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Innovating Responsibly in ICT for Ageing: Drivers, Obstacles and Implementation

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Abstract: Responsible research and innovation (RRI) is a nascent concept, promoted actively by the European Union and other policy makers around the world. Hitherto, this concept has been associated primarily with publicly funded activities but given the considerable proportion of research and innovation that is undertaken in the private sector, RRI will be rendered irrelevant unless it is adopted by industry. This paper introduces a private sector perspective of RRI, specifically that of the information and communication technology (ICT) industry, working in the field of healthy ageing. Drawing upon empirical data from 30 in-depth interviews with key industry representatives from across Europe, it explores: (a) the level of awareness of RRI; (b) the drivers and obstacles influencing its implementation; and (c) the factors deemed vital for facilitation of RRI in industry. The findings paint a varied picture, including significant concerns about adoption of RRI in an industry environment where the economic implications of all activities must be considered carefully. However, some companies have found their own ways to balance financial and altruistic goals, suggesting that there is both a willingness and a place for an RRI-type governance framework within the private sector.

Keywords: corporate social responsibility; ICT; industry; interviews; responsible research and innovation

1. Introduction

Modern societies rely upon research and innovation (R&I) to address pressing problems such as demographic change, security and environmental or social sustainability. Current European Union (EU) policy specifically underlines the importance of R&I in addressing these so-called "grand challenges" and, more generally, highlighting the need for a responsible approach to R&I activities [1,2]. In this context, the EU is promoting robustly the concept of responsible research and innovation (RRI) as a key governance framework that underlies its considerable investment in research and technology development (over €70 billion for Horizon 2020). The primary aim of RRI is to provide assurance that research and innovation activities address social, ethical and environmental issues effectively.

RRI is not limited to the EU. There have been, and currently are, attempts to promote RRI worldwide through a global network, including areas such the US, China, Japan, India, Australia and South Africa. This has attracted the interest of scholars and policymakers beyond the EU who are exploring how RRI can be embedded within their research policy agendas [3]. Overall, there is consensus in the literature that RRI is essential for ensuring that research and innovation, and the resultant products, have a positive impact on society [4,5]. Without the concept of RRI to drive innovation decisions, innovators run the risk of spending time and money on projects that will not be

accepted by society [6]. Moreover, society can be vulnerable to innovations that exacerbate, rather than improve, societal challenges. Given that the vast majority of research and innovation activities occur in the private sector, it is clear that the focus of RRI needs to extend beyond existing research governance and policy instruments such as technology assessment, philosophy and ethics of technology, or risk management [5,7]. Policy needs to be sensitive to specific industry-related challenges, such as tensions between the need for short-term profit versus long-term stability and corporate research cultures. Such an approach will allow for the transfer of knowledge and application of RRI to industry.

Companies that engage in R&I could benefit from the espousal of RRI in a number of ways. For example, a better understanding of customer needs might enhance customer satisfaction, and the incorporation of RRI into risk management procedures might lead to reputational gains. Companies that take their corporate social responsibility seriously may find that RRI is an effective way of advancing this aspiration. Early engagement with RRI can allow industry to anticipate the potential for adverse effects and hence develop ways of dealing with them proactively. Despite such benefits of RRI to companies, the current literature has little to say about RRI in industry. Aside from some notable exceptions [8], the focus of contemporary RRI discourse is on publicly funded research and, significantly, there is a paucity of evidence for how industry perceives RRI and what might drive or impede implementation.

This paper aims to address this knowledge gap. Empirically, we introduce new firm level data from 30 key industry personnel spanning eleven EU countries. Thus, we present real-world issues that influence corporate research and innovation activities at an EU level and contribute to the gradually expanding RRI literature through an analysis of: (a) the nature of current RRI-related activity; (b) the drivers and obstacles influencing its implementation; and (c) the key supporting components for facilitation of RRI in industry.

For our exploration, we identified the particular field of Information and Communication Technology (ICT) as it poses a number of challenges for responsibility in R&I. One characteristic that sets ICTs apart from other technologies is their "logical malleability" [9] (p. 269) or flexibility in terms of application [10] (p. 49). The term "logical malleability" was introduced into the discussion of ethics and computing to highlight the difficulty of predicting future uses and outcomes. While all novel technical developments and innovations can have unpredictable consequences, the added difficulty in the case of ICT is that these technologies are usually designed as multi-purpose machines. Consequently, it is not always possible to assess intended consequences, as the logical malleability of the technologies means that numerous and even contradictory consequences can be envisioned. In addition, the algorithms in ICTs are characteristically opaque; they are normally invisible to the user and able to hide particular views and positions [11]. Furthermore, they can interact with each other in unforeseeable ways and the actual use of any ICT technology or innovation often lies beyond the control of the innovator or researcher. This is caused, at least in part, by the "problem of many hands" [12,13]; the development of ICT, especially software, builds on past work which becomes embedded and can be impossible to extricate. It is therefore often impossible to draw causal chains from the actions of one person to a particular outcome. As the pervasiveness of ICT increases, so its logical malleability becomes more of a concern [14].

In this investigation, we focus on the application of ICT to one grand challenge, namely 'health, demographic change and wellbeing'. Demographic change, in particular the fact that average life expectancies are rising in most countries, has been recognised as an issue that demands novel solutions. Older people are also more likely to require health and social care, leading to bottlenecks in service provision and increasing costs. Many policymakers believe that some of these issues can be eased by through innovative use of ICT to help people stay healthy and independent for longer. This has led to the development of a growing number of activities and institutions that specifically fund research and innovation in ICT for this purpose (for example, the European Innovation Partnership on Active and Healthy Ageing or the Division on Health of the European Institute of Technology).

The subsequent sections of this paper are organised as follows: In Section 2, we discuss responsible research and innovation where, due to a paucity of relevant RRI literature, we draw on the Corporate Social Responsibility (CSR) literature to identify relevant drivers and barriers influencing implementation. CSR provides a useful framework for RRI [15] and thus can be used as a starting point for identifying potentially similar motives and obstacles for RRI in industry. Section 3 describes the empirical methodology that we employed and Section 4 presents the results. Section 5 discusses the paper's findings, while Section 6 provides a summary of the main conclusions.

2. Theoretical Approach

2.1. Responsible Research and Innovation

Responsible Research and Innovation is a newly emerging approach to the governance of science and innovation [7,16]. The most widely used definition describes RRI as a "transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)" [17] (p. 19).

The concept of RRI has as its predecessor the notion of "responsible development", as described in the US 21st Century Nanotechnology Research and Development Act (108th Congress), which aimed to address the possible consequences of nanotechnology. More recently, RRI has gained prominence in European research funding, particularly in the European Commission's Horizon 2020 (H2020) framework programme. During the lifetime of H2020 from 2014 to 2020, Science with and for Society, which is the home of RRI, is funding research activities worth €460 million. In addition, RRI is seen as a cross-cutting activity that should inform research and innovation activities in all other thematic areas (e.g., in health, ICT, and transport) [18].

RRI is also reflected in national research, as can be seen from examples such as the Dutch MVI programme, and the British Engineering and Physical Science Research Council (EPSRC) that recently published its own Framework for Responsible Innovation. Despite these significant efforts and investments in RRI, the term remains under development [2,16]. We believe that the abovementioned version adopted by the UK EPSRC, which is based on Stilgoe et al.'s [16] work, provides a useful starting point. The EPSRC AREA framework suggests that RRI includes anticipation of potential consequences, reflection concerning the underpinnings, and assumptions of research and engagement with a broad range of stakeholders. This view of RRI is compatible with the EU's description of RRI which pursues a number of clear policy objectives including attention to gender equality, open access, science education, ethics, public engagement and research governance [2].

The primary impetus for RRI stems from an increasing requirement, in modern societies, to monitor research and innovation activities, and it represents a significant departure from governance methods of the past. For example, in the period following the Second World War, the social contract between researchers and society typically awarded freedom from governmental interference in exchange for a steady production of technically innovative products [19]. However, a series of technical catastrophes and corporate scandals undermined this contract and led to a questioning the very basis of research and innovation activities [20].

It is, therefore, not surprising that RRI posits that such activities should be acceptable and desirable [18]. The question of how such goals can be achieved is typically answered with reference to grand challenges such as sustainability, health and economic growth [21,22]. Where research and innovation addresses such grand challenges, it should address stakeholders' concerns and fulfil the acceptability and desirability criteria. This position raises normative questions about what constitutes a grand challenge, who defines it, and on what grounds. Furthermore, it raises the epistemological challenge of just how we can assess whether, and in what way, a particular piece of research or innovation is likely to address a grand challenge.

A response to this latter issue, which seems to be broadly accepted in the RRI debate, is that in order to count as responsible, research and innovation activities must actively seek to understand their potential consequences [23]. At a corporate level, this can be undertaken through the integration of foresight into business research projects [24,25] and by addressing stakeholder demands when developing new products. The idea of predicting possible consequences of both corporate research conduct and the impact of products is reflected in a variety of impact assessments, such as risk assessment [26], social impact assessment [27], environmental impact assessment [28] and privacy impact assessments [29]. Equally, the promotion of stakeholder engagement is based upon the assumption that stakeholders, as the main recipients of both positive and negative consequences of innovations, should be involved in shaping innovative ideas and developing these ideas into products and services [30].

Due to the significant changes that may be required, some scholars have attempted to make responsible innovation more attractive to businesses by proposing a business case for it [31,32]. The argument seems to be that firms that are skillful at innovating and successful in exploiting new ideas might enjoy a competitive advantage over their rivals [33]. Similarly, it has been suggested [34] that, when companies take their social and environmental responsibilities into account, this can support the development of highly innovative products and services that, in turn, have a positive impact on the firm's success and profitability. The supposed reason for this is that companies, when they are forced to consider corporate responsibility, have no alternative other than to identify more efficient methods of doing business and invent new types of products. Equally, Manning [35] maintains that innovations that respond to the needs of local communities might be particularly beneficial since various stakeholders, who are positively affected by these innovations, will support these firms substantially.

Nevertheless, the short-term profit imperative of managerial capitalism [36] may reduce the significance of the above suggestions and make the development of products that address societal needs, or contribute to the public good, less attractive for firms. As a result, many companies currently adopt research and development (R&D) procedures that do not take foresight or stakeholder demands explicitly into account.

This is a great cause of concern: corporate innovation, unless carefully designed, may have significant negative impacts upon the economy, society and environment. For instance, investment in new drugs or genetically modified organisms (GMOs), solely for financial purposes, could engender serious challenges for company stakeholders and the environment. Clearly, there are ethical dilemmas that need to be addressed by companies when innovating. Clarification of the deterrents and drivers for the integration of RRI into R & D may help to facilitate corporate attempts to address the social and environmental aspects of their activities, thereby steering these activities in the direction of socially innovative products and services.

2.2. Drivers and Deterrents for Responsible Innovation

Innovation is an important component of corporate activities, and hence analysis of the CSR literature may provide a good basis for identification of corporate drivers for RRI. Insights from the CSR literature identify three main categories of motives behind the adoption of CSR practices, namely, ethical, economic/competitive or institutional/relational.

Ethical motivations imply a moral obligation on behalf of companies to act in a socially responsible way [37], while competitive motivations pertain to financial and strategic benefits [38]. Relational motivations relate to attempts to achieve legitimisation from outside observers/stakeholders [39]. These three categories of motives are not mutually exclusive; when demonstrating corporate responsibility, firms might be driven by both an interest in enhancing their environmental performance and the economic benefits gained from the development of environmentally sound technologies.

Equally, the corporate responsibility literature identifies several barriers to CSR implementation that can provide useful insights into topics that might hamper implementation of RRI in industry. These include financial issues such as budget constraints and unpredictable costs [40], an abundance of CSR tools leading to confusion [41], and lack of clear implementation guidelines [42]. Others have cited the voluntary nature of CSR as problematic with the absence of mandatory standards impeding corporate attempts to implement CSR practices [43]. Similarly, it has been proposed that the many definitions available, and the lack of a clear governance framework, can perplex those contemplating the implementation of CSR [44].

Additionally, the lack of firm evidence for any beneficial impact upon competiveness and financial performance [45] may serve to discourage companies that are driven by shortsighted financial goals [46]. Companies may be concerned about the time lag between investment in CSR practices and potential for return because CSR is regarded as a long-term investment [47]. Companies may also adopt an indifferent position if they perceive CSR as a "soft" and unimportant topic [48].

While not exhaustive, this summary of the drivers and obstacles for CSR provides us with a basis for subsequent analysis of the drivers and obstacles for RRI in industry. With these theoretical underpinnings in place, we now describe our empirical research.

3. Methodology

An interpretive perspective to investigation was adopted for study, with the intention of understanding the matters in question through the meanings the selected participants assigned to them [49], while acknowledging the influence of historical, political and social context upon these meanings [50]. The interpretivist framework is essentially concerned with meaning and the quest to understand a shared definition of a situation [51]. Employing a qualitative approach, the interpretivist perspective is suitable for generating rich descriptions and depth of understanding. There is nothing unusual about this approach; in the world of business, qualitative research methods are becoming increasingly important as Eriksson suggests, these methods open the possibility of adopting a critical and reflexive view about the social world of business and its core processes [52].

Qualitative researchers have the choice of many different forms of data collection but we selected in-depth interviews as the most appropriate for this study. Described by Burgesses as a type of: "conversation with a purpose" [53], interviews are perhaps the most well-known and commonly used form of qualitative data collection method. Interviews allow researchers to explore participants' attitudes, beliefs and concepts at a deeper lever than other methods such as questionnaires [54]. Furthermore, the use of interviews is also recognised as being highly appropriate for investigation of topics where the data might not be available in other forms, where it might only be found amongst key informants or people who are "key players in the field" [55]. Interviews with these key players can provide a direct route to a depth of information that is simply not available elsewhere.

To facilitate understanding of what RRI means for industry, we began with the following four research questions:

- What is the nature of current RRI-related activity?
- What are the potential obstacles for RRI in industry?
- What are the potential drivers for RRI in industry?
- Are there identifiable components that are key for supporting RRI in industry?

3.1. Data Collection

In total, 30 in-depth interviews were conducted by nine interviewers in eleven different countries across Europe. Prospective interviewees were sent an invitation to participate and an information sheet that were translated into their native language where appropriate. Those that responded positively were interviewed. Each interview lasted approximately 45–60 min and they were conducted either in person, via Skype or telephone. The interviews were audio recorded, transcribed and translated

into English where conducted in a different language. All interviews were conducted in line with ethical considerations such as informed consent, respect of privacy, and avoidance of harm and deception [56,57]. In addition, participants were free to veto any components of the interview that they did not want to be made public.

Every interviewer followed the same interview guidelines that had been developed specifically for this study and utilised the same interview schedule. This was necessary to promote consistency between interviewers.

The initial interview questions were developed collectively between the interviewers over a period of four months. Ten questions were developed that sought to reveal the interviewees' own experience and opinions on a range of topics that might inform the three research questions. They covered topics such as their own understanding of RRI, existing practice, perceived challenges and incentives for RRI, and how it might be implemented more widely (see Appendix A).

While the semi-structured interviews used predefined questions, the actual topics varied between participants to allow respondents to describe their individual experiences, opinions and feelings on the subject matter. The task of the interviewers was one of probing for further details or asking for clarification when necessary without offering opinions or using leading questions. A recursive approach to questioning was adopted for the interviews so that they proceeded as a conversation rather than a question and answer session.

3.2. Sampling Methods

For pragmatic reasons, the sample size was limited to 30 which is generally agreed as a good sample size for this type of qualitative research. As Adler and Adler point out, "we often suggest aiming for a sample of loosely around 30. This [. . .] offers the advantage of penetrating beyond a very small number of people without imposing the hardship of endless data gathering, especially when researchers are faced with time constraints" [58] (p. 8). This number is also acknoweldged by Dworkin as appropriate for interview studies [59] because it maximizes the possibility that enough data has been collected to clarify relationships between conceptual categories and identify variation in processes. Additionally, and importantly, Dworkin also highlights that this number maximizes the chances that negative cases have also been explored in the data.

Purposeful sampling of potential interviewees was undertaken to ensure that participants had sufficient relevant experience of working in ICT industries that were actively engaged in research and innovation. For the purpose of participant selection, the research team held regular meetings via Skype to discuss the on-going process. Through existing networks and contacts, a range of potential ICT companies/contacts were identified from across Europe. From these, a selected number, who were working in different roles, locations, sizes and types of ICT company, were invited to participate. Personal email invitations and flexibility in terms of time and medium for the interviews, were used as means to help improve response rates and reduce positive response bias.

There were three main rounds of the interviews until the target number of 30 had been achieved. Aside from on-going discussion, we conducted an in-depth review of the spread of interviewees between rounds one and two. This helped to guide our selection for the subsequent round. While it is not possible to achieve a representative sample from the ICT industry with this methodology, we have striven to incorporate the views from a broad range of industry personnel.

3.3. Data Analysis

Verbatim transcription of each recording was undertaken by the interviewer, and for those that had been conducted in a language other than English, the transcriptions were translated. All identifying information, such as names of people and companies, was removed from the transcripts and the anonymised transcripts were all sent to one central researcher who led the analysis.

Analysis of the transcripts was undertaken centrally to ensure consistency. The method used was that of content thematic analysis, as described by Burnard [60]. This method is commonly used for

qualitative data analysis and involves detailed scrutiny of the interview transcripts to identify themes and categories within the data. With the aid of NVivo 10, qualitative data analysis software, a four step coding procedure was conducted resulting in increasing levels of abstraction and interpretation, and the development of clear themes and categories.

During the initial step of open coding with NVivo, as many nodes as necessary were identified to describe all aspects of the content and this process resulted in a total of 32 nodes. These 32 nodes were then aligned with one or more of the research questions. Overlapping topics and duplicates were merged at this point with the result that the nodes were collapsed into fifteen themes.

While qualitative data analysis is inevitably a subjective process [61], we did attempt to verify the analysis process at this stage with the input from a second researcher who was asked to generate their own themes. The two researchers then compared themes and with the theoretical underpinnings of the research in mind, a final list of four categories (with associated sub-themes) was agreed. The interview data was then sorted according to these four categories.

In the final stage of the analysis, the data in the fourth category was further analysed for emergent properties to help identify any supporting structures for RRI. Here, we also looked for patterns and potential associations with interviewee characteristics such as country of origin and size of industry and so on, as well as the relationship to published literature. The aim at this stage was to identify any potential theoretical models arising from the findings.

4. Results

In total, 30 interviews were conducted with interviewees located in eleven different countries. All interviewees were currently holding, or had previously held, key positions in at least one large, medium or small, ICT company: they were all working with projects that, in some way, related to the use of ICT for health and wellbeing. To ensure anonymity, individual names of interviewees and their companies cannot be identified but an anonymised overview of interviewee characteristics is provided in Table 1.

Table 1. Anonymised overview of the interview participant details.

Code	Country of Origin	Type of Business	Size	Position Held
1	Cyprus	Medical technology	SME	Founder/Chief executive
2	Cyprus	Research/technology	SME	Employee
3	UK	Data management	SME	Partner
4	UK	Consultancy/e-health	SME	Director
5	France	Health robotics	Large	Marketing
6	Switzerland	Medical technology	Large	Vice president
7	UK	Medical data solutions	SME	National manager
8	Germany	Medical technology	Large	Chief executive officer
9	Germany	Medical technology	Large	Development manager
10	Spain	ICT	Large	Project manager
11	Spain	Telemedicine	SME	Chief technology officer
12	Spain	ICT	SME	Chief executive officer
13	Finland	Green IT	SME	Global sourcing
14	Germany	Engineering	SME	Head of programme
15	Finland	Telecommunications	Large	Head of Innovation
16	NL	R&I	SME	Researcher
17	NL	R&I	SME	President
18	NL	Technology	Large	Research director
19	Italy	Telecommunications	Large	Project manager
20	Italy	ICT	SME	Information systems manager
21	Italy	Web healthcare apps	SME	Project worker
22	Denmark	ICT	SME	Head of research
23	Denmark	Technology	SME	Business development manager
24	Denmark	Technology	SME	Business development manager
25	Finland	ICT	SME	Development manager
26	Spain	Immersive technologies	SME	Research & development Manager
27	UK	Health NGO	SME	Programme lead
28	Spain	Technology	Large	International director
29	UK	Technology for elderly	Large	Chief executive officer
30	Sweden	ICT	Large	Vice president

Table 2 details the four categories that emerged from the analysis showing the relationship between the research questions and the subsequent categorisation.

Table 2. Research questions and associated emergent categories.

Research Question	Category	Definition
What is the nature of current RRI-related activity?	**RRI engagement**	Understanding of and current activities that are related to RRI
What are the potential obstacles for RRI in industry?	**Money and time**	Time to market and economic implications as the primary obstacles for the implementation of RRI
What are the potential drivers for RRI in industry?	**Money and virtue**	Economic benefit and values-based incentives as the primary drivers for the implementation of RRI
Are there identifiable components that are key for supporting RRI in industry?	**Supporting structures**	Identifiable assets or factors that may help to support the implementation of RRI in industry

In the following section, the four categories are explained in more detail and the main themes within each are described together with illustrative quotations from the interviewees to help encapsulate the meaning. The interviews were coded (1–30); quotations are referenced with these codes and the position held by the interviewee within the company.

4.1. Category 1: RRI Engagement

This category summarises the interviewees' descriptions of RRI-related activities within their companies. The opening question for the interviews enquired about familiarity and understanding of the term "responsible research and innovation". All had at least seen the short description of RRI that was on the information sheet for this study and for most this was their first introduction to the concept. As one interviewee responded when asked whether they had heard the term before:

"Yes, because I've read your material!" (18: Research director)

Despite the interviewees' broad experience, some having even worked with EC funded projects, only seven of the 30 were somewhat familiar with the term RRI prior to the interviews. Having read the information sheet for the study, as well as having the opportunity to discuss the meaning of RRI with their interviewers, all 30 interviewees were able to describe at least a minimal form of RRI related activity.

Existing RRI-related activities and processes varied greatly between interviewees. Only a small minority of interviewees (4) intimated that there was little or no attention paid to RRI values. More common was the belief that RRI principles were inherent in their activities. This was attributed, in part, to the nature of the industries they were working in; all came from industries that are aiming to develop tools and processes that will help people. On a very basic level there appeared to be an inference that RRI is essentially about "doing good" and hence the assumption that their companies were already aligned with RRI goals because their developments would be doing some good. However, it is obvious from the conversations that, for some interviewees, there was a lot of confusion about what constitutes RRI. The one essential component of RRI, that all were able to exemplify, was that of stakeholder involvement as described below.

4.1.1. Stakeholder Involvement

All interviewees, without exception, acknowledged both the need for, and benefits of, stakeholder involvement, with this quotation being typical of the responses:

> *"The most significant action in our development work is to involve the end-users into process. All research and development should be based on actual needs and have significant meaning to the target group."* (5: Marketing)

There was broad acceptance that the end users are key drivers and must be involved but for most this appears to be primarily to ensure appropriate and relevant performance of the product, quality and acceptance, as opposed to more general responsible motivations. If products and services are not received well then, ultimately, reputation and profit are affected:

> *"It would be almost stupid to do something without having all the stakeholders involved.....we would probably be out of business if we don't deliver what works or what solves real need."* (13: Global sourcing)

Across the entire range of participants, a diverse range of stakeholders, methods and topics for consultation were identified as shown in Table 3.

Table 3. Stakeholders, methods and topics for consultation.

Stakeholders for Involvement	Methods Used for Consultation	Topics for Consultation
End users, Physicians Other health and social care professionals Hospitals Healthcare organisations Technology experts Patient organisations NGOs Special interest groups Relatives of users, teachers of users	Interviews Observation Questionnaire Focus groups Media for raising awareness Physical or virtual methods	Performance of the product Quality of the product Acceptance by users Broader acceptance by society Data protection Confidentiality

The ubiquitous appreciation of the need for stakeholder involvement is clearly reflected in the diverse nature of adopted approaches and the willingness to invest in this activity. In some companies, particularly the larger ones, there are dedicated units for undertaking consultative work, such as this one:

> *"Our company has a specific unit with the task of organizing these events. This unit works for all the branches of our company, also in different locations, and contacts the public out of a specific list, choosing the participants in the focus groups on the basis of the final target of the product/system under development."* (19: Project manager)

Others rely upon a third party, such as their customers. As one interviewee explained:

> *"The involvement of users is very important in the development we do, but we often are not the ones who perform this work."* (6: Vice president)

Aside from stakeholder involvement, two other aspects of RRI that were included in the interview topics were, the prediction of future consequences and open innovation. Although all interviewees readily discussed stakeholder involvement, for these two aspects of RRI, responses were not so coherent.

4.1.2. Prediction of Long-Term Consequences

When asked about measures that are in place for the prediction of broad impact or long-term consequences of research and innovation, the broad spectrum of responses revealed highly polarised practice. Eight interviewees stated that there was no consideration at all, such as the following two:

"We don't evaluate it." (26: Research and Development Manager)

"At present, we do not have any protocol or procedure to monitor future consequences of our developments." (10: Project manager)

Conversely, these two quotations show that, for others, the exact opposite is the case:

"In my company activities are carried out with great attention to the social and environmental impact, as for example trying to use recyclable materials and to save energy. There is also a specific training of our personnel on the issues of concern for the environment and correct ethical behaviour. Moreover, we support projects with social impact and some starts-up." (19: Project manager)

"We take it very seriously. We include worldwide risk assessment also providing information as to which risks they are within different countries, different geographical areas, and for different kinds of vendors that we have, with regards to labour and environment and their level of effects." (24: Business Development Manager)

Only a minority of companies (six of them and all large) had fairly well developed policies and procedures for the prediction of long-term consequences, such as green policies and long-term risk assessment procedures. Most respondents seemed confused about what this would entail and how to go about it. This is an area where clear guidance may be helpful as indicated by one interviewee:

"I would definitely suggest the use of structured procedures for risk assessment. The implementation of RRI would benefit if there were common guidelines to be followed." (25: Development manager)

4.1.3. Open Access to Innovations

The issue of open access to innovations was a complex and sensitive topic for the interviewees. The majority expressed reservations about making their data/results open, largely because of the need to protect investment and retain a competitive edge in the market. Whilst some appear to embrace open access fully, both in spirit, "*I am a great believer in open access*" (3: Partner) and practice, *"Most of our data is already open"* (15: Head of innovation), others simply do not engage at all:

"We don't make "open-source" products, because mainly because we aim at the monetization of our products and projects." (10: Project manager)

This divergence in engagement with open access may be due to a variety of factors but one that emerged here was a distinction between approach for software and hardware developments. For example, this participant, who develops software, explains how open access to innovation is normal for them:

"We always do that. It is normal at research that we do. As I mentioned in my area of software, it is very hard to get any kind of intellectual property right away, so we actually try to encourage all systems to be much more open. So that is our own vision for development, that I have very open systems, known innovation, you allow much more research and innovation action to be possible and integrate." (22: Head of research)

Conversely, this participant explains that they do not take this approach for hardware developments:

"On the hardware I don't think that the company would be keen to make it open because this is the core of the competition, and you don't want another competitor to access the way that you design your product." (5: Marketing)

Additionally, many companies are operating within regulated markets, which may affect their ability to engage with open innovation:

> *"In the healthcare sector, there is still very little activity when it comes to open sources, and open sourcing communities, because you need to understand that all of these companies are subject to highly regulated markets. . . . Given the fact that this is a highly regulated market, the environment doesn't really foster open source development."* (8: Chief Executive Officer)

While it was deemed easier, and maybe also a requirement, for publically funded research and innovation to maintain open access, inevitably, for companies, most developments are commercially sensitive. Several of the interviewees proposed that a kind of partial transparency could be achieved, either limiting what they share, or limiting with whom they share their results, such as this:

> *"The bulk of what they do, in essence, should be open but there will be some core things that give them the differentiator between what they do and what their competitors do. I think it's unreasonable actually to expect companies—commercial companies, as opposed to not for profit or community based organisations, to invest their own resources or their own commissioned research and development and to make all of their IP and results openly available."* (4: Director)

4.1.4. The Use of Protocols and Tools for RRI Related Activity

The majority of interviewees were aware of the use of standards and regulations, including internally established protocols as well as global initiatives and ISOs but there were mixed feelings about their value. Internally developed protocols and standards for RRI-related activity were identified by more than half of the interviewees but these varied widely, from seeking ethical approval for research activity, to having separate units for ensuring CSR.

In respect of external tools, some described the use of tools and standards but also highlighted the complexity of this given the differing requirements for trade in different regions and countries. Eight participants stated that they had no particular internal policy, or use of tools, to guide or assess any RRI-related activities. Some, particularly from smaller companies, highlighted that the costs involved, and the time required, can act as a barrier to adoption, issues that are further elaborated in the next category.

4.2. Category 2: Money and Time

> *"Nothing in this world happens only to be kind."* (4: Director)

When asked to describe the potential obstacles for the inclusion of RRI, without a doubt, the most commonly expressed concerns were to do with the financial implications:

> *"We are a commercial enterprise and for us, let's face it, our biggest driver is still about making money."* (13: Global sourcing)

A primary obstacle to the implementation of RRI is the perceived economic cost and the corresponding impact upon company profit. This imposes challenges in terms of balancing the need to achieve financial profit and the resources that are needed to conduct R&I activities in a responsible manner. A felt responsibility towards shareholders is driving activities to a great extent:

> *"Because you know as long as you work for shareholders, I am afraid . . . you know it's them who are gonna .want money. And fast money, and quick money, a lot of money."* (1: CEO)

Activities such as consultation with end users, ethical review and risk assessment all have cost implications. For example, the cost implications of stakeholder involvement were highlighted by this participant:

> *"Of course, let's not forget that all kinds of stakeholder involvement are a costly affair and you need a little bit deep pockets to be able to do that."* (13: Vice President)

Furthermore, this participant described costs as a barrier to the prediction of future consequences of R&I:

> *"And of course everyone agrees that maybe the investment that are needed to do this are not making this possible for any small or medium sized enterprise."* (6: Global Sourcing)

As well as the direct economic costs involved, engagement in RRI-related activities may slow the innovation and development processes which can be, for people working in the ICT industry, of significant concern. For those who work in the ICT industry, it appears that time is of the essence:

> *"The IT business...is changing so fast...smart phones, and tablets and whatever and how it looks on the screen and cloud-computing and everything so we have to be, we always kind of fear to be behind in development.... time to market is crucial...competition is fierce."* (30: Vice president)

Furthermore, the time pressures may be growing in intensity:

> *"In the past, an innovation process in ICT lasted even some years, now it is completely different. The duration of development phase of a new product is much shorter. Inclusion of RRI aspects could overextend the time for the introduction of innovation on the market."* (19: Project Manager)

When making decisions about a particular course of action, the economic costs and benefits of all related activities need to be clear:

> *"Any initiative bringing additional work represents also an additional cost for a company. A clear economic benefit is the main driver for implementing any new initiative."* (20: Information systems manager)

4.3. Category 3: Money and Virtue

Given that the inclusion of RRI requires additional effort and commitment of resources, it is reasonable to ask why companies should bother with it at all. Because of the profit-driven nature of their activities, for some commercial organisations the adoption of RRI may seem implausible:

> *"I think that perhaps the implementation of the RRI concept, being very important, might be more related to organisations whose activities are more closely linked to research and development and innovation that is based on public funding."* (10: Project Manager)

Nevertheless, some interviewees described a potential for very clear benefit for themselves as well as the end users. At the very least, the involvement of end users can help to ensure better alignment of products and services with their needs and this might ultimately yield economic benefits. Hence, the major obstacle for RRI (money) is also one of the key drivers:

> *"I don't believe this has anything to do with code of conduct, because there is a very strong business reason why we want to do it: We charge our customers based on their usage, so if our model is not used by a customer for whatever reason, we don't get paid. So, it is in our best interest to make sure that they are able to use it. So the money is the driver, it is nothing to do with a code of ethics."* (13: Global sourcing)

As well as ensuring fit with user needs, stakeholder engagement and alignment of the company's values with those of stakeholders can enable the company to be doing good while also taking care of profit:

> *"There's the overlap .... if you don't do it they are not going to buy it and at the same time, you do it because it is the right thing, so there are two good reasons to do it at the same time."* (5: Marketing)

However, this can take a long time:

> *"Seeing a big market there will be what will turn them on. But the interesting thing is trying to help them understand that you can actually do that in a socially responsible way, but you need to be prepared to handle and think about and stay attached to a number of your communities over a long period of time."* (4: Director)

Another frequently mentioned motivating factor for inclusion of RRI was the potential for an improved corporate image or profile. This is also associated with increased profit as it may provide a competitive edge:

> *"I would not speak about increased market penetration, but rather about limitation of market loss. In fact, if a customer can choose between similar products/services, one of the key drivers for his/her choice could be the evidence of the product/service compliance with environmental and/or societal requirements."* (19: Project manager)

As well as bringing long-term benefit to the corporate image, attention to RRI could help to avoid long-term harm:

> *"Plus the fact that they can avoid future problems or legal complications . . . this could bring better products mainly, and less problems in the future."* (2: Employee)

While consideration of the economic obstacles and drivers was paramount for most of the interviewees, one third also described more virtuous or altruistic drivers for the inclusion of RRI in their businesses, such as benefits to society, sustainability, preservation of the environment, addressing societal challenges, and generally "doing good for humanity". For some, this was associated with the type of industry that they work in (health and social care):

> *"In the area of elderly care, technology development should not be carried out only for the sake of personal gain (profit). Instead, it should be linked with a deeper motive of doing something good and in this way to fulfil genuine needs of people."* (25: Development manager)

Others described how RRI values were closely aligned with the company ethos. The responses from these participants can be viewed as illustrative examples of values-alignment [62], revealing the potential for impact when the values of organisational personnel are aligned with the values and goals of their organisation. These participants described better systems for addressing RRI-related concerns and were clear about the potential benefits of RRI. A striking aspect of these companies was that their values seem to pervade all activity, right down to the hiring process, as this interviewee described:

> *"I think that when we are hiring people, we don't hire people based on their diploma, or based on their line on their resume . . . . we are much more interested by the skills that this person could have acquired outside school and outside universities, and we are also very interested by the culture of these people. We want to make sure that their soul is compatible with the soul of (the company)."* (9: Development manager)

Finally, as some participants highlighted, once profits are ensured, there is more freedom to pursue higher values:

> *"In situations of wealth, when all the basic personal needs are covered, a firm can do it [apply RRI]."* (11: Chief technology officer)

4.4. Category 4: Supporting Structures

This section presents our interpretive analysis of the data to identify key components that may help to support and facilitate RRI in industry. In the interviews, participants spoke of their own experience and their opinions of RRI related concerns; they provided real life examples, described problematical situations, reflected upon implications, and offered their thoughts on the challenge of how to incorporate RRI into industry. Induced from this narrative are key components or assets that can help to strengthen the foundations for RRI in industry. There were three clear emergent themes:

- Corporate culture
- Awareness of RRI
- Greater clarity for data protection and ethical codes

4.4.1. Corporate Culture

Many interviewees identified the need for the RRI principles to be embedded within the culture of an organisation in order to bring about effective change:

> *"Well I personally think that you have to go to this culture development, trying to promote a culture that tries to make the world a better place and then everything else follows almost automatically."* (15: Head of innovation)

If RRI is perceived as being something that is "bolted on" or in some way separate from the core activity of the company, then it will be difficult to achieve. For effective RRI, it may be necessary for the whole company to be on board:

> *"The culture of RRI should be instilled in the researchers as well as the R & D managers so that all people involved in R & D of new products/systems will naturally take into account RRI principles in their activities."* (19: Project manager)

The embedding of RRI principles within corporate culture may describe an ideal scenario but it raises the issue of how to encourage a cultural shift within companies that are currently largely driven and maintained by profits. As previously mentioned, some interviewees stated that there was no, or very little, attention paid to RRI principles in their companies. Additionally, there is an obvious tension between the more altruistic motivations for inclusion of RRI-related activity (mentioned in category 3) and the need to generate profit (category 2) that, for some, was something that they struggle with on an on-going basis.

4.4.2. Awareness of RRI

It is evident that there was a significant amount of confusion about what RRI means. Accordingly, awareness raising is necessary for improved motivation and understanding, and different levels are required. On one level, awareness of RRI as a concept is important:

> *"I am going to suggest that that is the biggest need . . . . . raise awareness of the whole agenda."* (3: Partner)

Awareness raising also relates to how we can help people to understand what RRI means, why it is relevant and how it can be of benefit. The use of best practise case examples was suggested as one effective method for this. Within organisations, there is a need for internal awareness raising to be undertaken to promote the benefits of RRI and increase motivation:

> *"So, I think an organization which has more highly trained professional engineers . . . those people need to be told, you have a responsibility. You can't expect everyone to have that responsibility . . . those groups need to have some special training."* (18: Research director)

Additionally, four of the interviewees suggested that RRI should be included as a topic within professional education. In the long-term this may help to promote a culture of RRI and prepare people for responsible working in industry. To avoid confusion about what RRI actually entails, there was general agreement that some form of instruction is necessary:

> *"Because if they don't exist, we guess."* (30: Vice president)

However, there were contradictory opinions about whether RRI should be implemented through regulations or guidelines. Some believe that regulation is necessary for action, whereas others believe that guidelines would be better. Either way, there was clear warning that any suggested process for inclusion of RRI must be kept simple:

> *"be very specific and to demystify it."* (7: National manager)

4.4.3. Data Protection and Ethical Codes of Conduct

The introduction of new technology and new systems that are aimed at improving quality of life can generate a whole host of practical and ethical considerations. For example, in the transmission of data where there is no clear method for keeping it entirely secure, or in the potential for unforeseen use of developments:

> *"We have far more than 100,000 customers, so it's very, very difficult for us to implement a process where we can really make sure that the way that our software is used in the end is reasonable."* (9: Development manager)

Concerns were also raised about privacy with the introduction of sensors and monitoring devices:

> *"Sensors and data and those kinds of things are becoming so much more invasive . . . neither the guardians of social practice or the law really understand how invasive this is."* (18: Research Director)

There was also evidence that end users are concerned about privacy and sometimes it takes a lot of effort to persuade people to engage with new technologies if they are viewed as an invasion of privacy. Worryingly, there was a lack of adequate preparation for such outcomes:

> *"In many circumstances I had the feeling that I was not sufficiently trained to deal with this problem."* (21: Project worker)

For RRI to be effectively implemented in the ICT industry it appears that the challenges of working in a field where data protection and ethical codes of conduct are constantly put to the test need to be resolved in some way:

> *"Not only are we losing money and wasting time by not understanding what are the different codes that we need to respect but also, when they are not existing, we need someone to decide what is good and what is not good for the society."* (5: Marketing)

5. Discussion

Our research shows that while many aspects of RRI are reflected in the practices of these ICT companies, the term itself is not well known. This comes as no surprise, given that the RRI discourse is primarily promoted for publicly funded research, which many companies do not engage with.

As anticipated, many of the concerns associated with corporate responsibility are reflected in the area of research and innovation. On the one hand, as represented by our category "money and time", companies are required to produce profits; they are subject to competition and therefore need to consider the economic impact of all their activities. RRI activities, such as public engagement, can be resource intensive and there is no certainty of financial benefit from them. On the other hand, as can be seen in our category "money and virtue", the interviews have also shown that many companies are not solely profit-oriented. For many, profit might be better understood as a "necessary condition of continued operation" rather than the sole raison d'êtreetre. Many of the participants described motivations that extend beyond operational imperatives to achieve positive social impact. In some cases, this was also reflected by company strategies and visions that put benefit for the customer at the centre. Such statements could be interpreted as self-serving in nature or pure marketing. However, the nature of the companies that we talked to, and the fact that they produced innovations for ill and ageing individuals, means that many of their activities convey the potential for positive (or potentially negative) impact on vulnerable populations. This supports the contention that there is much genuine desire to do the right thing.

Despite the widely held view that firm competitiveness is defined by the market [45], the main driver for innovation might not necessarily be competitive advantage [63]. In particular, our results demonstrate that at least some companies, operating in the ICT for ageing sector, have an agenda that

is inclusive of societal and ethical issues. An important influencing factor for the perceived drivers and obstacles of corporate responsibility may be the sector in which a company operates. This assumption is supported by a study that focused upon the food industry. Here, Blok et al. found that both profit and social responsibility can drive firms' inclination to innovate [64]. It appears that companies operating in sectors that have pervasive social impacts, as is the case of companies operating in ICT for ageing or the food industry mentioned above, might find a more natural alignment between corporate responsibility and competitiveness. For these companies, social concerns play an equally important role, along with competitiveness, in driving innovations. This could be a relevant contribution, introducing a further consideration, to the discourse on CSR and competitiveness [65–68]. While CSR discourse has focused upon a supposed link between CSR and profitability in order to make corporate responsibility more alluring for managers, our findings appear to indicate that, for some, the products' positive impacts on consumers' lives might be as equally alluring as profit. This, in fact, mirrors suggestions found in the literature highlighting that the ethical standing of a firm provides a unique way to differentiate from competition [69]. Our results are also aligned with proposals that ethical mechanisms, such as an enlarged concept of responsibility to society and moral legitimacy, can significantly influence the managerial interpretation of innovation [70].

Our study findings suggest that, when innovating responsibly, critical factors can move beyond competitiveness to include issues such as external and internal values alignment. With reference to the former, our results highlight the issues of societal desirability and the inclusion of end users in decision making. In so doing, we suggest that corporate innovation needs to be the outcome of a collective effort; an effort that extends beyond corporate self-interest and is aligned with stakeholders' interests. This paper provides important empirical evidence to support this theoretical assumption of RRI [16] and is further corroborated by evidence coming from the finance sector on the importance of inclusion and deliberation in corporate innovation [71]. For internal values alignment, our findings suggest that responsible innovation can be supported and nurtured through internal efforts to align employees' values with organisational values and culture. These observations echo previous studies [72] that highlight the role of internal values in strengthening organisational capabilities to minimise the adverse impacts of innovations.

Further, our findings suggest that the promotion of RRI might be key for broadening corporate responsibilities to include research and innovation activities. Thus far, the corporate responsibility literature has described innovation as either "entrepreneurial action linked with social causes" (social entrepreneurship) or "environmentally focused innovation" (for example, clean technologies) [73,74]. Our results illustrate that responsible innovation cannot be confined to social entrepreneurship or environmental issues only, but offers a broader framework for corporate action in which private innovators and end users work closely together to ensure that the end products are socially desirable.

In spite of ongoing debate about the precise definition of RRI [16] and the concept's continuous evolution [75], there is much agreement about certain aspects and principles that contribute to RRI; these aspects have their roots in established activities, such as public engagement, science and technology studies or technology assessment. Companies could, therefore, make use of a range of existing tools and approaches if provided with the insights on how to do so [76,77]. Our category 'money and virtue' indicates that they are, in principle, prepared to do so; it is worth investing resources and efforts into RRI activities if the benefits are clear. A key obstacle may be confusion about how to incorporate and support RRI. Specific guidance for how RRI can be adapted for fit with the idiosyncrasies of ICT is certainly needed but for our respondents, this is not a purely technical question to be addressed by increased use of certain tools or guidelines. There is a profound concern that a culture of RRI needs to be cultivated within industry and arguably, such a culture could encompass other corporate responsibilities, with RRI as an additional component.

5.1. RRI as a Meta-Responsibility

Fundamentally, for RRI to be adopted in industry, it must be implementable within existing organisations and aligned with their existing processes, codes and responsibilities. Here the suggestion that RRI can be understood as a type of "meta-responsibility" [78], a responsibility that sits above and transcends existing responsibilities, may be helpful. As Stahl [78] explains, there are various functions involved in research and innovation in companies; individuals have a number of professional, technical, personal, social and other responsibilities that are normally well defined, and may interact in complex ways. The adoption of RRI does not need to replace these functions, or suggest that individuals were irresponsible prior to its introduction. Rather, when RRI is implemented as a meta-responsibility, it can help shape, maintain, develop, coordinate and align existing and novel research and innovation processes. The conception of RRI as a meta-responsibility allows for pragmatic and actionable recommendations. For example, when viewed as driver to promote and strengthen existing responsibilities, implementation might reveal the need for development of tools and support to help individuals understand and discharge their responsibilities. In the context of this paper, this would mean that the social and ethical concerns for ICTs need to be explored and discussed [79] and that guidance needs to be provided on how to do this [80].

The concept of RRI as a meta-responsibility raises many questions about the definition and implementation of this meta-responsibility. For example, the question of who should be responsible for RRI applies at both an organisational and a broader societal level; the question of how organisational culture can be shaped to promote sensitivity to social and ethical concerns leads us to consider (amongst other things) the education and training needs for employees and the associated practical considerations.

However, we believe that the conceptualisation of RRI as a meta-responsibility provides interesting avenues worthy of pursuit. From our own example of ICT for health, demographic change and ageing, it is evident that many of the (RRI-related) issues and challenges are already familiar to companies and are being addressed proactively. For example, matters related to privacy and data protection are familiar to companies, as is the need to involve stakeholders and end users. Other RRI-related activities, such as foresight and futures studies, are less common and, where they exist, tend to focus on risk management. This is understandable given the logical malleability and unpredictability of ICT, but it does demonstrate that there are gaps in current practices.

5.2. Study Limitations

While the exploratory design of the research enabled us to generate new insights, our approach precludes generalisability of the findings. In addition, we acknowledge certain limitations in our approach but believe these could pave the way for future research avenues.

Firstly, the sample size was limited to 30. Although each of the interviewees played a major role in their company's RRI practices, a more in-depth account of such practices could include middle-level managers and employees whose views might differ from those expressed here.

Secondly, our interviews were conducted by a range of individuals, in different environments, and this has, inevitably, an effect upon the uniformity of data collection.

Thirdly, while proactive attempts were made to reduce bias in recruitment, data collection and analysis, we must acknowledge that a certain element of bias is inevitable in qualitative research as the findings are "co-created" by those involved [81]. Thus, the findings presented here will be influenced by the perspectives of the researchers and participants alike.

These factors may raise methodological challenges, but our approach has allowed for a broad snapshot of opinions to be captured, from a range of countries and industries. Additionally, the use of a number of interviewers can help to minimise the effects that a single interviewer would have upon the data. Discussion amongst interviewers also helped to encourage a reflexive approach throughout the study. Furthermore, there is sufficient consistency within the results to instil confidence in our identification of drivers and deterrents for RRI in industry and although our list may not be exhaustive,

it is a useful basis to build upon. In particular, the issue of potential for increased profit as both driver and deterrent is worthy of further investigation, on both a philosophical and a pragmatic level.

Finally, further studies might expand the sample beyond the specific setting of ICT for health, demographic change and wellbeing. However, we believe that the insights generated by our study are of both theoretical interest and practical relevance, and hence will further the RRI discourse on multiple levels.

6. Conclusions

In this paper, we have introduced the concept of RRI, contextualised it within the discourse for the related field of corporate responsibilities, and presented an empirical study comprising 30 interviews with company representatives. Apart from its theoretical contribution, the paper has important implications for practitioners and policy makers. For practitioners, the RRI concept may feel like just another term that they need to address but, through our identification of the drivers and obstacles for RRI, we hope to assist practitioners to gain a better insight into the implications of adoption of this practice. Furthermore, we have shown that these drivers and obstacles are very similar to those affecting the broader field of corporate responsibility and hence that the implementation of responsible business conduct, irrespective of the approach, is influenced by similar issues.

The issues described in this paper are important for understanding of the current state of RRI-related activity and possible ways in which it may be relevant to industry. However, such an understanding can only be the first step; we still need a better conceptual representation of RRI in industry as well as practical support mechanisms and tools. Our own work has contributed to the development of a model for RRI in industry that takes the shape of a maturity model (see paper by Stahl et al. in this Special Issue). We hope that this model will provide a sound theoretical foundation for companies to use existing tools for RRI implementation, to highlight current gaps in tool provision and facilitate the development of new tools.

For policy makers, the findings allow for a better understanding of the real world application of RRI. Given the significant amounts invested in RRI, the identification of issues that facilitate or impede RRI implementation in industry will assist in decision making about where efforts are best placed.

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Appendix A. Indicative Interview Questions

1. The purpose of this interview is to seek your opinions about RRI in industry. Is that a concept you have ever come across before? (Probe further here if necessary and help by offering suggestions to find out about particular ways of how RRI can be recognized in practice)
2. In your experience what are the key drivers for this type of activity? (e.g., who is in charge, are there any requirements for, and what are people's motivations)
3. In your experience what are the main challenges for development and implementation of RRI?
4. What do you think would need to be in place to help with those challenges?

5. In what ways is consideration paid to your target or end users in research and innovation activities? (e.g., who is consulted in the development phase, who benefits from it and why these groups, do you interact with NGOs?)
6. What attention is paid to codes of conduct in your company? (e.g., Do you have any particular protocols in place to consider ethical aspects of research and innovation? How do professional ethical codes have an impact? If none then any idea why not?)
7. What attention is paid to ISO or other certifications in your company?
8. To what extent does your company attempt to predict (unintended) consequences of your product development and later product use, in particular when it comes to impact on the environment, society and the well-being of users? (Ask about any methods used in this assessment)
9. Have you or would you consider making the results of your research and/or other innovation data openly available? (What would be the benefits or reasons why not?)
10. Anything else you would like to add?

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