Fraunhofer pursues a "participatory innovation" to co-identify and concretise Sustainable Development Goals with citizenry



Our idea of a social contract with the citizens of Oberhausen

We believe everyone should be able to participate and engage in science regardless their background. For, everyone has a story to tell, question to ask, concern to share and an idea to spread. It is our deep reflection that only from leveraging the wisdom of the crowd, viable bottom-up and sustainable solutions to local problems can be developed.

Through this initiative, we would like to reignite our commitment to foster societal engagement. Wherein, scientific developments are made for society and with society.

Sustainability: Solving societal and environmental challenges, and creating inter-generational equity not just through top-down institutional mechanisms, but with explicit bottom-up citizen participation.

Transparency: Increase transparency and openness through stronger institutional decentralisation and increased civil society collaboration at various levels of the research and innovation process, from ideation, design and development to evaluation. Sharpening of civic awareness on science as well as candidly addressing the sensitive areas in scientific research.

Radical inclusion: Provide equal and inclusive opportunities for participation of social groups from all walks of life. To strengthen direct democracy and representative forms of participation of civil society actors in relation to scientific research and innovation processes.

Deliberation: Promote equitable, bilateral, and inclusive exchange of communication and information exchange between science and civil society. With simultaneous addressing of fears, uncertainties and other factors that impede bilateral, social interaction.

Capacity building: Increase access to local knowledge stocks, and increase the transfer and production of interdisciplinary knowledge to strengthen cooperation and enable co-creation between research institutions and civil society actors.

Figure 16: Participation Manifesto

3.3.2. Description of the pilot activity implementations

In science today, engaging citizenry is still predominantly done as-and-through isolated events. Citizens are invited to participate in important stakeholder dialogues or interviews in which they often contribute their interests, ideas and wishes to scientific discourse and relevant projects. However, the outcomes of these formats usually take form of highly condensed and abstracted reports, in which the participants hardly find their views reflected. At the same time, it is often unclear to both participating citizens as well as scientists on how and to what extent the results of the dialogues and interviews have tangible influence on science, its day-to-day functioning and its impact on research outcomes.

Fraunhofer therefore developed and piloted a set of SE formats that can ensure an active and dynamic exchange between citizens and scientists. Broader aim of these formats is to provide a template for other research organisations within Fraunhofer society, to adapt low-threshold high impact engagement formats to deeply institutionalise the RRI practices. In doing so, research organisations can act as open platforms for localised yet diverse discourses. With this, two main objectives will be attained: (1) facilitate and deepen citizen participation in science (2) allow continued citizen engagement in science as part of ongoing normality.

As discussed earlier, Citizen's Office and Fraunhofer Debates were developed and tested as apt instruments for SE. Both these formats were designed to enable a *permanent and low-threshold format for exchanges between citizens, civil society actors and scientists.*

- **Citizen's office**: is a series of citizens' meeting in which societal needs can be put forth to science

The citizen's office was conceptualised and designed as a hybrid model with a long-term intent to have a functioning office wherein citizen's can collectively work amongst themselves and with scientists to realise their contributions to everyday R&D activities and practices. It is a hybrid model in the sense there are two aspects to engagement within this model, wherein one part of the format aims at bringing the 'public sphere' into the institute, while the other part aims at taking the institute to the 'public sphere' (e.g. market place). Therefore, in the first part, certain premises of the institute becomes a public space on a pre-determined day of the month, through which citizen's gain access as well as have the opportunity to voice their ideas, opinions and concerns on the R&D topics at UMSICHT (see Figure 17). In the second part, once every alternative month, scientific staff take the institute to the local market place (see Figure 18).



Figure 17: Citizen's office at Fraunhofer UMSICHT



Figure 18: Citizen's office at market square

The logic for designing a hybrid model was to address or overcome the aura of elitist, otherly, or unwelcoming impressions institutions may project. Institutions by their very organisation, structuration and hierarchies entail an embedded layer of brutalism, which might alienate laypersons (ICE 2018). Hence, going into the field and participating in citizen-organised events and congregations can yield a greater level of collaboration through trust building, in comparison to expecting citizens to spend time and resources in a topic that is more benefiting to a practitioner's field of research than to a citizen.

The format of Citizen's office is outlined in Table 3. The objectives are to engage citizens and empower them to shape innovations as well as use the exchange to monitor and critically self-reflect on the R&D activities of the institute against societal needs.

Table 3: Format of Citizen's Office

Objective	- Engagement and empowerment of citizens - Improve reflexivity in research
Level of stakeholder involvement	Dialogue, Involvement, Empowerment
Geographical scope of application	Local – city of Oberhausen
Participant types	Citizens, CSOs, experts, Policy-makers
Measuring outcomes	Surveys, questionnaire, documentary evidence

The design of the citizen's cafe can be categorised into three project show rooms:

- Showroom I – Project show case and inspirations
- Showroom II – Identification of challenges
- Showroom III – Collective projection of ideas

In the first show room, a range of current and past projects carried out by the institute were presented to the citizens. The projects were pre-sorted on a scale of 1 to 9 according to the participation ladder (Arnstein 1969), which was done in consultation with selected principle investigators who had the time and interest to engage with the public during the course of JERRI. Citizens had the opportunity to inform themselves on the application-orientation science at Fraunhofer, get to know the scientists as well as draw inspirations to relate to some potential challenges they see in the society that is being addressed by science. Throughout the session, it was consciously opted not to use any PowerPoint slides, scientific posters or materials that would otherwise be used solely for educational or dissemination purposes. Though there was an element of informing and disseminating scientific knowledge, it was however revealed as in a deliberative exchange. The physical space in itself was rearranged to remove any furnishings that might signal a workplace environment (see Figure 19).



Figure 19: Project showroom I – project showcase and inspirations

In the second and third showrooms, the citizens were in the moderator's role. In the second showroom they had the opportunity to articulate and localise the challenges they face in their neighbourhood, while in the third with the aid of the scientists they were able to collectively project their ideas and vision (see Figure 20 and Figure 21).



Figure 20: Project showroom II - Identification of challenges

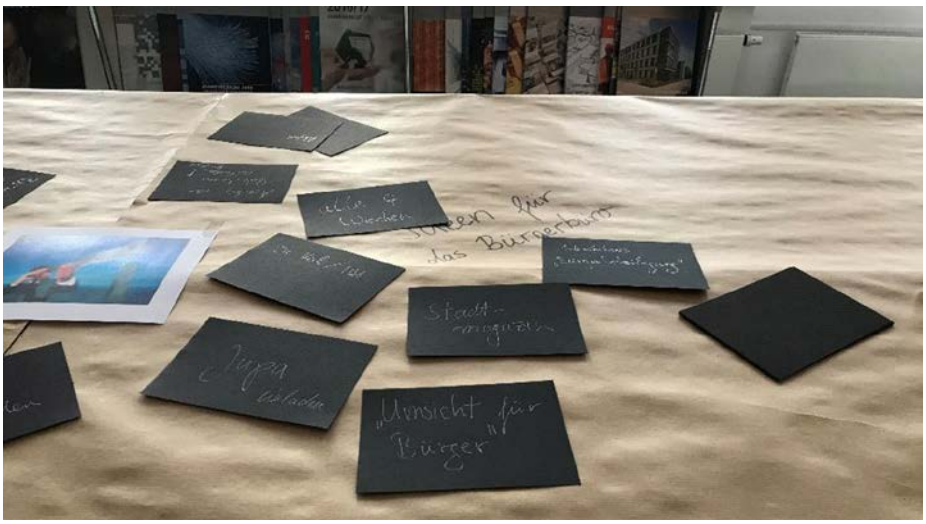


Figure 21: Project showroom III – Collective projection of ideas

The total duration of a session ranged between 2 and 3 hours with a short break. At times the challenges pointed out and concerns raised by the citizens were complex to be immediately addressed by the then present scientists. In such cases, the citizens were placed in contact with other experts within the institute who could alleviate the concern or discuss the issue in detail. Following the session, the citizens were allowed to freely evaluate the day's gathering on four aspects: transparency, responsibility, communication and participation (see Figure 21).



Figure 21: Evaluation of the session by citizens

The format of the Citizen's café was analogous to that that took place in the institutes

premises, the design however was different to reflect the outdoor environment. Finally, as mentioned earlier the main objectives were not only to deepen participation, but to allow continued citizen engagement in science as part of ongoing normality. To achieve that, the citizens were allowed to choose a project of their interest from the ones presented in showroom I. They then were placed in contact with the principle investigators of respective project, through which they can now establish a permanent bridge to the institute by contributing to the project of their choice. Some of the projects were SAIN (urban farming project), SDL (user design with senior citizens), FUV (Increasing acceptance for biotechnology innovations in society).

It is indeed the aim that these formats developed as part of the JERRI project, remain as an active platform beyond the project's timeline. With this in mind, a project website (www.umsicht4all.eu) was developed (see Figure 22) to invite new participants as well as to highlight the ongoing SE activities under JERRI. Upon the completion of the JERRI project in May 2019, the format will act as a gateway to the institute. Wherein, the initial mutual exchanges will occur through the three project showrooms, following which the citizens can self-select a suitable project according to their interest in which societal participation and contributions will be realised.

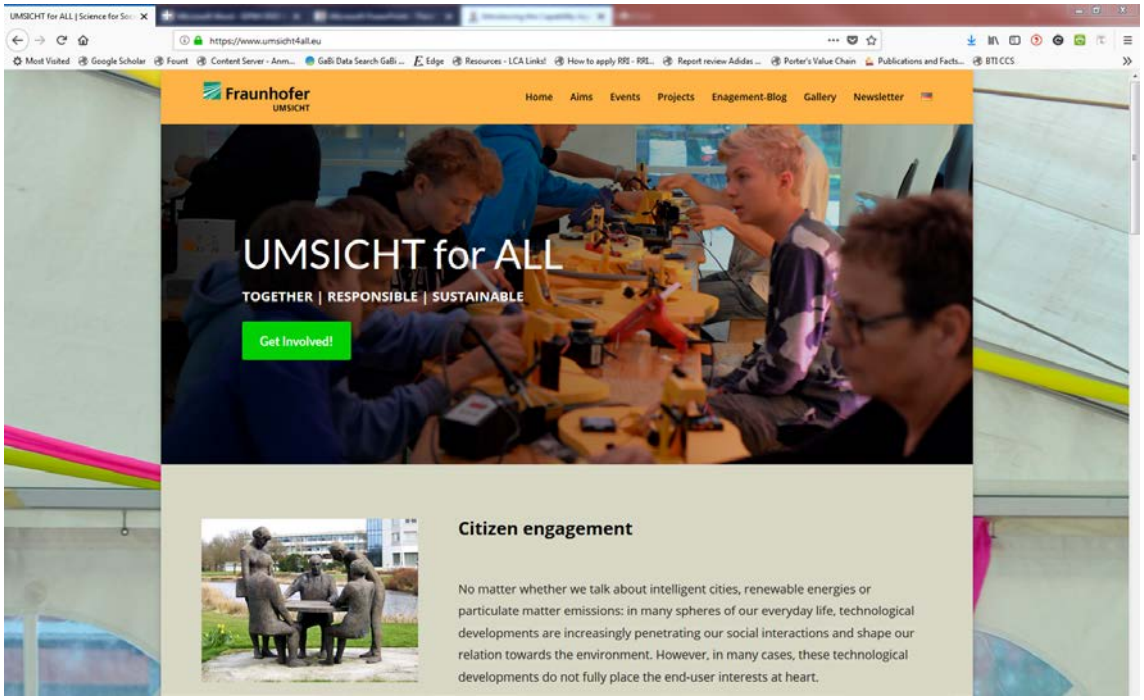


Figure 22: Project website

Fraunhofer Debate: The aim of this format is to facilitate a balanced public debate with actors from academia and civil society on a topic of current affairs.

Fraunhofer UMSICHT in the past has organised several such debates. In this context, topics with then-current social relevance were identified within the institute and were intensively discussed with external experts. Such deliberations in the past have often paved way to find relevance within the institute's own scientific work. So far, the 2008 financial crisis, food vs fuel debate, innovative nutritional concepts, the idea of a post-growth economy, the increasing secularisation of society were the topics of discussion in the past.

As part of JERRI, it is now intended to identify ideas and concerns with the citizens during the proceedings of the citizen's café pilot and funnel them into Fraunhofer debate. One such recurring theme was the topic concerning the impact of particulate matter in public spaces and residential neighbourhoods. The heightened concerns pertaining to this topic could be attributed to the ongoing discussions in the German press and media following the Volkswagen emissions scandal in 2015. Two such debates are envisioned for the following dates: 9th of April 2019 and the 16th of July 2019.

The format of Fraunhofer debates is outlined in Table 4 the objectives of which are to engage citizens to collectively deliberate on wider socio-technical problems.

Table 4: Format of Fraunhofer debates

Objective	Deliberation of socio-technical problems
Level of stakeholder involvement	Dialogue, Involvement, Empowerment
Geographical scope of application	Local, Regional or National
Participant types	Citizens, CSOs, experts, Policy-makers
Measuring outcomes	Live polls

3.3.3. Lessons learned

A reflection from the implementation of the pilot activities is provided in this section. In principle the Citizen's office format can be considered as a success, as it was the first

such attempt to enable unfettered access and unfiltered participation in comparison to previous SE or public outreach activities, wherein the stakeholder groups were often pre-selected. Interestingly, the quality of participation from the citizens was at a level higher than anticipated. It was observed that, majority of the participants were not just there for an informational session but indeed to actively seek out concrete areas for participation. Most of the citizens (being experts on the ground), were able to effectively identify ground challenges and relate it to ongoing projects. Furthermore, long after the first contact, some of the citizens were involved in other self-selected projects where concrete contributions could be made. Hence, in retrospect, pre-selecting some scientific projects with a potential for SE and sorting them according to various degrees of engagement potential was a good exercise. On the other hand, if there were only past examples to showcase and no ongoing projects for the citizens to contribute to, it would have left many of them disenchanted.

From an organisational perspective, the arranging and rearranging of the physical space, along with having numerous internal meetings to identify prospective projects in which respective principle investigators could have potential time and room for SE was challenging and time consuming. Each sessions easily required at least 4 to 6 hours in total for organising and executing. Therefore, from an organisational point-of-view Fridays were the most suitable days. However for the citizen's Fridays are generally inconvenient due to private plans that usually fall on the weekends.

The only deviation from the actual plan was the commencement of Fraunhofer Debates. Unlike citizen office, which was conducted once every month, the format for Fraunhofer Debate required prior preparation, availability of a physical space to accommodate 100 or more participants and along with the necessary resources. Furthermore, it was difficult to fix an amicable appointment with the expert panellists. Equally worth mentioning was the lack of interest from external experts to engage on contentious topics. For e.g. one overarching concern that emerged following multiple citizen office sessions was regarding particulate matter emissions. Although it might not have been difficult, to find an expert who could deliver scientific and statistical facts, it was indeed hard to find someone who could engage on socio-political issues surrounding this topic. As a result, Fraunhofer debate is yet to commence.

One of the potential challenges besides laborious work and required resources was to manage expectations or in other terms reputational risks. When aiming for an unfettered participation or the "democratisation of science" as it is commonly known, is chaotic like any democratic process. One cannot selectively choose certain concerns or focus on specific challenges due to resource constraints, when stakeholders persistently voice something else. This not only leads to misinterpreting societal needs, but could in turn

lead to loss in reputation and trust. Hence, in order to manage the public(s), some form of training for certain skills and temperament is required.

Finally, from an institutional perspective, there is a clear need for a change in institutional values and a culture of openness for SE. Despite strong grassroots activities, it could safely be concluded that only a handful of scientists (change agents) see value from exchanges with the wider public (non-specialists). For the majority of the research community social and environmental goals are often seen as a trade-off or distraction when matched against established KPIs (performance indicators) such as peer-reviewed publications, patents or values such as scientific rigour, objectivity, independent research etc.

Therefore, to democratise science at an organisation's level, SE must be embedded at multiple levels: at project level (e.g. stakeholder dialogues, user-design or citizen science projects); at organisational level (agenda setting, citizen's office); as a strategy (to manage risks; increase responsiveness; to reflect and align research interest). For this occur, a shift in a mind-set as well as concrete vision from Fraunhofer headquarters is necessary.

3.4 Open Access

3.4.1. Starting point: JERRI long-term goals and pilot activities

The following short-term activities (pilot activities) had been selected in the Open Access dimension (Warnke et al. 2018, p. 32ff.):

- Setting up and testing the Open Data infrastructure FORDATIS
- Development of an Open Access business models
- Development and test of "open paragraphs" in research contracts
- Communication strategy for Open Access at Fraunhofer for the purpose of the deeper institutionalisation.

1. Short preliminaries

A Business Model is the organisational, strategical (infra) structure of an organisation or company to generate and deliver *genuine social and economic benefits*. (Osterwalder et al. 2010) A business model can be described in many different ways and with emphasis categories, processes or events. One simple yet powerful description framework is the business model canvas by (Osterwalder et al. 2010).

Open Access is a principle of *Open Science*. Open Science is a movement to make all aspects of the scientific process openly accessible. (Open Science Handbook 2019). Open Access means free of costs, free of barriers, long-term, digital access to scientific processes in general, and to scientific outputs in particular. *Scientific outputs includes scientific publications (articles) or research data (data sets).* In the context of scientific publications, there are two important types of Open Access: Gold Open Access and Green Open Access. Gold Open Access means primarily publishing your results in a recognized peer reviewed Open Access journal. Green Open Access means secondarily publishing your results on an institutional repository (e.g. https://arxiv.org/) or on your own website (self-archiving) simultaneously or after you published your results in a traditional, restricted access journal*. In the context of Open Access to data, best practices are yet to come.*

Open Access incorporates transparency, a *fundamental principle of science itself*. Transparency makes processes traceable, results verifiable and outcomes reproducible. Open Access improves science itself and accelerate innovation cycles because research results can be used and reused easily. (Woelfle et al. 2011; The Open Science Training Handbook 2019) Moreover, Open Access helps to transfer knowledge and technology to the public, to clients and to cooperation partners.

The unique *Fraunhofer model* of the Fraunhofer-Gesellschaft unifies contract research with publicly funded research. Due to this sui generis model, the Fraunhofer-Gesellschaft can embrace unique opportunities at the interface between science, economy and society. On the one hand the Fraunhofer-Gesellschaft gives particular attention to effective contracts and business models. *On the other hand, as a publicly funded institution, the Fraunhofer-Gesellschaft proactively recognises its responsibility to provide easy, free and quick access to research results (including research data) for the good of science, economy and society.*[4,5] The Fraunhofer-Gesellschaft proactively strives for the leading position in the matter of Open Science, Open Access and Open Data. As the first non-university scientific organization in Germany, the Fraunhofer-Gesellschaft has committed to an open access strategy in 2015.[6]

Since 2017, the Fraunhofer-Gesellschaft supports publishing Gold Open Access, by an internal publication fund. To further promote Open Access, the Fraunhofer-Gesellschaft actively in workgroups founded in the “Allianz Initiative Digital Information”[7] in 2018 as well as in the project “National Open Access Contact Point”.[8]

---

4 Fraunhofer Open Access Strategy 2020 https://www.openaccess.fraunhofer.de/en.html

5 Project DEAL: https://www.projekt-deal.de/

6 Fraunhofer Open Access Strategy 2020 https://www.openaccess.fraunhofer.de/en.html

7 Allianz Initiative Digital Information: https://www.allianzinitiative.de/?lang=en

8 The National Contact Point Open Access OA2020-DE: https://oa2020-de.org/en/

According to the data provided by Fraunhofer-Publica there is a notable increase in the total Open Access rates at the Fraunhofer-Gesellschaft in the recorded period (see Fig. 23). Please note that despite the methodological diligence and the high quality standards at the Fraunhofer-Publica, we can only provide estimates. This is due to certain inherent limitations in the accuracy of the recording and reporting processes. The figures given in this report must interpreted carefully.

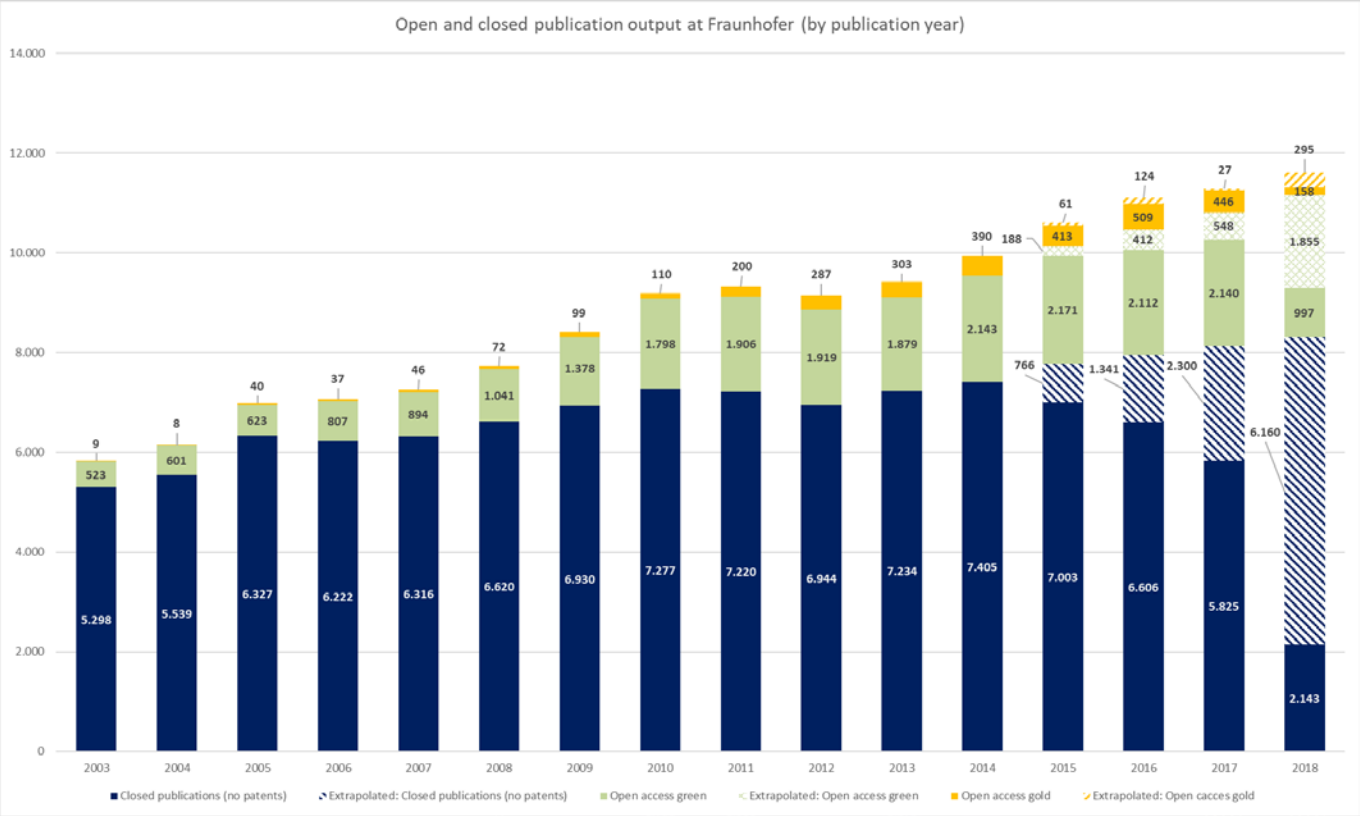


Figure 23: Open Access at the Fraunhofer-Gesellschaft (last update: 2018-11-21)

3.4.2. Description of the pilot activity implementations

In the following sections we will describe the pilot activities of the IRB, including the overall goals that were achieved and lessons learned. More detailed material can be found in Annex III.

1. Communication Strategy

The goal of this pilot activity is to develop a communication strategy for the deeper institutionalisation of Open Access at Fraunhofer. For this purpose, we analysed previous measures and services that Fraunhofer has carried out or offered to promote Open Access. In addition, we analysed previous communication channels. We listed and described all potential stakeholders in particular with regard to their relation to Open Access. Based on this, we develop three core messages:

- Fraunhofer supports Open Access and Open Data in line with Open Science in Horizon Europe. Fraunhofer is currently working on implementation and the identification of potentials of opening up to make research results accessible to economy, science, society and politics.
- The repository *Fordatis* is the central research data repository at Fraunhofer for publishing research data. Fraunhofer provides services, consulting and training for research data management. At the time of the go live of Fordatis a Fraunhofer Open Data policy will be published.
- The Open Access research output (publications, data, and software) at Fraunhofer is available in a one-stop-shop, called the Fraunhofer Open Science Cloud.

To communicate this core messages we developed a communication matrix describing which channels we want to use to deliver our messages to our various stakeholders. We composed a default communication text that includes all three core messages. The complete strategy can be found in ANNEX III.

2. Prototype for a research data management repository

The goal of this pilot activity is to develop a research data repository prototype *Fordatis* for Fraunhofer. First, we had to select a suitable software, a software that is able to connect to Fraunhofer's bibliographic database and Open Access repository Fraunhofer-Publica[9] (henceforth Publica). At the beginning of the JERRI project in 2016, another project at Fraunhofer was in the planning phase. The goal of this project was to evaluate Publica.

At this time, a redesign of Publica was emerging. Therefore, we decided to *not* integrate the Fordatis repository into the existing Publica infrastructure, but to set it up separately in order to bring both systems together optimally in the future. We analysed different software solutions and we decided in favour of *DSpace Version 6.3 JSPUI[10] (DSpace 2019)*. DSpace is an elaborate Open Source software with a large, international developer community and which is already used frequently in the scientific environment. DSpace fulfils a number of desired functionalities, such as multi-level collection workflow,

[9] Website of Fraunhofer publica http://publica.fraunhofer.de/starweb/pub09/index.htm

[10] Documentation of DSpace Version 6.3 JSPUI
https://wiki.duraspace.org/display/DSDOC6x/DSpace+6.x+Documentation

role management and standardized interfaces. In preparation for the implementation, extensive specification work took place.

First, we created requirement specifications, which describes all the necessary functionalities of the Fordatis repository. In addition to this, we created a comprehensive use case definition that describes all use cases the system should be cover. We wanted Fordatis to have *Digital Object Identifier (DOI)*. To accomplish this we contracted with TIB Hannover, because they can source DOIs for us.

The technical implementation of Fordatis could not be done in-house, and was therefore outsourced. In this case, funds from a Fraunhofer internal project could be used. We analysed several different solutions. We decided in favour of the company *The Library Code*. Owner of this company is Pascal-Nicolas Becker, who is one of two German DSpace committers and has extensive expertise in software development especially in context of the creation of research data repositories. The first implementation workshop with The Library Code took place form July 16 to 18, 2018. At this workshop, the scope of Fordatis was determined with interconnectivity to Publica in mind. In Fordatis only records with file attachments are to be registered. Records without a file attachment will be realized in Publica. This decision was made with visibility in mind. Most of the traffic is expected via Google and because of this, we have to ensure that a research data attachment could be provided for every Fordatis hit. Detailed functionality of Fordatis and their feasibility were discussed in the workshop mentioned above.

In August 2017, the installation and configuration of our test system took place on a server in the Fraunhofer Cloud. There were configurations of and training for the tools: Tomkat, Apache and Git. On September 17th and 18th 2017, the second implementation workshop with The Library Code took place. Here, the application profile containing all the describing attributes for the research data was set out.

The implementation phase took place in winter 2018. A first presentation of the prototype took place on the 20th of November. The feedback was very positive. Testing was done in December 2018. Test results are yet to be implemented. Steps for the go-live phase has already begun, such as the creation of privacy notices, terms of use, data privacy statement, approval of the general employee organization. Now we have to embed Fordatis into our organisation. Therefore we create an institutional workflow. In this way, quality assurance can be achieved through our data curators, persons at the institutes who ensure data quality. We strive to go live in summer of 2019. It is planned to publish the research data policy on this occasion.

Fordatis offers its users several features:

- Easy Publication of research data: enables fast and easy publication of research data, even independently of a scientific publication.
- Unambiguous referencing of the data: The data is referenced by a unique identifier: This means that they can always be found clearly, even if the physical

storage location of the data changes. For unique identification Digital Object Identifiers (DOIs) are used.

- Quality-assured submission: Research data to be published undergo a workflow in which the descriptive metadata is reviewed multiple times.
- FAIR compliance: Fordatis enables research data to be published in accordance with FAIR principles: data will be made discoverable, findable, accessible, interoperable, interoperable, and reusable.
- Standardized Metadata: Fordatis offers all Fraunhofer Institutes standardized metadata recording of their locally collected heterogeneous research datasets. It serves as a basis for data citation, which will become more important in the future.
- Connection to other research output: Via identifiers within metadata it is possible to connect research data to other items like publications or software.
- Securing data sovereignty: Fordatis ensures that sovereignty over the data and metadata remains at Fraunhofer Gesellschaft itself. This ensures long-term, secure storage of the metadata.
- Google indexing of metadata: The metadata stored in Fordatis is indexed by Google and can be found there.
- Connection to other repositories and portals: The use of common metadata standards allows connection with other repositories, portals and aggregators such as OpenAIRE or Re3data. This fulfils the requirements of funding organizations (for example the European Commission through the implementation of the Open Research Data Pilot in Horizon2020). It is also possible to increase the visibility of the data in the specialist communities by harvesting through the corresponding repositories.
- Link for research data in the Fraunhofer Data Space: Fordatis provides the link for research data into the Fraunhofer Data Space. The published data can thus be part of comprehensive queries.
- Supporting Services: The repository will be complemented by supporting services, such as reporting workflow, registration and consultation on "research data" and "data management plans" and "trainings".
- Measure of the Fraunhofer Open Access Strategy2020: Fordatis is a measure to implement the Fraunhofer Open Access Strategy 2020. Fordatis contributes by the publication and the increase of visibility of research data.

3. Open Access Clauses in Standard Contracts

The aim of this pilot activity is to examine the possibility of integrating Open Access (to publications and research data) in Fraunhofer standard contracts for collaborations with industry partners. The Research and Development Contract Division was contacted to discuss this possibility. The contact person considered the possibility of including an Open Access clause to be unlikely, since only the most necessary points are included in the standard contracts. Finally this point was under discussion in that department. The conclusion was that the Fraunhofer standard contracts are kept as short as possible.

Just the essential legal topics are mentioned as a legal base for the contract negotiations. No additional clause can be added.

But at the same time a Citizen Science Project took place at Fraunhofer. In this project the topic of exploitation of results was discussed together with the Research and Development Contract Division, an expert of the Competence Center Research Services & Open Science and the Project Partners Fraunhofer and a FabLab. During the contract negotiations a clause was negotiated within the consortium that said, that the contractors would jointly decide on the publication of the research results of all types. So for following Projects where the consortium wants to discuss the topic of Open and Intellectual Property, a contact person of the Research and Development Contract Division can support the discussions together with an expert of the Competence Center Research Services & Open Science to be able to find a reasonable balance between Open Science and IP Protection of results. Please find the Open Access template clause in ANNEX III.

As a possible workaround to the topic of standard clauses, fact sheets were developed (one for each contract party). These fact sheets can support Fraunhofer-researchers in integrating the topic of Open Access and Open Data into their contract negotiations. The factsheets contain the main arguments why Open Access to publications and data can be beneficial for both partners: research and industry. As a result two slightly different fact sheets were developed. One for the Fraunhofer-researchers to understand the benefits they can reach through Open Access and one for the Industry partners, which contains the benefits they can generate by applying Open Access (see Fig. 24 and also attached in ANNEX III. These can be given to the industry partners during the contract negotiation process.

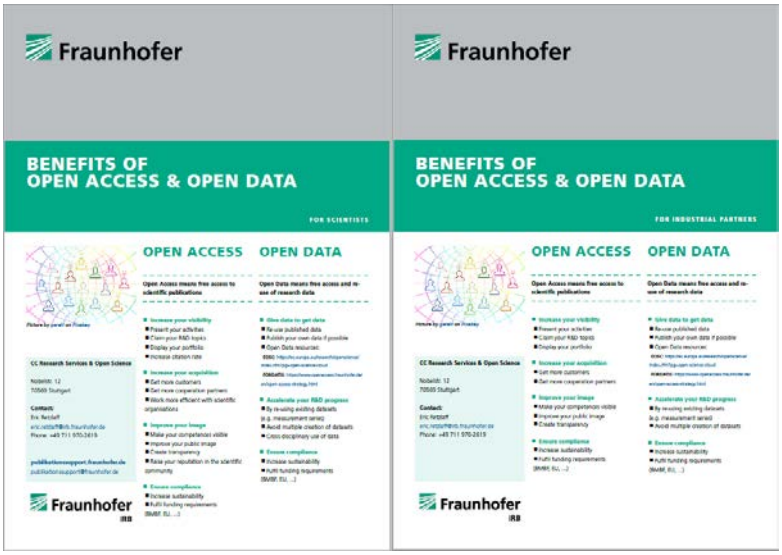


Figure 24: Factsheet for scientist and industrial partners

At the moment it is discussed in which way these fact sheets can be integrated in the corporate contract workflows of the R&D Contract Division. In either way they will be communicated to several stakeholders for the topic of Open Access and Open Data in Fraunhofer.

For this reason the following networks will be contacted:

Networks:

- Information Managers
- EU-Network
- Corporate Responsibility Network
- PR Network
- Marketing Network

The training of Fraunhofer scientists is an important step to empower them to be able to manage their research output in line with their strategic and scientific goals. So the fact sheets will be integrated into the following trainings:

Corporate Trainings:

- Trainings for Dissemination and Open Access
- Trainings for Data Management and Open Data

Through these activities a high penetration of Fraunhofer can be reached. Furthermore these Activities will be integrated in the Activities of the Fraunhofer Open Access Strategy 2020[11].

4. Open Access and Open Data Business Models

In this pilot activity we developed suggestions for archetypical business models for the exploitation of research data (Open Data). We followed a three-step approach to reach this goal:

1. Literature Analysis
2. Survey
3. Business Model Workshops

Literature analysis on Open Data business models:

Our literature analysis is comprised of the following 5 methodological steps:

- A systematic literature search was conducted.
- The results were fed into a bibliographic database.
- A careful sight of the gathered literature was carried out.
- A systematic review and analyses of studies, reports and documents on the topic of Open Data and Open Source business models was carried out.

[11] Fraunhofer Open Access Strategy 2020 https://www.openaccess.fraunhofer.de/en.html

- A systematic comparison and combination of the key findings of the analysis was carried out.

Concerning the *impact of Open Data* the most important references are:

Bilsen, Valentijn, Pieterjan Debergh, Isabelle De Voldere, and Miriam Van Hoed. 2015. 'EARTO – European Association of Research and Technology Organisations Rue Joseph II, 36-38 B-1000 Brussels'.

Crouzier, Thomas. 2017. 'IPR, Technology Transfer & Open Science'.

European Commission. 2017. 'LAB – FAB – APP — Investing in the European Future We Want'. European Commission.

———. 2018b. 'Europe's Future : Open Innovation, Open Science, Open to the World : Reflections of the Research, Innovation and Science Policy Experts (RISE) High Level Group.'

Hürtgen, Holger, and Niko Mohr. 2018. 'Achieving Business Impact with Data | McKinsey'.

San Chan, Wae, Wendy Carrara, Eva van Steenbergen, Sander Fischer, Fraunhofer Fokus, Sogeti, Open Data Institute, et al. 2015. Creating Value through Open Data Study on the Impact of Re-Use of Public Data Resources. Luxembourg: Publications Office.

Swan, Alma, and Sheridan Brown. 2008. 'To Share or Not to Share: Publication and Quality Assurance of Research Data Outputs. A Report Commissioned by the Research Information Network'. Monograph.

Concerning *Open Data* business models the most important references are:

Ferro, Enrico, and Michele Osella. 2013. 'Eight Business Model Archetypes for PSI Re-Use'. In Open Data on the Web Workshop, edited by Google Campus.

Zeleti, Fatemeh Ahmadi, Adegboyega Ojo, and Edward Curry. 20
14. 'Emerging Business Models for the Open Data Industry: Characterization and Analysis'. In Proceedings of the 15th Annual International Conference on Digital Government Research, 215–226. Dg.o '14. New York, NY, USA: ACM.

Concerning *Open Source* business models the most important references are:

Levine, Peter. 2014. 'Why There Will Never Be Another RedHat: The Economics Of Open Source'. TechCrunch.

Walker, John Mark. 2017. 'Building a Business on Open Source'. The Linux Foundation.

Walli, Stephen. 2016. 'There Is NO Open Source Business Model'. Stephen.

The methodological steps 4 and 5 of our analysis are comprised of 3 argumentative pillars: (a) we assess the impact of Open Data, (b) we assess and analyse the current Open Data business models and (c) we contextualise our results with the lessons learned from current Open Source business models.

Our literature analysis gives us reasons to identify the following 4 paradigmatic value propositions addressing the Open Data market:

4 Paradigmatic Open Data value propositions:

- Interpretation and analysis of the data through experts.
- Manipulation of the data by special tools (algorithms).
- Support, service and expertise regarding the data and data tools infrastructure.
- Additional features that enhance data relative to a specific use case.

This list of course is neither extensive nor exclusive but it gives us clues on potential Open Data business models. Yet, by carefully selecting and combining these results of our analysis of the theoretical frameworks with (a) the results of the empirical survey and (see below) (b) the results of our 2 workshops (see below) we arrive at well-informed potential Open Data business models. Please see ANNEX III for comprehensive results.

Survey:

To be able to understand the current situation in Fraunhofer concerning the awareness of Open Data in the context of business models we undertook expert interviews with experts from 8 different fields of research. In these Interviews several critical insights were caught that can be grouped in three topics: Potentials, Challenges and Recommendations:

Potentials:

- The type of research Output is hugely heterogeneous and has different levels or maturity in the context of possible exploitation
- There are even several increments during the research processes/projects that could be exploited
- The exploitation of Data is a topic of high interest
- Data exploitation needs data management and data curation as basic activities
- The exploitation of data can be seen internally in the working groups/institutes, in Fraunhofer (73 institutes) and outside of Fraunhofer. So different levels of potential re-users must be taken into consideration.

Challenges:

- A cultural shift must be started to help the researchers to think about the concepts of opening up, sharing, exploiting etc.
- Incentives for managing and opening up, sharing and reusing data must be created
- A lack of time to spend on these ideas and concepts can be seen

- The motivation of supervisors is missing
- Methodological help is needed to be able to realise the potentials
- Profound knowledge in data management and data curation is missing

Workshops:

We developed and conducted 2 distinct workshops. In the first workshop, we developed business models in the context of heterogeneous research data in the urban environment. In the second workshop, we developed business models in the context of Open Data in general.

1. To achieve maximal efficiency we chose the global parameters for the business model workshop to be: high intensity, short time interval (3 hours in total), small group and high level of expertise (3 experts).

2. To achieve maximal reliability of our results we did not inform the expert group on the results of our prior theoretical analysis.

3. We utilized a 30-minutes asynchronous brainwriting session followed by a short sorting and a 20-minute dot voting to generate initial potential value propositions, products, services and key features (1 hour in total).

4. We used a solo write up session combined with a follow-up session of lightning talks to develop initial business model canvases (1 hour in total).

5. We used 2 sessions of brainswarming. The goal of the first session was to immunise the initial business models against potential shortcomings. The goal of the second session to optimise for potential beneficial circumstances (1 hour in total).

The first workshop:

The first workshop on data-based business models took place on 8th May 2018 at the Fraunhofer IAO in the research field with heterogeneous research data in the urban environment.

Venue: Fraunhofer IAO in Stuttgart.

Participants: 10 experts in the field of urban environmental research, Fraunhofer IRB Tina Klages from Fraunhofer IRB, CC Research Services & Open Science.

Results: We generated 2 concrete data business models (these cannot be shown here for reasons of confidentiality) by using the method of Business Model Canvas by Osterwalder and Pigneur (2011).

The second workshop:

The goal of the second workshop was to generate new yet simple Open Data business models for RTOs and companies. To maximise the reliability of our results we did not

inform the participants on the results of our prior analysis. For detailed information on the methods and schedule, please see Table 2-3.

Date: 12th of February 2019, 11:30-15:30

Venue: Fraunhofer IRB in Stuttgart.

Participants: 3 experts drove this workshop: MBA Ekaterina Dobrokhotova from the Fraunhofer IAO/Urban Data & Resilience, Dr. Tina Klages, Andrea Wuchner from the Fraunhofer IRB/Competence Center Research Services & Open Science.

Results: We generated 6 distinct Open Data business model value propositions. Like in the case of Open Source products i.e. Linux operating systems, the added value stems not solely from the source code itself but from the features, services and the support on top of the already strong value of the Open Data/Open Source Code:

1. Data analysis, interpretation, visualisation and data literacy

   Added value: Raw data can be useful in some cases, in general though, to understand data, to unfold the true value of data, one needs to know the context of the data collection, needs to know how to analysis and interpret the data. The interpretation, analysis and visualisation requires a high degree of expertise and skill and adds genuine value to the raw data.

2. Data coupling, data matching and data-integration

   Added value: Even already analysed and interpreted data is in many cases just the beginning of the value chain. Even analysed data gets so much more informative if linked to or integrated with other data.

3. Data simplification and complexity reduction

   Added value: Data sets quickly gets large and complex. Streamlining complex data to just the rights bits is hard. The right complexity management uncovers the true potential of data.

4. Data services and support

   Added value: Data means power. With great power comes great responsibility. Managing data, its technological challenges, as well as the rights and obligations that accompanies data management needs well-founded technical and legal decisions. Getting the right support or having access to the right services provides security and reliable decision-making.

5. Data enrichment and enhancement

   Added value: Some data sets needs to be enriched or enhanced with other collected data, generated data or additional functionality. This is often the case in context of machine learning and artificial intelligence in general.

6. Data literacy training

Added value: If you want to manage, analyse, interpret or manipulate data you need to have some degree of data science expertise i.e. skills and knowledge in relation to algorithms, formats, programming languages, rights and obligations, etc. Data literacy training will give your business or organisation a decisive competitive edge.

Please see ANNEX III for comprehensive results.

Overall recommendations for Open Data business models development:

The overall recommendations are to set the frame for scientists and enable them to think about business models and create an inspiring environment to work on these new ideas. To reach this goal it is necessary to develop processes, create new roles in the institutes, develop incentives and train the scientists to empower them to reach the full potential in developing data business models.

Our analysis shows, that it is crucial to focus not only on business model development but also on key activities that supports proactively the socio-political and the socio-economic change and reduce overall uncertainty:

1. Develop clear-cut agendas, guidelines and fact sheets for data privacy and data protection as well as precedents to improve informed decision-making for all stakeholders.
2. Develop unambiguous copyright/licencing models (use de facto standards if possible) and pricing models to improve certainty for all stakeholders.

By combining the results from our 3 distinct approaches we arrive at the following 5 Open Data business model value proposition domains, which can serve as a basis for further business model development in the realm of the emerging Open Data markets:

1. Data-literacy, data analysis and visualisation through experts (data scientists) and the help of tools (algorithms).
2. Data simplification with through experts (data scientists) and tools (algorithms).
3. Data enrichment, enhancement, integration through experts (data scientists) and the help of tools (algorithms).
4. Data support, service, guidelines, governance and training from experts.
5. Data-coupling, data-matching and data integration through experts (data scientists) and tools (algorithms).

In summary, these 5 proposition domains combined with the 2 key activities can serve as a suggestion for further Open Data business model development. Please see ANNEX III for comprehensive results.

3.4.3. Lessons learned

In principle, the several activities within the Open Access Dimension can be regarded as quite successful. We came together with several stakeholders, informed them and discussed Open Access and the pilot activities intensely during two Stakeholder

Workshops (WP 2 & 4) that aimed to identify activities for the dimension Open Access. Through these events we created awareness on several institutional levels and divisions of Fraunhofer. We established an Open Access informal vision and a roadmap to foster deeper institutionalisation and identified 4 pilot activities which were supported by all of the stakeholders.
The impact is huge because now many more people, among them strategic important decision-makers know and think about Open Access and work on the realisation of this change then before. Open Access as a strategic goal of the Fraunhofer-Gesellschaft is thus experiencing even more commitment. This is clearly an irreversible development towards Open Access at Fraunhofer.

Furthermore, some activities alongside the JERRI pilot activities were undertaken that were inspired through JERRI because of the intense communication activities. The JERRI momentum was used to create synergy effects with established divisions such as Legal Corporate Governance or IP & Commercialisation and Publication Support and Training to continue working on Open Access Topics.
The measurable effects of the JERRI Pilot Activities will be seen in future (5, 10, 15 Years). Hopefully success will be seen in different areas:

- Overall awareness for Open Access topics has grown
- The advantages of Open Access are clear
- Opening up publications and data has become normal to scientists
- Open Access activities are supported by technical solutions
- New business models are created
- The cultural shift towards opening up research output has developed

In the following, we want to present in more detail our lessons learned from the implementation process of the several pilot activities.

- Research data repository Fordatis:
    - Working on Fordatis required different skills, knowledge and roles, and different people were involved in success in different ways.
    - Fordatis has interfaces and dependencies to other projects and developments, for example the Publica and the project Fraunhofer Dataspace, which have to be considered.
    - Research data management is a new topic still under development that will evolve over the coming years. There are still many unanswered questions in this context. Do now, what's possible today.
    - In addition to the technical implementation, the organizational embedding of a repository must be considered as well. For this, all relevant actors and networks must be brought on board and integrated.
    - It was difficult for Fraunhofer-IRB to find staff for software development, which led to delay and the work with an external partner.
- Communication strategy:
    - Fraunhofer supports communication with several stakeholder groups by mailing lists, centralized directory of people and events like Meetings and

Conventions. This is supporting for spread our content to all relevant persons.
    - The Competence Center Research Services & Open Science is already in contact to many important stakeholders.
    - To communicate Open Access and to increase awareness for this topic special occasions like the start of a new research data repository are suitable to communicate Open Access.
    - There are two successful trainings taking place at the Institutes that include the topic of Open Access: scientific publishing and research data management (Open Data). So we decide not to do an additional roadshow but to use these trainings to inform in detail of Open Access.
- Integrating Open Access Clause in standard contracts:
    - During the implementation stage we made the experience that it is quite difficult to make it clear to divisions that deal with totally different topics such as the legal consulting of R&D Contracts for the whole of 73 Fraunhofer-Institutes that Open Access is a concept that leads to several advantages for the whole Organization and for Science, Industry and Society as well. Experts with legal background are trained to protect research output as much as possible. So thinking about Open Access is a huge paradigm shift for them. It takes several meetings to be able to explain the concept of Open Access within the scientific system and show advantages and the overall trends that led to the Open Access developments.
    - At that point communication is key. It was critical to understand that stakeholders with different backgrounds, and different KPIs for their work have difficulties to change their thinking. Furthermore they have no incentives to do this extra work on top of their regular tasks. So the critical success factor was to understand their “world” or “way of thinking” and connect the Open Access concepts to that. The second factor was to communicate consistently and keep on reminding them persistently to get answers and results.
    - That is the reason why we had to derivate our activities in this context because the Corporate R&D Contract Division could not realize our plan to integrate an Open Access Clause into their standard contracts. So we thought about the intended outcome – every Researcher in Fraunhofer should be empowered to make Open Access a discussable topic in contractual discussions. To reach that aim we developed a different strategy as a workaround. Factsheets that are communicated widely in Fraunhofer should do the job in informing researchers about the main arguments for Open Access and Open Data.
    - For other RTOs that work on these topics it can be recommended to think about the potential Stakeholders, their view of the topic and try to convince and argue consistently to be able to develop slight insight in the concept of openness, even to a small extend to be able to discuss possibilities of integration in existing processes.

- Open Access Business Models
  - We made the experience that the concept of exploitation of data and business models around data is no common sense amongst the Fraunhofer-Scientists. The workshops and interviews showed that it is crucial to offer methodologic support for scientists to make it possible for them to understand what a business model is and how such concepts and ideas can be developed depending on their type of data, costumers and the overall markets they act in.
  - These workshops take time so it was hard to acquire scientists to join because it is not possible to pay other Fraunhofer institutes to join such workshops. More workshops in different fields would have been a good possibility to get even more results. So we had to work in a derivative form. We combined three steps of developing ideas for business models: We did a thorough literature research, made two workshops (one for data in the context of urban data; one for Open Data in general). Furthermore we interviewed researchers form different fields to generate an insight on their thoughts and activities around the management and exploitation or research results in form of data. This gave an interesting insight into the current and planned activities around business model development in Fraunhofer.
  - To be able to work on Open Access Business Models it was key to explain the concept of business models and the methods that enable everyone to think about it because most of the scientists in Fraunhofer do not have any work experience or qualification in economics.
  - In terms of business models there is no one size fits all approach possible. Every domain and research field has to think about ways to manage and exploit their data for their own – with methodological help.

- Exchange with TNO:
  - In our opinion, there was not enough time to exchange with TNO. We believe that this bottleneck was due to the project structure, which did not reflected the need for more meetings.
  - All of our meetings went well though. We also got along well personally.
  - The mutual learning took place between TNO and Fraunhofer in terms of good practices but due to different stages of Open Access realization and different organisational structures it was not possible to adapt these solutions.
  - Yet, we found the exchange interesting and we established solid contacts.
  - In summary: Inter-organisational exchange and mutual learning across national and cultural borders is great and important. However, there has to be enough provided meetings in the project structure in advance to support this exchange. There should also be at least two mandatory contact persons per project dimension, which must always be present at the mutual learning workshops or meetings.

4 Analysis and Conclusion

In the following section, we want to connect our practical experiences with the theoretical insights from the framework. By confronting both perspectives with each other, we aim to highlight some blind spots in both perspectives that need to be further explored in theory and practice. We will also come back to these questions in the following report D6.2.

Like already outlined in section 2, we can analytically differentiate between three organizational levels that should be considered for understanding organizational change: (I) interorganisational & environment level, (II) intraorganisational level and (III) the actor level. In the case of the pilot activities within **ethics**, it is obvious that the actor level was quite important in two ways. In one sense, it was important to mobilise a well-connected person on the central level (Fraunhofer headquarters) that serves as a bridge head between the JERRI team, the managers of the internal funding programme and several other institutes. In another way it was indispensable to have a change agent within the team that is highly committed to the topic of 'ethics in research', has quite a lot of experience with pushing the topic forward and therefore knows which contact persons, networks and units should be taken into account and be integrated. Furthermore, change agents have proven in our case also to be an immense help when it comes to the crucial task to communicate appropriately a certain topic to several stakeholders. Like outlined above (3.1.3) we made the experience that the right communication strategy is key in order to avoid misunderstandings and convince people.

On a more structural or intraorganisational level, we made the experience that the claim of 'ethics in research' is quite established. However, as Randles (2017, p. 22) pointed out regarding the overall RRI concept, the word 'Responsibility' is quite flexible and therefore can be interpreted differently. Also 'ethics' can been seen as a "word of power" (ibid. p. 22) in the sense that no one can be against it. If you follow this assessment, ethics can already be described - similar to the gender issue - as a 'boundary object' (Star and Griesmemer 1989). But what is still missing is a shared understanding of what ethics or responsibility means within the organisation that finally could create a "pervasive inter-dependent system with an overflowing" (Randles 2017, p. 39) and transformative effect. Our experience shows that this is due to two factors: the different levels of ethical knowledge among Fraunhofer staff and the different expectations or ambitions about ethics. What remains to be the biggest challenge on the intraorganisational level is therefore to translate ethical aspirations into the different institutional logics of the organisation and to convince others to go beyond established ethical and responsibility standards.

But setting ambitious new normative standards cannot be done by an even large organization (like Fraunhofer) alone. This is also a task that needs to be done on the wider interorganisational and environment level through for example adopting new policy guidelines, new framework conditions in order to create higher pressure on RTOs.

The experience of the **gender dimension** resonates strongly with the insights from our theoretical framework. Most prominently, it highlights the crucial role of change agents meaning “actors that have the capacity and resources to initiate change”. For the first two pilot activities and to a lesser extent even for the third one the “Equal Opportunity Officers” played a crucial role as catalysts for change. It proved vital that these change agents have an official mandate as well as dedicated resources to pursue activities fostering gender equality within their institutes. In contrary to actors from the central administration these change agents are at the same time rooted within the culture of the actual institute often they are researchers, engineers or human resources managers. Accordingly the function as boundary spanners between these two realms of the organisation and are able to initiate a cultural change. It could be hypothesised, that the case of gender in content is so difficult exactly because the organisation does not have such boundary spanners in this case. The practice experience indicates that among the change agents the ones who reach across boundaries are of special relevance for deep institutionalisation. Another aspect resonating with the theory is the importance of an organisation’s ability to embed new narratives into established ones. The recognition of gender aspects in research content can only be successful if it is firmly tied to the excellence narrative that is dominant in the organisation. This again points to the crucial role of leadership as it is the top-level leadership communicating this narrative but also mid-level actors need to take it up and translate it into their research domains. Actors in the gender domain largely agreed that more than any other aspect of RRI the gender perspective faces strong resistance for a number of reasons. One strategy that was proposed was to align the gender agenda with more accepted agendas like diversity or user centric, participatory innovation. Others strongly rejected this approach and voiced the fear the issue of gender equality would be at risk to disappear in such a scenario. This heated debate illustrates the crucial nature of narrative strategies.

Finally, the practical experience confirms the key role of landscape developments for initiating organisational change. On the one hand pressure from the outside (e.g. in the case of female leadership BMBF) is key in spurring action. At the same time evidence from the outside such as the gendered innovation platform as well as new qualifications brought into the organisation by young colleagues are recognised as important change drivers.

When reflecting about the experience from the **Societal Engagement** dimension, we come to similar conclusions as in the gender dimension. Although Societal Engagement is, compared to Gender equality, at a much lower level of institutionalisation, it reveals the critical role of change agents. While in the gender dimension the role of change agents could be carried out by staff with an official mandate ("Equality Opportunity Officers") and in addition were located at every institute, the topic of SE does not have such a lobby in the organisation yet. Although there are pioneer institutes with enthusiastic scientists such as UMSICHT, the topic struggles for a more systematic and Fraunhofer wide institutionalisation. What is necessary is to get SE practices from "niche integrated normative networks" to a "pervasive inter-dependent system with overflowing" (Randles 2017 p. 33). For this next step, it would be necessary to build a special network for the topic of SE within Fraunhofer. Another solution is to search for an already established role, that is institutionalised at all institutes (like the 'Equal opportunity officer') and that could be gained as change agents for the topic of SE. First signs of such a development could be the attempt to systematically connect Fraunhofer activities in citizen science projects that is underway at the moment. Also, the linkage with Open Access which was substantially strengthened in JERRI could be interpreted as a move into the system and out of the ad-hoc niche character.

From an intra-organisational perspective, probably the biggest challenge is to change the persistent scientific culture within Fraunhofer, from one that is orientated towards very classical notions of excellence to a more society oriented culture. Therefore, it is necessary to come to a new understanding of 'excellence in research'. One solution would be the integration of SE goals and practices into the KPIs. In the words of our theoretical framework: As institutional change "always comprise simultaneous institutionalisation and de-institutionalisation processes" (Randles 2017, p. 15), the meaning of 'excellence' has to be changed by adding new elements like participation practices and societal goals. However, changing the scientific culture of Fraunhofer is a challenge that cannot be solved through organisational change alone, but also depends on an overall change of the scientific landscape. Again, compared to the gender issue, the topic of SE so far could not raise an equal urgency and demand within the public. In addition, so far there has not been a legitimation crisis (ibid., p. 14) that could get used as a 'window of opportunity' for the topic of SE. This comparatively low attention for the topic also leads to a lower pressure from policy actors and funders compared to the gender issue.

Besides all these critical issues that need to be tackled, it seems that the topic of SE itself opposes somehow institutionalization. As the experience shows, participation processes are often a bit chaotic and results are to some degree not predictable. Furthermore, the duration of such participation processes can rarely be determined and

therefore it is difficult to integrate it into the timetable and the workflow of a project. In case that there is an inherent conflict between SE and institutionalisation, one can ask if it is maybe the genuine idea and benefit of participation practices to irritate in a constructive way the normal process of research projects. So far, the question to what extent SE practices should be institutionalised and what are the benefits and the disadvantages of institutionalising, especially regarding Societal Engagement, is not answered yet. In our view, this question deserves more attention both from a theoretical and from an empirical perspective. Nevertheless, we think that the concept of the citizen's office is a great solution for the controversy of invited vs. uninvited participation. By presenting a wide variety of projects and their different participation level and letting the participants decide in which project and to what extent they want to engage, it gives a very good example on how to balance these two logics.

Finally, the experience from the **Open Access** dimension can be linked to our theoretical framework. On an interorganisational level, it seems to be the biggest challenge to align the logic of Open Science with the existing logic of the scientific systems and legal frameworks of research contracts. What still remains to do after JERRI is to reform Fraunhofers KPIs. Only if the KPIs also acknowledge Open Access practices, there will be a real motivation for researchers to think about other ways of publishing. What seems to be even more difficult is to integrate Open Access clauses into standard contracts. We think that these experiences probably illustrates best what the theory calls "institutional pluralism" (Randles 2017, p. 18). Although the theory states that it is the normal case for large and complex organisations to deal with multiple institutional logics, for the ambitious JERRI goal of deep institutionalization it is the critical question of how to knit these two opposite logics together (ibid, p. 19). In other words: How to translate the idea of openness into the paradigms of creating R&D contracts that are focused on the exact opposite (knowledge protection & exploitation). As organisational theory and our framework claims that organisational respectively institutional change is a more evolutionary and iterative process, in which the mechanisms of assimilation or absorption can be found more often than erasure (ibid, p. 15), it is necessary to negotiate between different logics by putting yourself into the 'shoes' of other units or stakeholders.

On a more actor focused level, the experiences from the Open Access dimension again reveal the critical role of change agents, respectively the role of institutional entrepreneurs (ibid, p. 30). We suggest that the actor level is even more important if there are conflicting institutional logics on the intraorganisational level and a strong support through the higher management is missing, because then a strong bottom-up strategy is necessary. When it comes to the topic of institutional entrepreneurs, the theory states two strands: one is the strand of 'heroic entrepreneurs', which states the individual power and achievements of individual people and the other understands the

impact of institutional entrepreneurship as a process, that is based on collective, incremental and multi-level efforts/elements (ibid, p. 16f.). We think that the experience from the Open Access dimension fits more with the second strand. To make effective use of institutional entrepreneurs it is crucial to connect them to other relevant actors with similar agendas and to other ongoing projects and internal changes. The experience shows that alternative practices or new logics are only assertive if you connect them to similar projects, discourses or narratives (for example sustainability)[12]. Besides the important task to connect all these different elements on different levels, in a second step it is important to institutionalize this exchange and communication in form of new network groups (e. g. like the already existing Fraunhofer sustainability network), so that the various ongoing projects and researchers that deal with the topic of Open Science are linked together and can create "pervasive inter-dependent systems with overflowing" (Randles 2017, p. 39) effects.

[12] Our experience within the Gender dimension shows also that building on previous projects (here: the STAGES project) is quite supportive for reaching the goals of your own project/pilot activity.

ABBREVIATIONS

Fraunhofer IAO	Fraunhofer Institute for Industrial Engineering IAO
Fraunhofer IRB	Fraunhofer Information Center for Planning and Building IRB
Fraunhofer ISI	Fraunhofer Institute for Systems and Innovation Research ISI
Fraunhofer UMSICHT	Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT
JERRI	Acronym for the project Joining Efforts for Responsible Research and Innovation
KPI	Key Performance Indicator
NGO	Non-governmental organization
R&D	Research & Development
R&I	Research and Innovation
RRI	Responsible Research and Innovation
RTO	Research and Technology Organization
SE	Societal Engagement
TNO	Toegepast Natuurwetenschappelijk Onderzoek/The Netherlands Organization of Applied Scientific Research

REFERENCES

Brand, C. (2015): Ethik in der beruflichen Praxis. In: Ammicht Quinn, Regina, Potthast, Thomas (Ed.): Ethik in den Wissenschaften. 1 Konzept, 25 Jahre, 50 Perspektiven. Tübingen, 176-174.

Erdmann, L.; Eckartz, K.; Moller, B.; Tercero, L.; Teufel, B.; Fuchs, M.; Machacek, E.; Thorsøe, K.; Petavratzi, E.; Brown, T.; van der Voet, E.; Falck, E.; Bisevac, V.; Hofmeister, T.; Quental, L.; Katalin, S.; Radwanek-Bak, B.; Arnbom, J.-O. (2016): MICA Deliverable D2.1. Stakeholder Report: identification & analysis.

Grunwald, A. (Ed.) (2013): Handbuch Technikethik. 1st ed. Stuttgart: Metzler.

Lindner, R.; Kuhlmann, S.; Randles, S.; Bedsted, B.; Gorgoni, G.; Griessler, E. et al. (Eds.) (2016): Navigating towards shared responsibility in research and innovation. Approach, process and results of the Res-AGorA project. Karlsruhe. Available online at https://indd.adobe.com/view/publications/eaeb695e-a212-4a34-aeba-b3d8a7a58acc/jo0u/publication-web-resources/pdf/RES-AGorA_epaper.pdf, checked on 11.07.2016.

Osterwalder, A.; Pigneur, Y.; Clark, T. (2010): Business model generation. A handbook for visionaries, game changers, and challengers. Hoboken, N.J.: John Wiley & Sons.

Randles, S. (2017): JERRI – Joining Efforts for Responsible Research and Innovation Deliverable D1.2. Deepening 'Deep Institutionalisation'. Elaborating a Concept and Developing a Typology to Analyse and Contrast the Institutionalisation of De-facto responsible research and innovation (rri); and H2020 RRI in Research and Technology Organisations (RTOs). Available online at http://www.jerri-project.eu/jerri-wAssets/docs/deliverables/wp-1/JERRI_Deliverable_D1_2_Deepening-Deep-Institutionalisation.pdf, checked on 14.12.2017.

Teufel, B.; Röß, A. (2017): JERRI – Joining Efforts for Responsible Research and Innovation. Deliverable D2.2. Description of specified RRI goals at Fraunhofer. Available online at http://www.jerri-project.eu/jerri/results/deliverables/, checked on 21.06.2018.

The Open Science Training Handbook (2019). Available online at https://open-science-training-handbook.gitbook.io, checked on 11.04.2019.

Warnke, P.; Röß, A.; Mundt, I. (2018): JERRI – Joining Efforts for Responsible Research and Innovation. Deliverable D4.1. Discussion paper on the analysis of organizational barriers (Fraunhofer Part).

Woelfle, M.; Olliaro, P.; Todd, M. H. (2011): Open science is a research accelerator. In: Nature chemistry 3 (10), pp. 745–748. Available online at https://www.semanticscholar.org/paper/Open-science-is-a-research-accelerator.-Woelfle-Olliaro/c63b6a64b8a96b05a4abaebcbf3cb59ae9930cd8, checked on 11.04.2019.

ANNEX I (ETHICS)

Ethics module at the alumni meeting of the research managers

Date and location: July 18th, 2018, Fraunhofer ICT (Pfinztal) ca. 20 participants

Objectives

1. **developing the ethical competence of the participants** in the following five elements: perception, evaluation, judgement, action, and critical reflection on (a) ethical implications of research, (b) reflection on one's own moral positions, (c) discussion of ethical positions & arguments, (d) exchange & discussion on dealing with ethical aspects in research (approaches to solutions).
2. **pilot test of a format for ethics reflection** with regard to applicability in other Fraunhofer qualification programs

Input

- Specific material on the selected topics (current state of the ethical discourse in the respective field of technology, overview of ways of dealing with ethically relevant aspects, etc.)
- Selected sections of the JERRI ethical guideline
- Templates for individual reflection
- Feedback questionnaire
- Informed consent form
- Information from the keynote speakers
- Graphical recording with Heyko Stöber (visualization of the group discussions)

Procedure

Plenary	30min	• **Introduction:** background and schedule of the panel • **Short presentation:** introduction to "Ethics in Science and Research" and the JERRI project (15min speech, JERRI team) • **Brief presentation** of the three different session topics (medical technology, AI, general applied ethics) → Each session will have a keynote speaker from the circle of participants and a session moderator with professional competence (ISI/JERRI team). Participants will be assigned to one of the parallel sessions in advance in order to have diverse discussion rounds.
	20min	**Step 1: identification/problem outline:** perception of normative aspects of the research area/project • The keynote speaker will present his/her own topic and 1 project example with ethically relevant questions, the moderator will note central normative aspects on Post-its. • short discussion: questions on content, participants may name further ethically relevant aspects (record on Post-its)

	10min 20min 20min 10min	**Step 2: reflection on one's own moral evaluations:** • personal limits and values? • personal boundaries from friends or acquaintances with a different value orientation (e.g., religious, pacifist, transhumanist, etc.)? ("imagine other moral perspectives/valuation of the project"; write it down for yourself) • exchange (Appreciative Inquiry), moderator records the results on (small) Post-its. **Step 3: Reflection of normative principles of the field of technology** • Reflection of the "moral evaluation" (step 2) on the basis of ethical basic principles/ethical discourse (use/see the templates) **Step 4: Exchange & Judgment Formation** • mutual presentation of the considerations from step 3. The participants listen actively and record essential arguments. The moderators pin the essential 4–5 ethical aspects on the pin board. **Step 5: Action** • joint discussion about possible recommendations: How to deal with the identified normative aspects? (for example using alternative methods, involvement of ethic experts, involvement of users/affected groups/stakeholder etc.)
	15min	Coffee break
Plenary	35min	• **presentation** of the central discussion results from every session (along the discussed project example explain the steps and competence dimensions): perception, evaluation, judgement, action and critical reflection) • **conclusion: presentation of the drawings (visualization of the group discussions) made by Heyko Stöber**
Plenary	20min	• **methodological reflection** 1. request to fill in questionnaires (evaluation of the individual parts of the format) 2. feedback in the final discussion (What is the most important insight from the ethics module? How could the format be integrated into other Fraunhofer qualification programs, what parts of the module have to be adapted?

Template for: Medical Technology - Neurostimulation/Active Implants

Ethical Principle	Explanation/exemplary questions	Are these ethical principles relevant for this research project?
principle of damage avoidance	Exclusion of unacceptable risks with regard to the use of medical technology. Is the patient risk in proportion to the benefit due to the use of the technology?	
principle of well-being and therapeutic relevance	Is the use of a specific medical technology for the treatment of a certain clinical picture suitable and targeted?	
principle of autonomy	To what extent does the use of neuroprostheses or implants, for example, change the imputability and responsibility of patients? Is the patient's voluntariness and sufficient possibility of control against the danger of manipulation guaranteed? Does the collection of certain information or applications of medical technology impair the patient's independent and self-reliant lifestyle? (risk of manipulation/control of the patient)	
principle of justice and equal health opportunities	Refers to the unequal distribution of or access to medical technology products. To what extent can it be ensured within the development of the product that broad sections of the population have (financial) access? What (negative or positive) effect does the technology have on the consideration of the health needs of certain population groups?	
problems regarding the dissolution of medical boundaries (Human Enhancement)	Refers to medical technology that no longer pursues a preventive, diagnostic, therapeutic, rehabilitative or palliative purpose, but aims at optimising human performance.	
solidarity principle	Refers to medical techniques that make it possible to individualise therapies. Can the standard use of such medical techniques lead to a reduction in solidarity and discrimination within the health system? To what extent can the information obtained in this way also be used against the interests of patients?	

right to informational self-determination/data security	Concerns the negative consequences/ risks of collecting health-relevant information. Is there a danger that information will be collected against the interests of the patient and which possibilities of informational self-determination remain for the patient?	
possibility of misappropriation (dual use)	What is the probability that normative goals will be thwarted and that negative effects will occur or be misused for other purposes? How likely is a non-civilian use or misuse for harmful purposes?	

Template for: Artificial Intelligence - Face Analysis

Ethical Principle	Explanation/exemplary questions	Are these ethical principles relevant for this research project?
equitable distribution of labour	What are the consequences for the job situation? Will certain human work become superfluous?	
quality of work	What are the consequences for the quality of work? Is certain human work becoming less demanding? Will the quality of interaction change?	
damage prevention	Are there increased risks during use/operation? What is the relationship between the (control) capability of the user and the complexity of the AI system?	
clear responsibility and attribution of action	How are negative consequences caused by the use of the technology system? Will the attribution of responsibility change?	
relationship between autonomy and control	Is a technical system entrusted with decisions that were previously reserved for human beings? Is there a balance between control and confidence in the results of the system?	
principle of transparency	To what extent is it possible to still understand the results and decisions of AI systems and thereby counteract possible wrong decisions, critically evaluate results and objectively assess them?	

opportunities to participate in the use of technology and its advantages	Are the realities of life and opportunities for participation of different groups of people (e. g. women/men) affected differently by the use of technology? For example, are certain groups of people preferred or disadvantaged in the interaction possibilities with the AI/Robotics system? (danger of profiling/categorisation of people and, for example, of a desolidiarisation in the health sector)	
justice	Is there an impact on social inequality between different social groups (e. g. through cost increases, new access barriers or the consolidation of stereotypes)?	
principle of self-determination	Are there any effects on the citizens' self-determination? Are options for action restricted?	
conscious social design	Are there unwanted effects on social relations (e. g. social tensions, exclusion, erosion of trust)?	
avoidance of misuse	Is there a potential for misuse for harmful purposes?	
data protection	Does such a concentration of data pose a risk to data protection?	
protection of privacy	Are there any implications for citizens' privacy?	
dual use	How likely is a non-civilian application?	

Template for: Security and military research

Ethical Principle	Explanation/exemplary questions	Are these ethical principles relevant for this research project?
orientation towards peaceful/peace-keeping goals	Is research oriented towards peaceful/peace-keeping goals?	
orientation towards defensive goals in military research	To what extent can it be ruled out that the military technology to be developed will be used as an offensive weapon? Is it possible to control research in	

	such a way that this technology is used later only as a means of defence?	
commitment to international security	Is the research activity accompanied by a commitment to international security to minimize the demand for military technology?	
principle of transparency of the purposes	Are the objectives/purposes of the research activity known?	
principle of transparency vis-à-vis the public	Is information on (partly) publicly funded research projects also accessible to the public? To what extent?	
possibility of misappropriation	What is the probability that normative goals will be thwarted and that negative effects will occur or be misused for other purposes? How likely is it to be misused for harmful purposes?	
respect for the ethical principles of the cooperation partners	Are ethical principles of cooperation partners (e. g. civil clause) affected?	

ANNEX II (GENDER)

Submission Form for Practical Examples for the **Gender Diversity Toolbox**:

Practical Example for the »Gender Diversity Toolbox«

The Toolbox is a selection of tried and tested actions and offers on the topic of equal opportunities and gender diversity at research organizations. The Toolbox is available to all interested parties and invites to publicize successful actions and offers and to encourage others to follow suit. That way it is possible to learn with and from another. We would like to invite you to share your practical examples, so others can benefit from your experience.
With filling out this form you can describe an offer or action that is offered at your organization to promote equal opportunities and gender diversity. The description is intended to point out why the offer was developed, how it was implemented, and how it is used in practice.

Thank you very much for your support!
Your Gender-Diversity-Toolbox Team

The Offer/ Action of our Organization is called:

Description of Issues and Targets
The action/offer was developed for the following reasons:

Description of Offer/ Action
Our offer achieves the targets as follows:

Implementation Approach
Our offer/action was installed in the following way:

Formal Requirements
These legal, financial and personnel requirements should be considered:

Results and Modes of Action
Our offer has so far proven itself as follows and is being used accordingly:

Success Criteria and Possible Obstacles
The following promoting or inhibiting factors need to be considered:

This Offer is Part of the Category (select from the dropdown list):

Also this Offer is Part of the Category (second possible selection):

Further Comments on this Offer/ Action:

Pictures
Do you have pictures of your offer or action? If yes, we´d be pleased if you attach them to the e-mail you send us to submit this form.

My contact details (not intended for publication)
The contact details are not intended for publication. They are required only in case of questions of the toolbox operators and for forwarding possible inquiries.

Organization, where your practical example is installed:

First name und surname:

Address:

Phone:

E-mail address:

Consent for Publication

I hereby declare that I consent to the publication of the practical example of my organization on the website www.gender-diversity-toolbox.de in German.

I hereby declare that I consent to the publication of the practical example of my organization on the website www.gender-diversity-toolbox.de in English.

I agree that the Toolbox Team forwards questions concerning my practical example to me.

GUIDELINE
GENDER IN RESEARCH CONTENT

A Result of the EU-Project JERRI – Joining Efforts for Responsible Research and Innovation

Fraunhofer IAO, 2018



1
© Fraunhofer

Fraunhofer

Inhalt

- Introduction
  - Sources and Basis for the Work
  - What is Gender in Research?
  - Why Gender in Research and Gender in Research Content?
  - Definitions and Concepts
- Guideline
  - Objectives of the Guideline
  - Possible Results of this Guideline
  - Structure of this Guideline
  - Step 1: Check for Gender Relevance – General questions
  - Step 2: Check for Gender Relevance – Specific questions
  - Step 3: Considering gender aspects in different project phases
- Sources
- Contact

2
© Fraunhofer

Fraunhofer

Sources and Basis for the Work

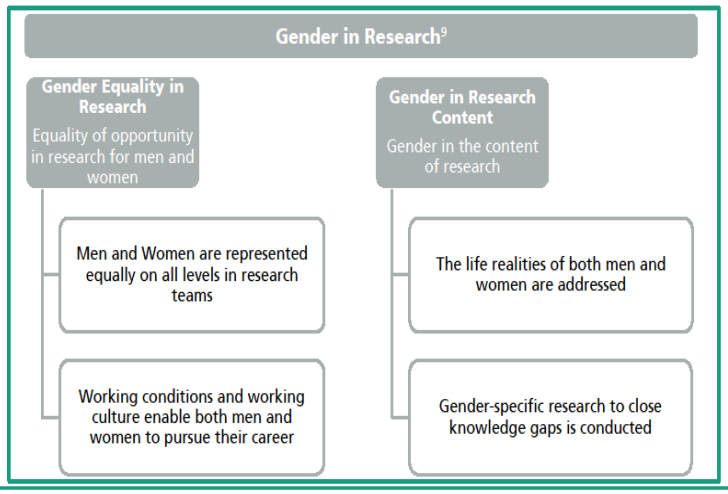
- This guide is largely based on the guideline »Gender-Aspekte in der Forschung«, edited in 2006 by Dr. Susanne Bührer and Prof. Dr. Martina Schraudner in the Project »Discover Gender«.[1]
- The »Toolkit Gender in EU-funded research«[9] by Yellow Window Management Consultants on behalf of the EU served as a basis for this guide as well.
- If any of these or other sources have been used this is indicated by a superscript number in the text. The respective source can be found at the end of this guideline.

4
© Fraunhofer

Fraunhofer

What is Gender in Research?

And what is Gender in Research Content?



© Fraunhofer

Fraunhofer

Why Gender in Research and Gender in Research Content? (1/3)

A demand of the EU

- Considering gender in research has been a core topic of the EU for many years and therefore represents an important aspect in EU-funded research:
  - Amsterdam Treaty: Gender mainstreaming has been established as a strategy to promote equal opportunities for women and men (1999)[2]
  - Seventh Framework Programme (FP7): Gender equality and integration of the gender dimension should be addressed in all areas of research (2007).[5]
  - Horizon 2020: Gender in Research is one of 3 goals on Gender Equality in Horizon 2020
    - The integration of gender and gender analysis in research and innovation content contributes to improving the scientific quality and societal relevance of knowledge, technology and/or innovation[6]

© Fraunhofer

Fraunhofer

Why Gender in Research and Gender in Research Content? (2/3)

A few good reasons[9]

- A gender-sensitive approach to research content can lead to higher quality and validity:
  - When research considers differences between men and women in the population, it is more representative.
  - Gender-sensitive research tends to reach a larger group of addressees (namely men and women) and more likely to accommodate different needs and desires.
  - The consideration of gender aspects from the beginning to the research results can prevent an inadvertent gender bias in the results.

© Fraunhofer

Fraunhofer

Why Gender in Research and Gender in Research Content? (3/3)

Examples for non-gender-sensitive development of technology

- Airbag: In the development of airbags, the ergonomic factor »height« was not taken into account because the developers assumed their own body measurements. The first airbags therefore posed a life-threatening risk for smaller people, especially for women and children.[1]
- Speech recognition: Women's voices were not included in the development of speech recognition systems. Since higher voices were not recognized, the product had to be further developed, which in turn caused costs.[1]
- Virtual Assistants: Virtual assistants, from Siri to Cortina, are by name and voice build after women (although, after protests, the users now have the option of a male voice). This Gender assignment is linked to stereotypes: Siri was conceptualized as a slightly naughty, restrained assistant.[8]

© Fraunhofer

Definitions and Concepts (1/2)

- **Gender:**[4]
  »Gender« is defined as the socially and culturally influenced gender roles of all genders. These are - unlike to the biological sexes – socially learned and thus changeable.
- **Gender-sensitive Research:**[9]
  In Gender-sensitive research Gender is consequently considered in the research cycle.
- **Gender aspects:**[4]
  The consideration of gender aspects in applied research means taking into account diverse life realities and the resulting different needs in the development of technologies and products.

© Fraunhofer

Definitions and Concepts (2/2)

- **Gender Mainstreaming:**[4]
  Gender mainstreaming is a concept of examining all sectors of society whether the diverse life situations and interests of different people are taken into account and whether the planned measures serve to create equal opportunities.
- **Gender Equality:**[9]
  This term describes a situation in which individuals of all genders can freely develop their own abilities and make decisions without being constrained by strict gender roles. Different behaviors and needs are equally taken into account, appreciated and promoted.
- **Gender Bias:**[9]
  Gender Bias describes the often unconscious and implicit differentiation between women and men by assigning one gender to a hierarchically higher position in relation to the other gender, as a result of stereotypical images of masculinity and femininity.

© Fraunhofer

GUIDELINE

Fraunhofer

Objectives of this Guideline

- The guide aims to sensitize researchers to the issues,
  - that gender aspects can play a role in various research projects and
  - that the consideration of gender can lead to new perspectives and not yet discovered research results.
- It also gives advice on how to define which role Gender plays in each research project.

Fraunhofer

Possible Results of this Guideline

- Gender plays a significant role in the respective research project.

  ➡ Then this aspect should also be actively considered and implemented in the research project. This guide provides starting points for the implementation.

- Gender plays no significant role in the respective research project.

  ➡ Therefore, this aspect does not have to be taken into account in research. However, other dimensions such as ethnicity, age, income, sexual orientation, education, religion, disability, etc., may play a role in the research project, and it may be considered to include the respective perspectives.[1]

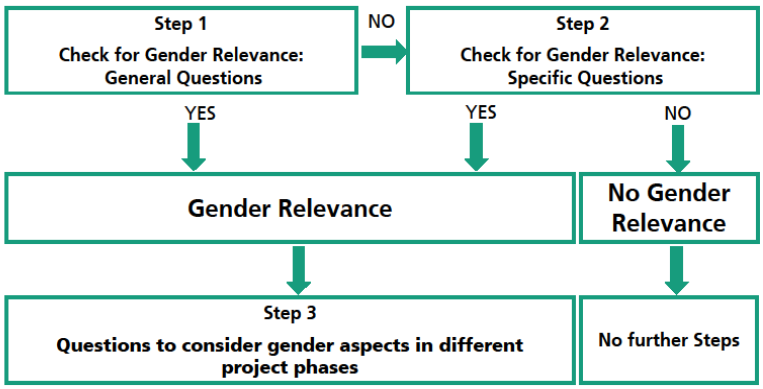
Fraunhofer

Structure of the Guideline (1/2)

- **Step 1**
  - First, in step 1, you will find **general questions** to check whether gender is relevant in your research project. If at least one of the general questions is answered positively, it can already be assumed that gender plays a relevant role in your project.
- **Step 2**
  - If none of the questions in step 1 are answered positively you can continue to check for gender relevance in step 2 using **specific questions.** Gender relevance occurs if one of the specific questions is answered positively.
- **Step 3**
  - If you detected gender relevance in step 1 or 2, you will find **questions on gender aspects in different phases of the project** in step 3. These should serve to adequately include the topic of gender in your project or to check whether this has already been adequately implemented.

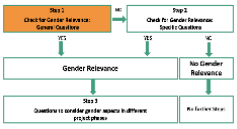
© Fraunhofer
Fraunhofer

Structure of the Guideline (2/2)



© Fraunhofer
Fraunhofer

Step 1: Check for Gender Relevance – General Questions



Can you answer YES to at least one of these questions for your project?

- Are people research objects or directly affected?[7]
- Are people indirectly affected by the research project, i.e. the research results concern everyday life?[7]
- Is the research project portraying only one gender?[3]
- Are the people who come into contact with the research result different in their various characteristics (gender, age, occupation, tasks, education, income, way of life, relationship to technology, ethnicity etc.)?[1]
- Is sex or gender particularly important in your research object?[1]

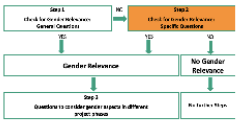
NO → It is not yet clear if gender is relevant to your project. **Go to step 2: Specific questions**

YES

Gender relevance applies, go straight to **Step 3: Questions to consider gender aspects in different project phases**

© Fraunhofer
Fraunhofer

Step 2: Check for Gender Relevance – Specific Questions (1/2)



Can you answer YES to at least one of these questions for your project?

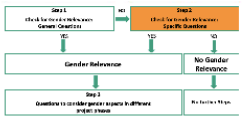
- Are there any physical differences between women and men that should be taken into account in the design of the research subject (e.g., physique, tone of voice, internal muscle tension, sense of smell and taste)?[1]
- Is it possible to find out different usage contexts of the research result (e.g. applications in the working life, in the leisure time, in the family)? Does this result in different user habits and frequencies among users?[1]
- Are there different requirements for men and women regarding the application of research results that need to be considered?[1]

Continued on the next page

© Fraunhofer

Fraunhofer

Step 2: Check for Gender Relevance – Specific Questions (2/2)



- Do users have different demands on the »content« of the research results? Is there a risk of stereotyping or hurting personal feelings by the content or outward appearance of the research result (e.g., role-image assignment, language, avatar design, sexism)?[1]
- Is there a risk of systematic exclusion of female or male reference groups through a specific design of the research results?[1]
- Is the existing social division of labor additionally codified by a specific design of the research object?[1]

NO → **Gender is not relevant to your project**

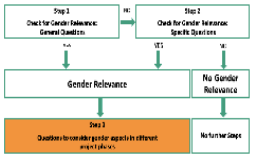
YES

Gender relevance applies, go straight to **Step 3: Questions to consider gender aspects in different project phases**

© Fraunhofer

Fraunhofer

Step 3: Questions to consider gender aspects in different project phases (1/4)



The following illustration should help you determine if and to what extent your entire research design includes gender. In addition, it should also show starting points for improvement.

Project idea/ Application phase

- Formulating Gender-sensitive Research Questions[9]
- Selection of a gender-sensitive methodology[9]

Research phase

- Gender-sensitive Data Collection und Analysis[9]

Publication phase

- Communicate data in a gender-sensitive way[9]
- Use gender-sensitive language[9]

© Fraunhofer

Fraunhofer

Step 3: Questions to consider gender aspects in different project phases (2/4)



First phase: project idea/application phase

Please check if you can already answer YES to the following questions for your project. If this is not the case, see these questions as a suggestion and try to include them in your project.

- Does the method selection ensure that all possible gender differences are examined across the entire research process, e.g. by collecting and analyzing data on sex and gender and that these can be used for the publication?[9]
- Does the project proposal explain explicitly and comprehensively how gender issues are dealt with (for example in a specific work package)?[9]
- Were possible differentiated outcomes and effects of research on women and men considered?[9]
- Have you reviewed literature and other sources related to gender-specific differences in relevant research?[9]

© Fraunhofer

Fraunhofer

Step 3: Questions to consider gender aspects in different project phases (3/4)



Second phase: research phase

Please check if you can already answer YES to the following questions for your project. If this is not the case, see these questions as a suggestion and try to include them in your project.

- Are questionnaires, surveys, focus groups, etc. designed to detect potentially relevant gender and/ or sex differences in your data?[9]
- Are the groups involved in the project (e.g. samples, test groups) balanced?[9]
- Is data analyzed by gender variables? Are other relevant variables related to gender analyzed?[9]

© Fraunhofer

Fraunhofer

Step 3: Questions to consider gender aspects in different project phases (4/4)



Third phase: publication phase

Please check if you can already answer YES to the following questions for your project. If this is not the case, see these questions as a suggestion and try to include them in your project.

- Are statistics, tables, figures and descriptions used that represent gender differences?[9]
- Are journals and channels focusing in particular on gender, in addition to the commonly used research journals and channels, also eligible for publication?[9]
- Have you considered a specific gender-related publication or event? Do you advise your customers on the gender aspects that you identified?[9]

© Fraunhofer

Fraunhofer

Sources (1/2)

1. Bührer, Susanne; Schraudner, Martina (Hrsg.): Wie können Gender-Aspekte in Forschungsvorhaben erkannt und bewertet werden? Karlsruhe: Fraunhofer IRB Verlag, 2006
2. Bundesministerium für Familie, Senioren, Frauen und Jugend: Strategie »Gender Mainstreaming«. [Online]. © 2016. [Access on: 31.10.2018]. https://www.bmfsfj.de/bmfsfj/themen/gleichstellung/gleichstellung-und-teilhabe/strategie-gender-mainstreaming/strategie--gender-mainstreaming-/80436
3. Bundesministerium für Familie, Senioren, Frauen und Jugend (2005): Arbeitshilfe zu § 2GGO: »Gender Mainstreaming in Forschungsvorhaben« [Online]. © 2005. [Access on: 31.10.2018]. https://www.bmfsfj.de/blob/80450/3412003d3b884cf7e7d1e22c329910a3/gm-arbeitshilfe-berichtswesen-data.pdf
4. Bundesministerium Verkehr Innovation und Technologie (Österreich): FEMtech. Gender-Aspekte in der Forschung. [Online]. © 2009. [Access on: 31.10.2018]. https://www.bmvit.gv.at/innovation/aktuell/downloadsaktuell/genderaward.pdf

Sources (2/2)

5. European Commission: Research & Innovation FP7. [Online]. © 2016. [Access on: 31.10.2018]. http://ec.europa.eu/research/fp7
6. European Commission: Vademecum on Gender Equality in Horizon 2020. [Online]. © 2014. [Access on: 31.10.2018]. https://ec.europa.eu/research/swafs/pdf/pub_gender_equality/vademecum_gender_h2020.pdf
7. Hochschule Hannover: Gender in der Forschung – Leitfaden zur Integration von Gender in Forschungsvorhaben. [Online]. © 2017. [Access on: 31.10.2018]. https://www.hs-hannover.de/forschung/genderaspekte-in-der-forschung/leitfaden/index.html
8. Stanford University: Gender in Design. Thinking about Gender. [Online]. © 2018. [Access on: 31.10.2018]. http://genderindesign.com/gender
9. Yellow Window Management Consultants: Toolkit Gender in EU-funded research. Luxembourg: Publications Office of the European Union, 2009

Contact

- Fraunhofer Institute for Industrial Engineering IAO
  Nobelstr. 12 | 70569 Stuttgart

  Anne Spitzley
  Phone: +49(0)711/970-2062 | E-Mail: anne.spitzley@iao.fraunhofer.de

  Michaela Friedrich
  Phone: +49(0)711/970-2219 | E-Mail: michaela.friedrich@iao.fraunhofer.de

JERRI This guideline was developed as part of the project »JERRI – Joining Efforts for Responsible Research and Innovation«: www.jerri-project.de and www.gender-diversity-toolbox.de

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No.709747.

ANNEX III (OPEN ACCESS)

Table 1: Open Access communication matrix

Communication Chanel	Type	Stakeholder	Content	Links
Internal Website of the Fraunhofer-Gesellschaft https://www.fraunhofer.de	• Website “Open Access Strategy”	Public, Politics, Scientific community	Increase visibility of publications, good accessibility to publications and research data, goals an roadmaps	• Open Access Website ePrints
Internal Website of the Fraunhofer IRB https://irb.fraunhofer.de	• Website of the Competence Center Research Services and Open Science • Link to Open Access Strategy (PDF) • Link to Open Access Website Link to ePrints	Public, Scientific community	Present the service portfolio of the department Research Services & Open Science	
Intranet of Fraunhofer-Gesellschaft	• Website “Scientific Publishing” • Website of the department Research Services & Open Science	Scientists at Fraunhofer „Fachinformationsmanager”, Staff of the “Zentralverwaltung“	• Overview service packages e.g., Open Access • Short description of the service packages at the department Research Services & Open Science, library support and publications support	• Publication Support Wiki • Publica/ePrints • Open Access Policy • Open Access Strategy • Website “Open

				Access“ of the Publications Support Wikis • Website with information on Open Access
Website ePrints http://publica.fraunhofer.de/starweb/ep09/index.html	-	Staff of the Fraunhofer-Gesellschaft, Scientists/Interested public	• Short description oft he ePrint servers • Legal backgrounds on Open Access • Open Access and its benefits, ePrints + publication support	• Recherche • Open Access Strategy • “Berliner Erklärung” • Open Access Website • Support for authors • Guidelines Technical documentation and contact
Publications Support Wiki	• Open Access (What is it? What is it good for? What do authors have to do? Open Access Strategy? Links to Materials and Website) • Services of the department Research Services & Open Science	Scientists at the Fraunhofer-Gesellschaft	Detailed information on Open Access and its application	Links to all important resources Open Access

	• Publica/ePrints (Information, Tools for Authors, Expert Information/Library) • Open Science (Open Science in the EU, disambiguation) • Research Data (What are Research Data? Lifecycles of Research Data? How to cite Research Data? Research Data Management and Sustainable Archiving? Support and Services) • Copyright • Bibliometrics • Publication Media • FAQ • Contact About			
Open Access Website https://openaccess.fraunhofer.de	• Introduction to Open Access: What is it? What is it good for? Open Access at Fraunhofer, Circumstances • Open Access Strategy Goals • Open Access Publications: Open Access Gold, Open Access Green • Fraunhofer-Publica: Link to Publica, Link to ePrints References to Open Access Publications, Fraunhofer-Publica, Open Access Strategy https://www.openaccess.fraunhofer.de		Central information platform on Open Access at Fraunhofer	

Flyer	• Flyer “Publikationsprozesse effizient gestalten” (Optimise your publication process) • Flyer “Open Access to Publications”	Scientists at the Fraunhofer-Gesellschaft	• Detailed advice to on scientific publishing by reference to an outline of a publication process considering Open Access • Detailed Flyer for scientists on Open Access and its application	
Brochure *Checklist for Publishing*	•	Scientists at the Fraunhofer-Gesellschaft	• Primary and secondary publications on Fraunhofer Open Access Servers (ePrints) • Benefits of Open Access • Legal issues • Framework conditions • Promotion funds for Open Access publications	
Poster	• Open Access Integration (2011): Benefits of Open Access, Open Access should be included into the of publication process • Publication Funds (2017): We designed a poster to promote the publications fund. The poster has been used at all institutes.	Scientists at the Fraunhofer-Gesellschaft	• Open Access integration (2011): Benefits of Open Access, Open Access should be integrated into the publication process • Publication fund (2017): To promote the publication fund we designed a poster and handed it to all Institutes	

Publications in context of the "*Allianz-AG"*	• Brochure "Open-Access-Position, Prozesse, Perspektiven" (2009) • Brochure "Open-Access-Strategien für wissenschaftliche Einrichtungen" (2012) • Brochure "Open-Access-Publikationsfonds" (2014)	Scientific institutions, decision maker at the central administration	• Introduction to Open Access, Perspectives and processes in the European knowledge landscape, Perspectives of other research organisations in context of the thematic focus "*Digital Information*" by the "*Allianz der deutschen Wissenschaftsorganisa tio nen"* • Building blocks for research organisations to implement Open Access, specific examples • Detailed recommendations on how to organise and finance publication funds, on workflows or the minimum requirements for the cost absorption for Open Access publishing	
Internal Journal: "*Quersumme*"	• "Open Access umsetzen – Orientierungshilfe für Autoren (2007)" • "Die Quote heben" (2008) • "Erfolgreich Publizieren" (2011) • "FORDATIS" (2017)	Scientific institutions, decision maker at the central administration, prime mover at the Fraunhofer-Gesellschaft	• Contents stemming from activities of the Competence Center, short (3000 characters) articles	
Mailing List: "BFI"	• News feed of the Competence Centers Research Services and Open	Expert information community,	• News for the customer group	

	Science to the Community of "FIMs"	"Fachinformationsmanager", staff of the central administration, decision maker, staff of the libraries	"Fachinformationsmanager"	
Mailing List: "*PR-Netzwerk"*	•	PR network	• Topics at the PR network	
Mailing List: "*Ombudspersonen"*	•	Ombudsperson	• Topics at the mailing list of the group of Ombudspersons	
Newsletter: "*Tipps und Tricks vom Publikationssupport"*	• Published at the end of every month.	Expert information community, staff of the libraries	• Hints for the user group "Fachinformationsmanager" and the staff of the libraries stemming from the activities of the publications support team	
Newsletter: "*Trendradar"*	• Published erratically	Expert information community, other stakeholder at the Research-Services and Open Science e.g., central administration	• The "TrendRadar" newsletter provides information on trends in the context of publication and Open Science	
Information event: *"Scientific publications"*	• On demand	Scientists at Fraunhofer	• Detailed information on all fields of scientific publishing, especially its specific application	
Seminar: "Research Data Management"	• On demand	Scientists at Fraunhofer	• Detailed information on the issue of publishing research data	
Presentations and publications	• Talks at and participation in open forum discussion events organised by the	Open Access community,	• Open Access at the Fraunhofer-Gesellschaft	

	Open Access Community. • Talks at several networks of the Fraunhofer-Gesellschaft	"Fachinformationsmanager", IT manager, Ombudsperson		
Networking meetings	• Symposium "Netzwert" • Task force on "Open Access" of the Alliance of Science Organisations in Germany • Task force at EARTO • "Fachforum und Netzwerktreffen Fachinformation" • Meeting of the IT Managers • Meeting of the group of Ombudspersons • Open Access Days • Open Science Conference	Open Access community, "Fachinformationsmanager", IT manager, Ombudsperson, Scientists at Fraunhofer, German research organisations, European RTOs		
Publications	• Klages, Tina; Wuchner, Andrea (2017): Open Science bei Fraunhofer, • Küsters, Ulrike; Klages, Tina (2018): Fostering Open Science @Fraunhofer	Open Access community	• Open Science at the Fraunhofer-Gesellschaft	

Open Access template clause

If the beneficiary publishes her or his findings resulting from the funded research project as a contribution to a scientific journal, this should be done in such a way that the public can access the electronic version (Open Access) to the contribution. If the contribution does not initially appear in a journal accessible to the public free of charge and electronically, the contribution should also be made available to the public free of charge and electronically, if necessary after the expiry of a reasonable period (embargo period) (secondary publication). In the case of a secondary publication, the embargo deadline should not exceed twelve months.

Figure 1: Fact sheets for integrating open data into contract negotiations

Fraunhofer

BENEFITS OF OPEN ACCESS & OPEN DATA

FOR SCIENTISTS



Picture by geralt on Pixabay

CC Research Services & Open Science

Nobelstr. 12
70569 Stuttgart

Contact:
Eric Retzlaff
eric.retzlaff@irb.fraunhofer.de
Phone: +49 711 970-2619

publikationssupport.fraunhofer.de
publikationssupport@fraunhofer.de

Fraunhofer IRB

OPEN ACCESS

Open Access means free access to scientific publications

- **Increase your visibility**
  - Present your activities
  - Claim your R&D topics
  - Display your portfolio
  - Increase citation rate
- **Increase your acquisition**
  - Get more customers
  - Get more cooperation partners
  - Work more efficient with scientific organisations
- **Improve your image**
  - Make your competences visible
  - Improve your public image
  - Create transparency
  - Raise your reputation in the scientific community
- **Ensure compliance**
  - Increase sustainability
  - Fulfil funding requirements (BMBF, EU, ...)

OPEN DATA

Open Data means free access and re-use of research data

- **Give data to get data**
  - Re-use published data
  - Publish your own data if possible
  - Open Data resources:
    EOSC: https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud
    FORDATIS: https://www.openaccess.fraunhofer.de/en/open-access-strategy.html
- **Accelerate your R&D progress**
  - By re-using existing datasets (e.g. measurement series)
  - Avoid multiple creation of datasets
  - Cross-disciplinary use of data
- **Ensure compliance**
  - Increase sustainability
  - Fulfil funding requirements (BMBF, EU, ...)

Fraunhofer

BENEFITS OF OPEN ACCESS & OPEN DATA

FOR INDUSTRIAL PARTNERS



Picture by geralt on Pixabay

CC Research Services & Open Science

Nobelstr. 12
70569 Stuttgart

Contact:
Eric Retzlaff
eric.retzlaff@irb.fraunhofer.de
Phone: +49 711 970-2619

OPEN ACCESS

Open Access means free access to scientific publications

- **Increase your visibility**
  - Present your activities
  - Claim your R&D topics
  - Display your portfolio
- **Increase your acquisition**
  - Get more customers
  - Get more cooperation partners
- **Improve your image**
  - Make your competences visible
  - Improve your public image
  - Create transparency
- **Ensure compliance**
  - Increase sustainability
  - Fulfil funding requirements (BMBF, EU, ...)

OPEN DATA

Open Data means free access and re-use of research data

- **Give data to get data**
  - Re-use published data
  - Publish your own data if possible
  - Open Data resources:

  EOSC: https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud

  FORDATIS: https://www.openaccess.fraunhofer.de/en/open-access-strategy.html
- **Accelerate your R&D progress**
  - By re-using existing datasets (e.g. measurement series)
  - Avoid multiple creation of datasets
- **Ensure compliance**
  - Increase sustainability
  - Fulfil funding requirements (BMBF, EU, ...)

Fraunhofer IRB

Process for Development of Open Data Business Models

EXECUTIVE SUMMARY

We created suggestions in the context of Open Data business model development. First, we analysed the current theoretical frameworks. Second, we conducted an empirical survey. Third, we held 2 different hands-on workshops.

We derived the following results:

Two key activities

Our analysis shows, that it is crucial to focus not only on business model development but also on key activities that supports proactively the socio-political and the socio-economic change and reduce overall uncertainty:

1. Develop clear-cut agendas, guidelines and fact sheets for data privacy and data protection as well as precedents to improve informed decision-making for all stakeholders.
2. Develop unambiguous copyright/licencing models (use de facto standards if possible) and pricing models to improve certainty for all stakeholders.

Five value proposition domains

By combining the results from our 3 distinct approaches we arrive at the following 5 Open Data business model value proposition domains, which can serve as a basis for further business model development in the realm of the emerging Open Data markets:

1. Data-literacy, data analysis and visualisation through experts (data scientists) and the help of tools (algorithms).
2. Data simplification with through experts (data scientists) and tools (algorithms).
3. Data enrichment, enhancement, integration through experts (data scientists) and the help of tools (algorithms).
4. Data support, service, guidelines, governance and training from experts.
5. Data-coupling, data-matching and data integration through experts (data scientists) and tools (algorithms).

These 5 proposition domains combined with the 2 key activities can serve as a suggestions for further Open Data business model development.

METHODS

To generate optimal results for WP6 we used the following 3 distinct methods:

6. Theoretical analysis
    a. A systematic literature search was conducted. (approximately 100 resources)
    b. The results were fed into a bibliographic database. (approximately 50 resources)
    c. A careful sight of the gathered literature was carried out. (approximately 30 resources)
    d. A systematic review and analyses of studies, reports and documents on the topic of Open Data and Open Source business models was carried out. (approximately 10 resources)
    e. A systematic comparison and combination of the key findings of the analysis was carried out.
7. Empirical survey
    a. Interviews with 8 experts à ca. 1-1-5 hours in different research areas
    b. Guiding questions regarding the following topics:
        i. Knowledge of Open Access and Open Data
        ii. The state of affairs at the respective Institute
        iii. Handling of Data
        iv. Awareness regarding utilisation possibilities of data
        v. Are there any good practices?
8. Do you see potentialities or challenges?
9. Hands-on workshops
    a. To achieve maximal efficiency we chose the global parameters for the business model workshop to be: high intensity, short time interval (3 hours in total), small group and high level of expertise (3 experts).
    b. To achieve maximal reliability of our results we did not inform the expert group on the results of our prior theoretical analysis.
    c. We utilized a 30-minutes asynchronous brainwriting session followed by a short sorting and a 20-minute dot voting to generate initial potential value propositions, products, services and key features (1 hour in total).
    d. We used a solo write up session combined with a follow-up session of lightning talks to develop initial business model canvases (1 hour in total).

We used 2 sessions of brainswarming. The goal of the first session was to immunise the initial business models against potential shortcomings. The goal of the second session to optimise for potential beneficial circumstances (1 hour in total).

MAIN PART

1. THEORETICAL ANALYSIS

To develop suggestions in the context of Open Data business model development we reviewed and analysed the existing theoretical frameworks on this topic.

Our theoretical analysis is comprised of 4 parts: First, we assess the potential impact of Open Data in general. Second, we classify current business model resorting to pre-established taxonomies. Third, we contextualise the most promising business model patterns by critically assessing current Open Source business models. Fourth, we integrate our results from the first 3 parts.

The result of our analysis process is a small selection of only the most promising potential business models and their aspects. These business models serve as a basis for informed decision-making in business model development.

1.1. The potentials, challenges and the impact of Open Data

Open Data and Open Science in general, is a new global trend with huge transformative potential. However, it is hard to predict which of the current Open Science trends and its corresponding paradigm shifts will translate into new stable markets. It is clear though that the existing data infrastructures are undergoing a transformation process right now. This in turn will at least open up a short-term market for transformational technologies and services.

Following Mohr and Hürtgen (2018) data is already important and will be even more important in value creation in the near future. There will be more data, richer data and more data tools also driven by the internet of things (IoT). (Mohr, Hürtgen 2018, 2) One of the most prevalent cases for the massive impact of data are the synergetic effects between artificial intelligence and big data. (Mohr, Hürtgen 2018, 3) However, artificial intelligence require large amounts of clean, rich and bias-free data. In this context, raw data is almost useless but with a high quality systematically managed value chain, it is possible to capture the genuine value of data, (Mohr, Hürtgen 2018, 3) not only to drive artificial intelligence but also to drive an entire class of new smart solutions. While algorithms are already freely available commodities, companies keep their data under lock and key. (Mohr, Hürtgen 2018, 5) As the total volume of available data increase, relevance assessment, timing, thoughtful pre-analysis and logical layering of the data becomes more and more important. (Mohr and Hürtgen 2018, 6) In general, following Mohr and Hürtgen (2018), enriching data with additional information and extracting insights using artificial intelligence will likely become mainstream activities. Insight-based value creation can be achieved by supporting growth, by reducing costs or by creating new portfolio items. (Mohr and Hürtgen 2018, 8) However, following Hürtgen and Mohr (2018, 13) there are also at least 3 challenges: (1) linking data and business, (2) closing the gap between insight and impact and (3) consistent integration of data analytics. Mohr and Hürtgen 2018, p. 8) To address these challenges Hürtgen and Mohr (2018, 13, 14) propose 5 guiding principles and 5 strategic action principles derived from best practices in successful companies.

Guiding principles (Mohr and Hürtgen 2018, 13-14):

1. Analytics is a language not a tool.
2. Translators between data and business are crucial.
3. Change management is crucial.
4. IT must develop freely.
5. Agility must be lived and breathed.

Strategic action principles (Mohr and Hürtgen 2018, 13-14):

1. Business model first data second.
2. Focus on the top-3 use cases.
3. Rapidly build the IT infrastructure.
4. Hire data scientists.
5. Set yourself up for scale.

Arguably, the same general potentials and challenges holds true for both: companies as well as research and technology organisations (RTOs). Following Bilsen et al. (2018, 3) the core mission of RTOs is to deliver research and technology to the market and society. (Bilsen et al. 2018, 3) Open innovation is a key paradigm of RTOs. (Bilsen et al. 2018, 3) There are 2 types of activities of RTOs that attribute to their total economic impact or footprint: (1) funding and employment, (2) collaborative contract research and spin-off activities. (Bilsen et al. 2018, 3) In 2016 those activity types of 9 European RTOs in total caused the creation of 284.000 jobs. (Bilsen et al. 2018, 3) The total fiscal return adds up to 2.6 billion. (Bilsen et al. 2018, 3) On average for each job in one of the RTO another 4 jobs are created in the economy and for each euro invested 3 euros flow back to the national government. (Bilsen et al. 2018, 4) Due to globalisation, digitalisation, and short product cycles, research and development (R&D) in companies changed a lot during the last couple of years. Complexity, specialisation challenges companies to be more collaborative and more open. (Bilsen et al. 2018, 72)

Complexity and heterogeneity is one of the key challenges for companies and RTOs. Following Swan and Brown (2008, 7, 14) creation, management, appreciation and sharing of data is highly heterogeneous among individual researchers and various disciplines. (Swan and Brown 2008, 7, 14) Arguably, making data usable, re-usable, sustainable and interoperable is a challenge and requires significant long term commitment. Co-operation between institutions, research funders and researchers is key to ensure data sustainability. (Swan and Brown 2008, 9)

Openness, deep cooperation and free sharing of data seems to be a natural approach to deal with complex markets and short product cycles. At the same time openness, cooperation and free sharing, is also a challenge. Especially intellectual property and Open Data seems to contradict each other. Nevertheless, Open Science (including Open Data) and intellectual property rights are of course compatible in principle—there is at least no conceptual or logical necessity for them being incompatible. Yet, to integrate both worlds there is a need, for guidelines, frameworks and precedents. The European Commission plays a key role to build a sound framework of Open Science and copyright policies. (Crouzier 2017, 2) Following Crouzier (2017, 2) one should draw inspiration from best practices and established policies within RTOs, which do have social commitments as well as partnerships with the industry. (Crouzier 2017, 2) Crouzier (2017) gives the following recommendations:

> *"Preserve the European Commission base principle for Open Data: 'as open as possible and as closed as necessary'. […] Support of "bottom up" growth of Open Science and Open Data, while encouraging translation of research outputs into the commercial world." (Crouzier 2017, 2-3)*

Following the European Commission (2017, 6) there are 11 recommended key actions to maximise the impact of EU Research & Innovation programmes in context of Open Science in general and Open Data in particular. Overall, some of the key recommendations stated in this report are:

1. "Make international R&I cooperation a trademark of EU research and innovation Action: open up the R&I programme to association by the best and participation by all,

based on reciprocal co-funding or access to co-funding in the partner country." (European Commission 2017, 6)

2. "Europe must embrace the transformative power of open science, allowing for a faster circulation of increasing amounts of knowledge, and seize the potential of open innovation to trigger faster and fairer growth, building a knowledge economy that is open to the world." (European Commission 2017, 8)
3. "For its part, the post-2020 EU R&I programme should reinforce support for skills and competence development in EU-funded projects. Collaborative R&I projects should include training activities for the next generation of researchers and innovators, particularly skills needed for data-driven open science." (European Commission 2017, 13)

Very likely Open Science will have a socio-economic impact not only in Europe. Open Science and Open Data has high potential to improve the European society as well as the European economy. (San Chan et al. 2015, 10) *"Between 2016 and 2020 25,000 jobs directly related to Open Data will be created"* (San Chan et al. 2015, 10) The European Union should take further steps in *"creating a 'data value chain friendly' policy environment. The objective is to put in place the 'systemic' prerequisites for effective use and re-use of data through legal and soft law measures."* (San Chan et al. 2015, 7)

Similarly, the European Commission (2018, 11, 12) states that openness in its 3 aspects open innovation, Open Science, Open Science is the key factor that guarantees welfare and sustainability in Europe for the next decade. (European Commission 2018, 11, 12) The 3 O's paradigm will improve Europe's *"'broken' knowledge-innovation nexus"* (European Commission 2018, 159) only if it is

> "fully embedded within an new policy vision. A vision which sets out a European long-term framework: a new social contract, allowing for flexibility, learning and experimentation whereby openness in research and innovation and openness to the world is part of the new digital democratization process bringing together citizens, academics, researchers, innovative firms building a common project 'to the benefit of all'." *(European Commission 2018, 159)*

The current de facto impact of data combined with the transformative power of Open Science in general and Open Data in particular gives rise to the question of the potential social and economic impact of Open Data in the near future. There are good reasons to believe that Open Data will have a socio-economic impact. However, to ensure long the term success of Open Data and its emerging markets, we need a clear understanding of the socio-economic and socio-political workings of current and future Open Data business models.

1.2. Current Open Data business models

To deal with the socio-economic and socio-political complexity that accompanies Open Data and related business models, it is reasonable to choose a taxonomic approach. For example, according to Ferro and Osella (2013) there are 8 archetypical Open Data business models especially in context of Public Sector Information (PSI) re-use (see also (Howard 2013)):

1. premium product/service,
2. freemium product/service,
3. Open Source like,
4. infrastructural razor and blades,
5. demand-oriented platform,

6. supply-oriented platform,
7. free as branded advertising,
8. white-label development: subscription models.

Zeleti et al. (2014, 3–5), for example, identify 15 types of Open Data business models. In contrast to the perceived opportunities that arise from Open Data, our literature analysis shows that it is difficult to obtain solid evidence that underpin the soundness of those and similar types of business models. Zeleti et al. (2014 ,1) seems to share this impression:

> "[…] scholarly efforts providing elaborations, rigorous analysis and comparison of open data models are very limited. This could be partly attributed to the fact that most discussions on open data business models are predominantly in the practice community. This shortcoming has resulted in a growing list of open data business models which, on closer examination, are not clearly delineated and lack clear value orientation" (Zeleti, Ojo, and Curry 2014, 1)

We consider the results from Ferro and Osella (2013), Howard (2013) and Zeleti et al. (2014) to be the most conclusive ones so far. In summary, our analyse shows that—according to the authors mentioned above—the most important Open Data business models seems to cluster around the following 7 themes:

1. Premium: We charge a fee upfront for the premium version that includes future updates and support.
2. Freemium: A small basic version is free, for a more elaborate version we charge a fee.
3. Open-source-like: We generate money by charging our service or support or by raising funds.
4. Infrastructure: The basic infrastructure is free; tools operating on it will be charged.
5. Subscription based models: Customers pay periodically for the product or service.
6. Advertising: Advertising and traffic for other business areas.
7. Multi-licensing: Private or social use is free; the version for commercial or institutional use will be charged.

Those high-level considerations on current and potential business models are valuable in regard of preliminary sorting business model approaches and recognising reoccurring patterns in business model development. However, those theoretical considerations are not informative or have only limited predictive power. To address this challenge and to improve our predictions on how successful different Open Data business models might be, we did another short review of current paradigmatic Open Source business models. This approach is prima facie valid because data and source code are closed relatives in the digital domain.

1.3. Current Open Source business models[13]

While there are arguably no clear-cut cases of Open Data business models yet, there are however successful business models in the realm of *Open Source* for many years. That fact suggests *eo ipso* the following objective: By analysing current Open Source markets and their successful as well as unsuccessful business models we can derive insights as well as well-founded decisions regarding possible business models for the *bona fide* Open Data markets.

Open Source software and collaborative Open Source development in particular is undoubtedly one of the most important pillars of our modern life. On the one hand, closed

13 Please note, that it was *not* the focus of our work package to consider and analysis of Open Source per se. However, Open Source is the third important output category.

source is common in the desktop market: about 82% of desktops are powered by a closed source, proprietary operating system i.e., Microsoft Windows. (statcounter 2019) On the other hand, about 88% of our smart phones are powered by Android, an Open Source unix-like operating system. (Statista 2019) Browser market share worldwide is about 57% for Chromium, an Open Source web browser. (statcounter 2019) Open Source unix-like servers power about 69% of the accessible websites worldwide. (w3techs 2019) In this regard, Open Source is arguably very successful. However, in contrast to the widespread successful use of Open Source (software), the *business success* of Open Source (business models) is *not* clear-cut.

The plurality of Open Source approaches on paper and in real life seems to suggest that there are at least some niches for Open Source business models, however conclusive cases for real world proven Open Source business models are surprisingly rare, as it turns out on closer inspection. Levin (2014) for example argues that there is indeed no real world example of a working Open Source business model with the exception of Red Hat, a multinational open-source software company. Arguably, this specific case can considered being an exception not the rule. (Levine 2014) The only approach that is really working according to Levin (2014) is the *software as a service model*. Levin (2014) distinguishes between collaborative development of Open Source software on the one hand and an Open Source business model on the other hand. According to Levin (2014) Open Source software development is *"the best software development and maintenance methodology over the long term" but in contrast, "[t]here is no 'open source business model.'"* (Levine 2014) Walker (2017) argues that the true value proposition in the context of Open Source lies in the platform of a team or company *not* the Open Source code itself:

> *„No proprietary product built as an addition on top of open source software has ever achieved ubiquity in the modern data center, with the possible exception of VMware […]. It seems that the only successful products that utilize open source components are those where the proprietary bits are the platform, and the open source parts are simply the commodity bits that fill in the gaps that developers can use to more quickly create a product." (Walker 2017, 9)*

In line with this thinking, Walli (2016) argues that one must not confuse the Open Source software development with the Open Source business model for the former does exist the latter does *not* exist. This does not mean that there is no Open Source business model at all, but that one should differentiate between Open Source business models and Open Source development. It seems reasonable to suppose that, the same line of thinking applies to Open Data. At least it is reasonable that we can transfer the lessons learned from the current Open Source market to the current and future Open Data market.

1.4. Combined results of the theoretical analysis

In the light of the first 3 steps of our analysis i.e., (a) the impact of Open Data, (b) the current Open Data business models and (c) the current Open Source business models, we identify the following 4 paradigmatic value propositions addressing the Open Data market:

1. Interpretation and analysis of the data through experts.
2. Manipulation of the data by special tools (software).
3. Support, service and expertise regarding the data and data tools infrastructure.
4. Additional features and tools that enhance data relative to a specific use case.

This list is of course neither extensive nor exclusive but it gives us clues on potential Open Data business models. Yet, by carefully selecting and combining this results of our analysis of the theoretical frameworks with (a) the results of the empirical survey and (b) the results of our 2 workshop we arrive at well-informed potential Open Data business models.

2. EMPIRICAL SURVEY

Please see section 3.4.6. (Survey) in the main document: *JERRI – Joining Efforts for Responsible Research and Innovation, Deliverable D6.1, Fraunhofer implementation report*.

3. HANDS-ON WORKSHOPS

We developed and conducted 2 distinct workshops. In the first workshop, we developed business models in the context of *heterogeneous research data in the urban environment*. In the second workshop, we developed business models in the context of *Open Data in general*.

3.1. Heterogeneous research data in the urban environment

The first workshop on data-based business models took place on 8th May 2018 at the Fraunhofer IAO in the research field with heterogeneous research data in the urban environment.

Venue: Fraunhofer IAO in Stuttgart.

Participants: 10 experts in the field of urban environmental research, Fraunhofer IRB Tina Klages from Fraunhofer IRB, CC Research Services & Open Science.

Results: We generated 2 concrete data business models (these cannot be shown here for reasons of confidelity) by using the method of Business Model Canvas by Osterwalder and Pigneur (2011).

The workshop led to several findings concerning the work on business models in the context of a certain research domain.

Before the work could begin, it was crucial to thoroughly explain the concept of business models and why they are an important concept of exploitation of research data.

- First step is to think about the kind of data the research fields generate (types, quantity and how they are generated).
- The next important step was to discuss all potential stakeholders around this data
- The third step was to analyse the market for these types of data.

These topics had to be clear before the business model canvas could be used to talk about business models that fit to all these domain specific requirements.

Furthermore, some challenges in the context of the possible reuse of research data were identified (see table 1).

Table 2: Workshop 1: Challenges in the context of the possible reuse of research data

Challenges	- Legal issues
	  - Who owns the data?
	  - License? Copyright?
	- Data transfer to customers is complicated
	- Capacities and competences
	- Transparency
	- Contracts and processes
	- Financing structure
	- Typing of win-win models
	- Lack of interoperability

Requirements at the ILO	- Security for the employee that data may be collected / shared - Anonymization of data - Neutrality → Sharing needs "Trust" - Easier data platform (Dropbox) - Uniform non-proprietary data space - Own data outside the ordinary project business - Time: clear incentives for participation - Holistic approach (reduces capacity requirements on the long run, requires extra capacity at the beginning, though)

3.2. Open Data business models

The goal of the second workshop was to generate new yet simple Open Data business models for RTOs and companies. To maximise the reliability of our results we did not inform the participants on the results of our prior analysis. For detailed information on the methods and schedule, please see table 2-3.

Date: 12th of February 2019, 11:30-15:30

Venue: Fraunhofer IRB in Stuttgart.

Participants: 3 experts drove this workshop: MBA Ekaterina Dobrokhotova from the Fraunhofer IAO/Urban Data & Resilience, Dr. Tina Klages, Andrea Wuchner from the Fraunhofer IRB/Competence Center Research Services & Open Science.

Results: We generated 6 Open Data business models ranging over 6 distinct value proposition domains, please see fig. 1:

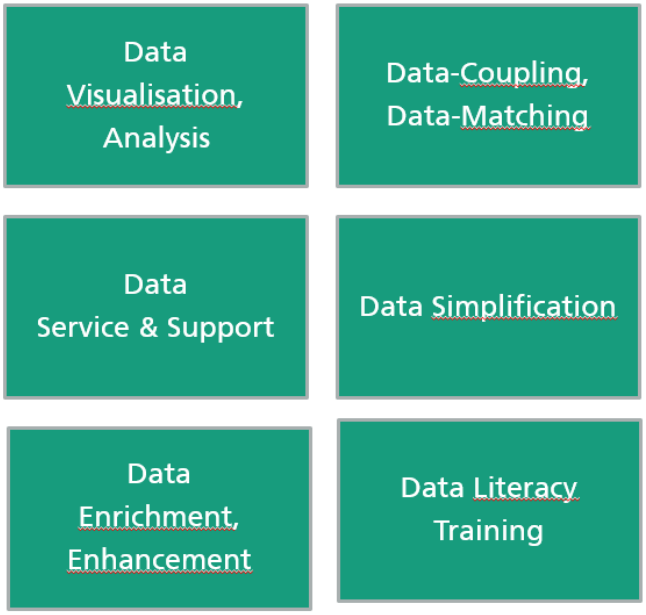


Figure 2: Open data business model value proposition domains

Table 2: Workshop 2: Methods in detail

Slot				Time				Topic	Content
Chapter	Method								
Intro				15					
Diverge	Free Ideas (Solo)			5				Questions and Ideas	Open Data?
	Intuitions Asynchronous brainwriting	1	write	3	16	30	40		What is it that makes you smile if you think of open data?
			review	1					Which products, services or key features can you think of?
		2	write	3					Which products, services or key features would you buy?
			review	1					
		3	write	3					
			review	1					
		4	write	3					
			review	1					
			dot vote	14					Result: Top 4 ideas
	Free Ideas (Solo)			5					
Lunch				30					
	First thoughts		solo write-up	30				BM Canvases	Basierend auf den 4 besten Ideen: **Welche Geschäftsmodelle fallen dir jeweils ein?**
		1	lightning talk	5	20	30	60		
		2	lightning talk	5					
		3	lightning talk	5					
		4	lightning talk	5					
			dot vote	10					Result: **Top 4 Business Models (BM)**
Bio break				10					
Converge	Brainswarming	1	write: good conditions	5	10	20	30	Conditions	Based on the top 4 BM: **Which good circumstances can you think of?**
			post: good conditions	5					
		2	write: bad conditions	5	10				Based on the top 4 BM: **Which bad circumstances can you think of?**
			post: bad conditions	5					
			discuss	10					
	Second thoughts		solo write-up	10			60	BM Hardening	Based on the top 4 BM: Which imporved BM can you think of?
		1	lightning talk	5	20	30			
		2	lightning talk	5					
		3	lightning talk	5					
		4	lightning talk	5					
Wrap up				10				Take home message	

Table 3: Workshop 2: Blank business model canvas used in the business canvas session in style of Osterwalder and Pigneur (2011)

<table>
<tr><td rowspan="2">Key
partners</td><td>Key
Activities</td><td rowspan="2">Value propositions</td><td>Customer relations</td><td rowspan="2">Customer segments</td></tr>
<tr><td>Key resources</td><td>Channels</td></tr>
<tr><td colspan="3">Cost structure</td><td colspan="2">Revenue statement</td></tr>
</table>

CONCLUSION

To create suggestions for business model development we chose a threefold approach: First, we analysed the current theoretical frameworks. Second, we conducted a supplementary empirical survey. Third, we held 2 different hands-on workshops.

The result of our threefold approach is a guideline consisting of 2 main points: (a) *key activities* and (b) *value proposition domains*.

Two key activities

Our analysis shows, that it is crucial to focus not only on business model development but also on key activities that supports proactively the socio-political and the socio-economic change and reduce overall uncertainty:

1. Develop clear-cut agendas, guidelines and fact sheets for data privacy and data protection as well as precedents to improve informed decision-making for all stakeholders.
2. Develop unambiguous copyright/licencing models (use de facto standards if possible) and pricing models to improve certainty for all stakeholders.

Five value proposition domains

By combining the results from our 3 distinct approaches we arrive at the following 5 Open Data business model value proposition domains:

1. Data-literacy, data analysis and visualisation through experts (data scientists) and the help of tools (algorithms).
2. Data simplification with through experts (data scientists) and tools (algorithms).
3. Data enrichment, enhancement, integration through experts (data scientists) and the help of tools (algorithms).
4. Data support, service, guidelines, governance and training from experts.
5. Data-coupling, data-matching and data integration through experts (data scientists) and tools (algorithms).

These 5 Open Data business model value proposition domains can serve suggestions for further Open Data business model development. We believe that business models, which builds on those proposition domains, are promising candidates for successful Open Data business models for the emerging Open Data markets.

REFERENCES

Bilsen, Valentijn, Isabelle De Voldere, Miriam Van Hoed, and Kleitia Zeqo. 2018. 'EARTO – European Association of Research and Technology Organisations Rue Joseph II, 36-38 B-1000 Brussels', 74.

Crouzier, Thomas. 2017. 'IPR, Technology Transfer & Open Science', 23.

European Commission. 2017. 'LAB – FAB – APP — Investing in the European Future We Want'. European Commission. http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/hlg_2017_report.pdf.

———. 2018. 'Europe's Future : Open Innovation, Open Science, Open to the World : Reflections of the Research, Innovation and Science Policy Experts (RISE) High Level Group.' Website. 28 September 2018. https://publications.europa.eu/en/publication-detail/-/publication/15e2ff8d-c525-11e8-9424-01aa75ed71a1.

Ferro, Enrico, and Michele Osella. 2013. 'Eight Business Model Archetypes for PSI Re-Use'. In *Open Data on the Web Workshop*, edited by Google Campus. https://www.w3.org/2013/04/odw/odw13_submission_27.pdf.

Howard, Alex. 2013. 'Open Data Economy: Eight Business Models for Open Data and Insight from Deloitte UK'. https://www.oreilly.com/ideas/open-data-business-models-deloitte-insight.

Levine, Peter. 2014. 'Why There Will Never Be Another RedHat: The Economics Of Open Source'. *TechCrunch* (blog). 2014. http://social.techcrunch.com/2014/02/13/please-dont-tell-me-you-want-to-be-the-next-red-hat/.

Mohr, N.; Hürtgen, H. (2018): Achieving business impact with data. A comprehensive perspective on the insights value chain. McKinsey & Company.

Osterwalder, Alexander, and Yves Pigneur. 2011. *Business Model Generation: ein Handbuch für Visionäre, Spielveränderer und Herausforderer*. Translated by J. T. A. Wegberg. Frankfurt New York: Campus Verlag.

San Chan, Wae, Wendy Carrara, Eva van Steenbergen, Sander Fischer, Fraunhofer Fokus, Sogeti, Open Data Institute, et al. 2015. *Creating Value through Open Data Study on the Impact of Re-Use of Public Data Resources.* Luxembourg: Publications Office.

statcounter. 2019. 'Desktop Operating System Market Share Worldwide'. StatCounter Global Stats. 2019. http://gs.statcounter.com/os-market-share/desktop/worldwide/.

Statista. 2019. ‘Mobile OS Market Share 2018’. Statista. 2019. https://www.statista.com/statistics/266136/global-market-share-held-by-smartphone-operating-systems/.

Swan, Alma, and Sheridan Brown. 2008. ‘To Share or Not to Share: Publication and Quality Assurance of Research Data Outputs. A Report Commissioned by the Research Information Network’. Monograph. June 2008. https://eprints.soton.ac.uk/266742/.

w3techs. 2019. ‘Usage Statistics and Market Share of Operating Systems for Websites, February 2019’. 2019. https://w3techs.com/technologies/overview/operating_system/all.

Walker, John Mark. 2017. ‘Building a Business on Open Source’. *The Linux Foundation* (blog). 5 June 2017. https://www.linuxfoundation.org/open-source-management/2017/06/building-a-business-on-open-source/.

Walli, Stephen. 2016. ‘There Is NO Open Source Business Model’. *Stephen Walli* (blog). 25 October 2016. https://medium.com/@stephenrwalli/there-is-no-open-source-business-model-cdc4cc20238.

Zeleti, Fatemeh Ahmadi, Adegboyega Ojo, and Edward Curry. 2014. ‘Emerging Business Models for the Open Data Industry: Characterization and Analysis’. In *Proceedings of the 15th Annual International Conference on Digital Government Research*, 215–226. Dg.o ’14. New York, NY, USA: ACM. https://doi.org/10.1145/2612733.2612745.