

# Responsible-Industry



Responsible-Industry



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# 1 Summary

This report describes a horizon scanning activity that was undertaken using Amanatidou et al.'s (2012) methodology of "issue centred scanning" to identify potential futures for the ICT for ageing industry. The main issues that were identified were that there could be potential problems for industry in definitions of ageing and the elderly, stereotypes of older people and technology, differences in opinion about what future technologies for older people might look like, and operational and design issues for incorporating RRI into ICT for ageing. We then paint some potential futures, namely future technologies, future companies, future environments, and future elderly, and look at what motivation for innovation (and particularly responsible innovation) there might be in the future as well.

# 2 Introduction

Responsible research and innovation in industry is a complex topic. The Responsible-Industry project's treatment of the topic draws on a number of theoretical sources and empirical investigations. In order to ensure that the insights developed by the consortium remain current, task 1.3, "RRI in Industry – Horizon Scanning" aims to draw in further sources and develop additional insights that can be fed into the ongoing activities, notably the case studies and focus groups and that can inform the outputs of the project. This is described in the DoW as follows:

*"The Responsible-Industry project will have a sound and robust conceptual basis from which to implement RRI in the chosen cases and from which to generalise beyond these cases. However, this conceptual basis will be developed during the first year of the project, as outlined in the tasks above, and will therefore need to be updated to include further developments in the field in the subsequent years.*

*This last task of the first work package will therefore undertake a horizon scanning exercise that will focus specifically on issues around RRI in industry. Horizon scanning is a well-established methods in foresight and related research (Amanatidou et al., 2012). In this case appropriate methods and techniques from horizon scanning will be used to ensure that the theoretical and conceptual basis of the project remains current."*  
(Responsible-Industry DoW, p. 6)

This task is broken down in two deliverables which undertake the horizon scanning activities. This first deliverable is due on M 20, thus coinciding with the start of case study research and focus groups. It furthermore provides the conceptual and methodological basis for the second one, due in M 40.

The document starts by outlining the methodology employed in the horizon scanning exercise. It then describes the primary signals and the weak signals that can be identified from the literature. On this basis the conclusion discusses which lessons for the RI project can be learned from the horizon scanning exercise.

This exercise takes as its focus industry that centres on ICT for an ageing society, which is the broader focus of the Responsible-Industry project. The objective of this exercise is to determine potential future issues for ICT for an ageing society, particularly in an industry context. These potential future issues will feed into further RRI related activities that the Responsible-Industry project will engage in with a view to raise the profile of these issues and potentially address them.

### 3 Methodology

Horizon scanning is a process by which a set of future issues is identified in order for the issues to be potentially addressed or mitigated at an early stage. It can also give ideas of future scenarios within a particular context, and future opportunities that could potentially be exploited. Within the context of Responsible-Industry, there is the potential for future RRI methods to change the behaviour of companies, as well as future technologies and future elderly people to shape the world around them in unexpected ways. Horizon scanning allows us to look for “weak signals” that could point towards these future issues.

This horizon scanning activity builds on the methodology by Amanatidou et al. (2012). While there are other methods, such as scenario building and participatory approaches, we felt that an information systems approach for this first deliverable would be the most appropriate and feasible methodology to conduct within the scope of the project, using data already collected as part of the activities for the rest of the project. The next horizon scanning activity will incorporate different methods for collection of data. We have chosen the “issue-centred scanning” approach of Amanatidou et al. (2012) as it is the most manageable approach within the timescale of this project. This approach allows us to use previously identified emerging issues as a starting point to scan for “weak signals” which we can then use to “reinforce the hypothesised emerging issue or reveal changes, modifications and disruptions of existing emergent issues” (ibid.). This will allow us to anticipate emerging issues with a higher degree of precision and accuracy, and to further explore related emerging issues that may not have been identified initially. It is important to understand that this approach will not allow us predict issues, but will instead allow us to identify impact-rich issues that could require policy attention.

This activity is not simply a “big data” analysis project – it requires a large degree of contextualisation and understanding of the social and political climates within different areas of society. Amanatidou et al. (2012) reinforces the need to understand the identifiers of emergent issues and debates surrounding them,

“taking into account the interests, emotions and attitudes of different stakeholders as well as experts”.

From this theoretical perspective the horizon scanning activity will take place.

Firstly, we need to **conceptualise the frame of reference** for the domain.

Secondly, we **look for existing anticipated issues** that already have a narrative associated with them (“primary signals”). These might include trend reports, foresight exercises, scientific articles, statistical analyses, scenarios, stakeholder workshops, etc. These will then be qualitatively analysed to determine the implicit and explicit indicators for the realisation of the narrative, with further clues identified (secondary signals) that can be followed to determine the likelihood of the realisation of the narrative.

Thirdly, a second round of material will be sought based on the further understanding of the narratives, following secondary signals, policies, and any disturbances to these (“wild cards” or “countervailing issues” (Amanatidou et al., 2012)) that may have changed the course of the narrative.

This will allow us to have a set of potential issues that have rich narratives and trajectories that we can be relatively certain are likely to have impact on the domain.

### 3.1 Selection of Primary Signals

Primary signals were selected in the following way:

- The frame of reference is defined
- Existing issues were identified within the frame of reference from:
  - Existing project deliverables (e.g. FP7, H2020, national-funded research) – found through Google searches
  - Existing foresight exercises – found through a special issue of the journal *Technological Forecasting and Social Change* and Google searches
  - Policy reports in the area – found through Google searches
  - Interviews and Case Studies previously conducted for the Responsible-Industry project<sup>1</sup>

A full list of the sources used for primary signals is found in Appendix 1.

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<sup>1</sup> Deliverables based on this data collection can be found at <http://www.responsible-industry.eu/dissemination/deliverables>, namely D1.2 and, for the interviews, D2.1 and 2.2 where expert interviews informed the Delphi study.

These sources were coded using NVivo and thematic analysis of emergent themes. These themes were then synthesised into a set of overarching themes. The related areas that were merged together are discussed in each of the signal descriptions, with the view to explore each theme thoroughly.

The signals were then assessed according to the following criteria (from Amanatidou, et al. (2012)):

- Described impact
- Desirability (how desirable is it to understand this signal)
- Factual basis (how much evidence is there for the signal within the body of data)
- Plausibility (how plausible is the signal)
- Novelty to policy-makers
- Interests at stake
- Emotional aspects/critical aspects (if there are emotional or ethical legal aspects)
- Changeability (if the issue or its impact can be changed)

From this assessment, the main issues will be clustered and their narratives combined into a selection of primary signals. The secondary signals will be incorporated into this assessment as reflections on the likelihood of the realisation of the narrative. From the primary and secondary signals, weak signals will be identified as described below.

### 3.2 Identification and analysis of “weak signals”

According to Hiltunen (2008), weak signals are 'warnings (external or internal), events and developments that are still too incomplete to permit an accurate estimation of their impact and/or to determine their complete responses'. Weak signals from the primary signals will be identified and analysed qualitatively, using a critical approach. A secondary round of data collection will be conducted, in more general terms, such as:

- Internet news searches
- Industry-specific forum searches
- Emerging technology blogs

The primary sources and these secondary sources will be scanned and analysed for weak signals. In following the Amanatidou et al. approach, the signals will be clustered and their significance assessed. Once this is complete, a model of the issues will be developed, identifying possible emerging issues.

### 3.3 Final stages

The model of the possible emerging issues will be compared with the primary emerging issues and their narratives, and a critical assessment of the likelihood of the primary and possible issues conducted.

### 3.4 Frame of Reference

In this horizon scanning activity, it is important to firstly establish the frame of reference. In the Responsible-Industry project, we are focused on exploring the domain of ICT for an ageing society. Within this domain, this horizon scanning activity will be aiming to identify potential issues surrounding RRI in industry in order to ensure that the outcomes of Responsible-Industry remain current.

The activity will therefore be based on two main categories of emerging issues: general issues to do with RRI in industry (on a higher level, such as integration with business, etc.), and issues to do with the more specific domain of ICT for an ageing society that could inform future RRI actions within industry and policy.

## 4 Primary Signals

Primary signals have been gathered from the following sources:

- Interviews carried out for Responsible-Industry with industry sources
- Case study descriptions from Responsible-Industry
- Deliverables from related European Commission and UK-funded projects that conceptualise and/or discuss RRI from the perspective of ICT for an ageing society
- Existing foresight activities in the area of ICT for an ageing society

The signals have been clustered and are described according to the Amanatidou et al. criteria below. Interviews are referred to by number, to protect the privacy of the interviewees.

It is important to note that while there may be other issues within these signals that are not discussed, the descriptions and analysis offered here are based firmly within the literature and other data collected for this activity. We situate this discussion firmly within the analysis of the data, but contextualise it later within the discussion of weak signals and our conclusions.

### 4.1 Definitions of “ageing” and “the elderly”

#### 4.1.1 Described Impact

Defining “ageing” and “the elderly” is one of the major issues within this area. It is much discussed within the interviews and other forecasting studies, with various definitions, from demographic through to situational, suggested. Some of these are more recognised than others, such as “active ageing”, which focuses on capabilities, with technology enabling older people to have responsibility over their own bodies rather than treating, and “ageing in place”, which focuses more on treatment or monitoring to enable people to live in their homes rather than move to care facilities. The problem with these is that people are doing both

active ageing as well as ageing in place, rather than just one, and they are largely contradictory, with current technology often unable to manage the transition between home care and outside-of-home care. Alarms and sensors are the main technologies that are problematic, with ambient fall detectors or activity monitors unable to determine when someone is outside the home.

There is also a potential for conflict between the desire for active ageing or ageing in place – conceptually, there is a tendency for people to assume that older people are house-bound for the most part, with families often preferring this so that they know their family member is safe; yet this is very often not the case, with active older people ensuring they exercise both mentally and physically – which often occurs outside the home. This is bound up in definitions as well, with older people not wishing to consider themselves “elderly” as it suggests infirmity or disability, and sometimes referring to “the elderly” as the *other*, usually with negative aspects, such as lack of ability with technology.

What is needed instead are contextual definitions – for example, definitions of what ageing is in the context of a particular technology, for example, medical or clinical technology, everyday technology – with these definitions coming from real contexts that take into account issues like increased acceptance of technologies in laboratory settings; the need for “real life” settings; and the need for co-creation of definitions with stakeholders. These definitions can be positive or negative, focusing on capacities of older people (good ageing) or deficiencies (vulnerability, decline, frailty). Developers may also need to question the idea of what “good ageing” is, or be neutral in definitions (such as using “government of later life”) – questions about what “normal” is could also be useful to determine the contexts in which the technology is developed (although unlikely to be answered, asking such questions can help with reflection in the design of technology).

Additionally, companies need to determine whether they are aiming for lifestyle devices or care devices, as these can change the definitions used and context in which a technology is developed and deployed. Another choice that needs to be made is whether they wish to go for individualisation of the technology (i.e. so that the technology can be tailored to individual needs) or generification of the technology (the technology can be generalised to fit more situations and to be made more ubiquitous, taking on more flexibility or general tasks). These have benefits and disadvantages, but can often come into conflict with one another, making it difficult to produce technology that does both aspects well.

#### 4.1.2 Desirability

While it might be useful to have a generic description of elderly/ageing/older/etc. people, it's very difficult to actually construct one. Future development may just wish to avoid it altogether & look at co-construction of their audience with stakeholders. Other definitions of related terms, such as “good ageing” also need contextualisation.

#### 4.1.3 Factual basis

The papers included as part of this study indicated some of the definitional issues; the interviews conducted contributed further information and potential issues. For example, the issue with ability-based definitions or age-based definitions are encapsulated in this quote from one of the interviews: “we probably have to look a little bit from inclusive design perspective so that the solutions that we create are then usable for the people who are let’s say 55 on about average of users that work in our factory that are on [unclear], so it’s closer to the guidelines and then of course the [unclear] of failing eyesights and more? loss of motoric control which [unclear] them in being able to work with IT systems so of course we have to make sure that these are taken into consideration” (Interview 13). The issue with “othering” age is well illustrated in Pritchard and Brittain (2015) where their participant Tom says “It felt like an old folk’s place, if you know what I mean. And I’m not an old folk!”

#### 4.1.4 Plausibility

The extent of this discussion makes it an extremely plausible future concern, especially as life expectancy and later life health increases, and consideration of changes to retirement and pensions, etc. might be needed. Other definitions also show some of the potential problems with general definitions and the importance of contextual definitions.

#### 4.1.5 Novelty to policy-makers

This is a very important issue to policy-makers due to decisions as mentioned above. The Lund Declaration states that this is “perhaps the most important long-term challenge for the European welfare states” (European Union, 2009)

#### 4.1.6 Interests at stake

This signal would be interesting to government, industry, citizens, and research.

#### 4.1.7 Emotional aspects/critical aspects

Nobody likes to think of themselves as getting old (fear of mortality), as can be seen by the groups that referred to “the other” elderly people (not themselves). The concept of ageing itself has negative implications, that can theoretically be staved off by “ageing well” or through “healthy ageing” or “active ageing”. There is a potential conflict with definitions that change retirement age which can be a very emotive issue.

#### 4.1.8 Changeability

It's highly likely that this issue will not change, but will adapt - definitions will continue to change to fit whatever purpose they're required for. This will likely continue to alienate and generalise or not address the desired population. However, it is important to know that this is an issue that designers need to at least be aware of so they can look at what it is they are innovating to do. However it's worth being cautious as well because people don't like to be treated as a subset of problems (rather than whole people). This is a complicated issue that is not likely to be solved easily.

### 4.2 Concerns about future ageing technologies

#### 4.2.1 Described impact

The impact in this section can be split into two sections: concerns of the ageing society ("bottom up" concerns), and concerns of the government, industry, and service providers ("top down" concerns).

##### 4.2.1.1 "Bottom up" concerns

People identified as members of the ageing society have a great many concerns about future technologies. They can be anxious about using new technologies, especially in public places, asking questions about technologies (often repeatedly), and about their friends or others knowing that they have to use "technology for old people". The shame of not knowing how to use or not understanding common technologies, or feeling incompetent using them is a big concern to older people. This is despite many older people having a desire to know about or understand the technologies, especially if they have had education or training in technology, such as being an engineer. In fact, such people with this desire to understand can feel joy at being able to control technology, but also can be concerned about the fast pace of technology development and its increasingly complicated usability, which can lead to a feeling of lack of control.

Other concerns include being worried about marginalisation of "the other" elderly that cannot or do not want to engage with technology, expressed by those who were more interested or able.

There were also significant concerns about technology becoming so ubiquitous that it replaced humans, or that people became dependent on the technology, with an associated fear of loss of autonomy as the companies who make the technology become more controlling. This was echoed in one of the papers (Suopajarvi, 2015) where the older people were anxious about using the

computer “for too long” at a time, worried that they would become addicted to the computer.

Technology bringing social isolation was another concern, especially with the ageing in place type technologies not allowing older people to go out without some alert being triggered.

More specific concerns were around the fear of mortality – where older users were reminded by the use of their technology that it meant they were old and likely to die soon (for example, push-button alarms). These powerful feelings were also present when older users compared their abilities with younger users. According to Suopajarvi (2015), even if their skills improve they feel as though there is no way they could ever be as competent with new technology as younger people. These feelings of “being old” and “not being as good as they used to be” can be powerful motivators to avoid the use of technology. Some older people also just are not interested in technology, which can cause conflict if it is inflicted upon them. Such forced technologies can lead to deliberate forgetting to turn it on or wear a device, though forgetting about technology can often be attributed to other issues, such as dementia or infirmity.

Finally, a significant concern is about the dehumanising nature of technology – older people don’t just want to be seen as a collection of disabilities or ailments but as people with legitimate concerns and opinions about the technologies they integrate into their lives.

#### 4.2.1.2 “Top down” concerns

Concerns that come from the “top down”, i.e. from government, industry, or service providers tend to be around management of expectations, ensuring coverage and availability, ensuring value for money, privacy and data protection, and other more general concerns. A significant concern for these groups is that the target market will simply not engage with the technology being provided for them, and therefore they will need to address the bottom up concerns described above.

Concerns about misinterpretation of health data provided by personal health monitoring tools are important to be dealt with – already some companies are minimising the amount of data that is returned to the user – but there is a balance that needs to be struck between ensuring the effectiveness of the health data reading and patient privacy. Additionally, these health monitoring tools should not have their claims overstated, and be advertised in the right way: as a supplementary technology that cannot be a replacement for appropriate medical advice.

Governments and funding bodies want to have technologies developed not just where there is profit-bringing demand but for a range of contexts, disabilities, and illnesses of later life. They want individualised care, but in a generalisable form. This is, as discussed previously, very difficult to do.

These groups are also concerned about the forcing of technology onto people, as mentioned as one of the bottom-up concerns. They feel the need to respect the way older people integrate technologies into their lives, to make technology “cool”, promoting education about new technologies and facilitators for new installs to prevent disengagement with the technologies, such as deliberate “forgetting” or skewing of results where older people can say that they do use a technology in order to make a company or family happy when actually they don’t. Additionally, they are concerned about irrational rejection of technologies, such as has happened with genetically modified organisms, which can come as a result of forcing technologies on people who are not adequately prepared or who cannot see the benefits.

This is why some of the main top-down concerns are how to ensure that their technologies benefit the users, and that these benefits outweigh the disadvantages. Governments are cautious about “hidden” disadvantages such as privacy issues, as well, because these can backfire – but there is a fine line between needing access to personal health data for the public health interest and respecting the privacy of individuals. To complicate things, different people have different ideas about what data of theirs should be shared, ideas which should be respected. They also want to positively impact social inclusion – hence attempts to improve usability and include users in developments. However, these could run the risks of generalisation and stereotype discussed in the previous section. Governments are also concerned about exploitation of vulnerable people by companies out for profit – this is only likely to increase as the ageing population also increases.

But then of course is the complication that people don’t always know what they want, so perhaps user consultation can only go so far. Additionally, some more advanced technologies are not easily explainable to an extent that users would be able to fully grasp the intricacies of the development of that technology. A balance needs to be struck here. In user tests, users do not meekly follow scripts (and particularly users who are not convinced of the benefits of a new technology), and “real life” situations will always pose more problems than lab-based trials. This will continue to be a concern in the future development of technologies.

#### 4.2.2 Desirability

Addressing both top down and bottom up concerns is highly desirable in order for greater acceptability of technology and improvement of older peoples' lives.

However, new technologies will only be desirable where there would be a significant positive impact to the quality of life without significant drawbacks or exploitation of vulnerable people.

#### 4.2.3 Factual basis

The factual basis is well established in the literature and interviews.

#### 4.2.4 Plausibility

The concerns from both "sides" are extremely plausible and fit with already-established understandings of the problems with technology and healthcare in general.

#### 4.2.5 Novelty to policy-makers

Understanding acceptability of technology in a difficult realm of health is highly novel for policy makers. Balancing different values and investigating priorities for funding and support are difficult and need to be better understood before decisions are made.

#### 4.2.6 Interests at stake

This signal would be interesting to government, funding agency for research, companies, and users/patients.

#### 4.2.7 Emotional aspects/critical aspects

Many of these concerns have emotional and critical aspects to them, as discussed above.

#### 4.2.8 Changeability

Yes - many of these could be changed through application of RRI tools/methods. Some are more philosophical and some require more social change.

### 4.3 Assumptions and stereotypes about older people and technology

#### 4.3.1 Described impact

There are some serious stereotypes of older people and their relationship with technology. Although these might be made in the best of intention, they can work

negatively against the people using the technology, possibly alienating or making them feel forced to use the technology.

Some physical assumptions include those in the area of eyesight and motor control, but not all older people have these physical problems.

There can also be assumptions about ability and willingness to engage with new technologies, that technology needs to be simple so that "people with limited IT skills can understand it" (D1.2 Case Study Descriptions), that older people have time to "spend hanging around in the city center and [use] novel technologies" in smart cities (Suopajarvi, 2015), and that "researchers and developers often think it is impossible to get the view of people with dementia" (D1.2 Case Study Descriptions). In fact many older people are quite excited about new technologies, knowing how they work, etc. as discussed in previous sections. From the interviews (especially those who claim they have "not much ethics") we see many companies who make these assumptions about ability or willingness or physical problems; in the papers the case studies show that there is a lot more to it - older people are likely to play down their skills (even though they may be quite competent) especially when comparing to younger people. Some stereotypes may be true and should be acted on, i.e. there may sometimes be assumptions that are made that are deliberately obscuring difficulty some users might have with technology, e.g. privacy policies, terms of services, etc., such as assumptions that people will read these documents, understand them, and be able to give consent.

The result of not understanding actual abilities and instead making assumptions is that older people can be made to feel stupid, patronised, alienated, forced into using technology they don't want to use, and they could be exploited, or technology companies wouldn't feel that important issues need addressing (e.g. consent issues). In one interview (21), the company representative stated "I do not think that presently the users have such clear knowledge of privacy issues [...] that they would prefer the services offered by a company that guarantees more effectively the data protection". Yet, in other parts of the data collected, it was found that older people seem to be well aware of certain security issues (not trusting internet banking, knowing about email breaches etc.).

One of the trends in technology development is the creation of "fictional users" to assist in developing targeted technology. The use of "fictional users" may not accurately capture the actual users (as they are constructed from (probably) a younger person's perspectives of older people), and sometimes these are idealised users that "exist out there" (but don't really). This ties into the issue of "solutions looking for problems" type technologies that are really created due to a non-older person thinking they have found some sort of opening for technology (e.g. the shopping trial (Östlund et al., 2015)).

Instead it is important to know that "aging adults are not a homogenous group [...] in fact [they are] the most heterogeneous when we look at the age group" (Suopajarvi, 2015), and that the use of these stereotypes has not changed over time in 10 years ("I argue that the social discourses on the issue have thus not changed. The computer skills of the aging adults may nonetheless have improved." (ibid.)). In fact, "the notion of what is social and the expectation of what technology should contribute with is unchanged" (ibid.).

Even positive descriptions such as "silver surfers" etc. can "affect the ways elderly people experience their own relationship with ICT and themselves as members of the information society" (Suopajarvi, 2015).

However, when it comes down to it, older users forced into using technology will often just use it (or say they use it), because they feel like they have no other choice thanks to pressure from family, healthcare services, peer groups, carers, or other groups.

#### 4.3.2 Desirability

Understanding the issues of stereotyping is highly desirable - we want to make sure that new technologies that help older people are effective and accurately address their competence and ability levels as well as providing for disability or illness where appropriate.

#### 4.3.3 Factual basis

There is good factual evidence for these issues within the body of data collected.

#### 4.3.4 Plausibility

It's plausible that this will be an ongoing issue - unlikely that definitional problems will be solved as they are difficult as it is. This will mean that stereotypes will continue to be used and abused.

#### 4.3.5 Novelty to policy-makers

Policy will continue to attempt to define and, as above, it means that there will continue to be stereotypes. Policy makers will, however, benefit from better knowledge of actual practices if they attempt to do away with or minimise the effect of stereotypes of older people.

#### 4.3.6 Interests at stake

This signal would be of interest to policy-makers, older people, companies, researchers, and government.

#### 4.3.7 Emotional aspects/critical aspects

Being stereotyped is extremely emotive. People get upset if they are patronised or it's assumed that they are not as capable as they might otherwise be.

#### 4.3.8 Changeability

As the generation that grew up with the internet gets older, this may change - although many of today's elderly people grew up with modern technologies like computers, yet still see themselves as less competent than younger people. RRI methods could help designers accurately capture the capabilities and expectations of their audience. In one of the case studies included in the data analysis, "by involving people with dementia throughout the design and development process, the researchers and innovators [...] had their assumptions challenged and [hopefully produced] a more relevant and useful product." (D1.2 Case Study Descriptions)

### 4.4 Ageing in a wider social context

#### 4.4.1 Described Impact

It is well accepted that there is a growing ageing population, and that people are living longer, healthier lives. This has caused concern about the burden that increased numbers of older people might place on welfare and healthcare services, as although lives will be healthier generally, there will be increasing amounts of healthcare required to maintain well-being. It is generally accepted that technology can help to ease these burdens by allowing for healthcare and welfare to reduce the need for reliance on humans to do administrative and other work, but this can lead to dehumanisation of the patients and welfare recipients and a loss of personalisation of healthcare.

Additionally, there are concerns about whether technology can really help – one study suggested that technology has afforded no significant changes in health. The impact of this issue is big though – with lots of factors involved in health and ageing there are going to be significant social implications if any of the potential negative factors are not taken into account. However, the rewards are high if technology is correctly implemented in ways that benefit everyone, and don't just focus on cutting welfare and health costs.

#### 4.4.2 Desirability

A positive ageing society with good technical support is a very desirable future, with the benefits being lower costs of welfare and healthcare for an increasingly ageing population.

#### 4.4.3 Factual Basis

Well-established.

#### 4.4.4 Plausibility

It is highly plausible that we could get to the desired future, and highly plausible that this is partly technology-driven. The important aspect is that it should not be left solely to technology to solve but a wider environment needs to be considered.

#### 4.4.5 Novelty to Policy Makers

Novel: there are large amounts of money at stake so this area is a high priority for policy-makers.

#### 4.4.6 Interests at Stake

Groups that are interested in seeing this become a reality: government, tech industry, healthcare industry, research, elderly people & families.

Groups that are interested in maintaining some sort of status quo, or a minimised version of this desirable future: Health/tech industry that provides treatment/long term care for chronic illness, workers in areas which are at-risk to be taken over by technical solutions.

#### 4.4.7 Emotional/Critical Aspects

Some of the aspects that come up related to these topics are issues to do with fear of mortality, the definitions and philosophies of ageing (especially when it comes to aspects such as retirement, as discussed in section 4.1). These also manifest in welfare-related aspects, such as the right to end life, and potential relationships between family members and the older person, especially if care is involved. Additionally, those at risk of losing their jobs to technology would likely protest its introduction. Finally, technology developers and funders should remember that many people feel that older, non-modern-technical solutions are superior to their more modern counterparts, for example, currently, newspapers, land line telephones, etc. so these aspects of the social environment need to be taken into consideration.

#### 4.4.8 Changeability

In this topic there is a huge potential for change, but caution is needed so that the right balance of technical and social support is made.

## 4.5 Operational issues that may impact RRI in industry of ICT for ageing

### 4.5.1 Described impact

The potential impact of this category has been subdivided into five subcategories, potential enablers of RRI, potential barriers of RRI, RRI-related issues that companies are concerned about, RRI-related issues that companies are not concerned about, and times when RRI activities have gone wrong. These are specifically mentioned because enablers and barriers could help with the understanding of the future uptake of RRI; it is good to note the concerns that companies do have in order to identify good practice; there could be areas that companies are not concerned about but which are otherwise indicated as needing attention; and lessons learned can assist with future positive and useful approaches to RRI.

#### *4.5.1.1 Potential enablers of RRI*

Some of the potential enablers of RRI touch on areas that other primary signals have already discussed, but are important to note explicitly, as they could be a way to “sell” RRI practices to companies. Some enablers are ways in which RRI can be incorporated into practice; other enablers are more selling points to raise interest in RRI activities.

Companies could incorporate RRI in their practices through the "domestication" of technologies to serve existing practices (and thus make them more acceptable to older people). They could collaborate with research and other industries more, and include non-profit organisations to develop a more multidisciplinary approach that allows for better alignment of technology with user needs. Developing sustainable business models can incorporate RRI methods in it. By committing to engage with the system responsibly, companies can incorporate good practice guides, self-assessment tools, and corporate social responsibility into their everyday practice. (This requires that such tools exist, however.) Finally, by innovating responsibly, companies can show and share good practice amongst other companies for overall better business approaches.

According to the data analysis, companies can benefit from RRI because it allows them to be more interactive with their consumers, before horror stories reach social media. Most companies want to be seen as a good company with good values – RRI could help with that. RRI can also help with cost savings by reducing unintended consequences, ensuring acceptance of technology, mitigating potential negative impacts, aligning with government funding, ensuring long term economic impact through sustainable business models, and addressing user concerns early on in development rather than later in the development cycle.

#### 4.5.1.2 *Potential barriers*

Some potential barriers to implementing RRI identified by companies could include conflicting priorities, such as priorities to produce a return for shareholders, or profit margins, or staying the market leader. In one interview with a smaller company, competition with big companies was cited as a potential barrier, with “no time” for thinking about responsible innovation aspects. These would mean that RRI is pushed into the “nice to have” rather than “doable” side of things. Other problems could be the increasing pushes for generification, and embeddness of computing meaning that the hardware/software divide is more complex, leading to other priorities (such as getting things to work), or integration into bigger company solutions, where it may not ultimately matter if one tiny subset of things was innovated responsibly so not considered important. Of course, additional work means for additional cost, and in a cost-savings world this may mean that RRI is not a priority. Companies are also wary of being required to open up their data or patents. Finally, companies may be wary of the traceability of users of innovations – fixes or updates that solve issues responsibly may be unable to be pushed to devices or devices may not be easily recalled, according to one company.

#### 4.5.1.3 *RRI-related issues companies are concerned about*

Some of the issues that we would consider responsible research and innovation issues are things that companies do care about. These could be used as entry points to softly introduce RRI methods as solutions to these problems. Companies are concerned about including users in their development, but note that large groups of stakeholders can be difficult to gather requirements from, and some users are not easily accessible, or are vulnerable. The other side of the coin is that they are also concerned about users preventing their innovation or interfering with their creativity, possibly due to irrational fear of the technology or lack of desire to integrate it into their lifestyles.

Other, more technical issues include accuracy of data collected, privacy, interface design that is accessible, hacking and security, and compliance with legal obligations, such as privacy law or the EU directive MDD.

However, concerns about “user compliance”, aligning innovation with market expectations, trust between industry partners, and the difficulty of moving lab work into the field (or “real life”) are particular social issues that also could be potentially addressed through RRI methods.

#### 4.5.1.4 *RRI-related issues companies have identified but are not concerned about*

Some issues that we consider RRI-related issues companies know about, but are less concerned by than researchers or academics include aggregation of data

(privacy concerns are apparently easy to address), and design and deployment of technology (within certain environments). However, some companies also think that simple deployment of “neutral” technologies is not a problem, and some companies that develop these “neutral” technologies think that deployment is where the ethical and social issues come in. The lack of understanding of the potential impact of their technologies or deployment of technologies could be problematic for RRI because of the focus on responsibility – who would be responsible for negative impacts due to poor deployment of a technology, or for negative impacts due to correct deployment of a poor technology? Some companies also misunderstand the idea of user engagement – thinking that engaging with the direct users, such as physicians, is enough for stakeholder engagement even though the technology actually has a major impact on that physician’s patients.

Finally, if companies don’t think that their users care about privacy, they think that privacy is not worth spending time and money on.

#### *4.5.1.5 Times when RRI activities have gone wrong*

Some of the data analysis turned up some situations where companies had tried to do “what’s right” but it hadn’t gone according to plan. The main problems that were identified might be useful to learn from in order to determine the correct approach for RRI activities.

One group that did ethnography with a company found it hard to make the ethnographic accounts understandable to the business people.

Another group found that users did not “meekly follow scripts” and were independent and determined to use the technology in a way that suited them, not the company. Additionally, sometimes legitimate concerns about a technology can be downplayed or ignored because they don’t fit the company’s narrative about their technology.

Technologies can be rejected by users, but sometimes pushed on them anyway, making “care-at-a-distance technologies unattractive and potentially coercive” (Aceros et al., 2015).

Finally, definitional problems abound. Who is “ageing”? Who are “the elderly”? These questions made it difficult for companies to target their market appropriately in some situations.

#### 4.5.2 Desirability

It is extremely desirable to enable companies to include RRI activities in their practices. Knowing the barriers and enablers, as well as good practices can be the key to ensuring more responsible innovation. More good practice can be found in the next primary signal.

#### 4.5.3 Factual basis

Well-established.

#### 4.5.4 Plausibility

Very plausible – these align with general understanding of the benefits and disadvantages as found in the Delphi study.

#### 4.5.5 Novelty to policy-makers

Highly novel, for the desirability reasons mentioned above.

#### 4.5.6 Interests at stake

This signal is of particular interest to industry, research, government, policy, and funding agencies.

#### 4.5.7 Emotional aspects/critical aspects

These are discussed in the first section, but the main emotional/critical aspect is that stakeholders don't feel that the technology is being built for them.

#### 4.5.8 Changeability

It is likely this can be changed if the right points are found to improve and better embed responsible innovation within existing methods.

### 4.6 Designing technology for ageing

#### 4.6.1 Described impact

This signal has significant potential impact, through recommending ideals for future technologies and their development, as well as things that designers of technologies should be aware of if they are going to innovate in this area.

##### 4.6.1.1 *Future technology needs*

Future technologies need to be motivating and useful, empowering older citizens, and serving their quest for meaning and identity. They need to have a positively experienced predecessor for it to be "fascinating" to people, or be brought "through life" from earlier ages (e.g. robots) so that they are "domesticated" or incorporated into everyday routines and social practice. Technology should have privacy built in, for example: if a publicly used technology, making users feel as though they are at least in a semi-private place when using to overcome potential anxieties; or only capturing minimum necessary information, in order to improve a user's care, and not for advertising or profile building; discussing the extent and implications of monitoring with users; assessing whether proactive monitoring involving feedback and interventions for developing health conditions are useful or necessary; giving users control over their devices, allowing them to turn them on and off, or temporarily disabling monitoring.

Technologies should not be technological solutions for technology's sake - many "traditional" ways of doing things are preferred by older users (and often social

solutions are preferred to technical ones). Finally, technologies should balance out generification and personalisation, such as through limiting user access to raw monitoring data (contextual) & offering multiple levels of summarised feedback to users

#### 4.6.1.2 *Technology design*

Innovators should use person-centred design vs. designing on basis of scientific knowledge about ageing processes, and not try to solve everything at once. They should also move away from only consulting experts and producers and involve older users, creating open channels of communication with users. They should avoid stereotypes about users, especially negative ones about their capabilities, such as that they might have more time to use technology, or that they are all the same and have the same needs (e.g. that they all have similar levels of cognitive ability).

Designers should recognise users' strong will to remain mobile and continue living independently – understanding previous negative and positive experiences with technology is essential.

It is also important that innovators recognise the relationship between users' technological and offline interactions and determine whether design could reinforce offline social relations, which can be much stronger than online relations. This ties into the fact that innovators need to know the difference from the lab context to real-life settings and to understand the real-life setting first – before they start developing their technology. Knowledge of who the users really are (not just the purchasers, or the health care workers, or families) and what role their device serves (consumer device? fancy gadget? empowerment tool for self-management of disease? traditional medical support or help with treatment plan?) in this environment is really important.

Designers also need to be aware of the fact that awareness of being monitored will alter peoples' behaviour (often negatively); that people will also want to please designers. This could be mitigated through ongoing evaluation, which should be integrated into testing procedures anyway – though this may be difficult if the technology is particularly complex. Another mitigation strategy, and a process that is recommended is that designers are flexible with their timelines to allow for users to give good feedback, rather than being pressured for feedback before the user has sufficiently evaluated the technology.

Additionally, designers should recognise that if their technology is not working, they shouldn't force users to use it – even through persuasion or manipulation via family and friends – this is problematic from an informed consent perspective and individual autonomy should be respected. This is the demographic reality – not all older people need technology, and not all older people will want to use it. Some have greatly different capabilities and desires from others.

Finally, technologies should not be seen as the only solution, and should not be replacing current human-filled jobs that have social capacities. Staff also need to be trained properly and supported.

#### 4.6.2 Desirability

Recommendations for future design and needs are highly desirable to make sure that tech development is efficient, acceptable, and effective.

#### 4.6.3 Factual basis

Well-established in pre-existing scenarios and experience, with applications for future development.

#### 4.6.4 Plausibility

These techniques should be further tested but are grounded in reality. The likely impact could be significant – if these are not met, there could be negative effects.

#### 4.6.5 Novelty to policy-makers

Highly novel. Collections of best practices and recommendations can feed into policymaking.

#### 4.6.6 Interests at stake

This signal is of interest to industry, policy, and stakeholders.

#### 4.6.7 Emotional aspects/critical aspects

Users wish for their needs to be taken seriously. Technologies need to support them and be empowering. Autonomy is particularly important.

#### 4.6.8 Changeability

These recommendations could change current development methods, if integrated correctly. Through more testing, the recommendations themselves could change and improve.

### 4.7 Future Technologies for Ageing Societies

#### 4.7.1 Described impact

This primary signal aims to describe how future technologies for ageing societies might look. It is split into subsections: future utopias, where technologies are integrated positively; future dystopias, where technologies are not; then an overview of technologies that are currently still in development (so futuristic, but here already to some degree). The data also provided a list of current “mainstream” technologies – these are excluded from this section because they are already well-established rather than future trends. This does not mean that current technologies will not continue to be a part of the future landscape of ICT

for health and ageing, but that as technologies in and of themselves they are not of particular interest except in integration with other technologies (such as in the future visions of how ICT for health and ageing might work).

#### *4.7.1.1 Future utopias*

One of the most recurring ideas of how future technology might work for ageing populations is the smart house with 'welfare technology' (cameras, alarms, sensors) and automation with robots to do the chores, cooking, etc. These robots will have significant AI, companionship abilities, medical treatment functions, and can provide assistance in the bathroom and toilet, and dosing of medication. Technologies in these smart homes might have behavioural pattern recognition, the ability to estimate self-care ability, and detection of declines in health. Robots might be generic hardware platforms with "app stores", or generic entry points for a broad range of services and third party apps.

Healthcare itself could come from these technologies, with fully-fledged "e-health" or "telecare" technologies allowing remote contact with healthcare professionals in the home. Along with a fully-centralised medical record system, and streamlined health system (using data from monitoring technology sent to the physicians to allow for better diagnosis and treatment), temporary and chronic illnesses can be better monitored and supported, leading to reduction or removal of unnecessary medication.

Future elderly life will also be assisted outside the home, with driverless cars, monitoring technology that works outside the homes as part of active and healthy ageing campaigns, and mobile applications that are actually used by older people (rather than forced on them by family). Shopping requirements will be solved through home delivery of goods by drones. More gadgets and technology such as these will allow for people to have more time to enjoy life, and enjoy their "elderly lifestyle" with specific lifestyle coaching, entertainment, and other positive technologies, rather than focusing on care or disability. Ideally, of course, all of this wonderful technology will be available equally to everyone in the world, regardless of nationality, socio-economic status, religion, ethnicity, gender, sexuality, etc.

There is also likely to be disruptive technologies that come into play – what these might look like are a little less clear, but things like brain-computer interfaces, other technological/medical devices or advances in knowledge of the human body could shake up the entire ecosystem.

#### *4.7.1.2 Future dystopias*

For all the potential positives of the technologies described, there are some things that were identified as being potentially negative implementations of future ageing technologies. Concerns about technology taking over from humans leading to unemployment and deskilling, or that replacing humans with robots could lead to de-socialised people (who are only able to talk to robots and not to humans), or that telecare could lead to very ill people only being visited electronically when they could really use some social contact with real people.

Another significant concern could be that the ageing in place technologies outstrip or are more funded than the active ageing technologies and become the “default” basic generic technology leading to people becoming prisoners in their own homes. Additionally, commercialisation remains a potential problem – with peoples’ health data profiling being sold to the highest bidder, even on state-subsidised healthcare. In fact, any linking of health data with commercial activities (e.g. supermarket shopping) or commercial gains from medical data are considered extremely problematic within the data sets.

As with the utopias, there is the potential for disruptive technologies here as well, which could have negative impacts.

#### *4.7.1.3 Current techs that are still developing*

Many of the technologies and outcomes mentioned above already are in place in some way. For example, smart houses are becoming increasingly networked through high-availability and affordable broadband, with many devices connecting to the internet. In areas of ICT for ageing, these include ambient alarms, such as care alarms, fall alarms, and alarms generated by implements that aren’t used for a while, and blood pressure, activity and glucose alarms. There are home-based touch screen devices for caretaker services, pharmacy delivery, meals and grocery orders. Some devices monitor for disease or provide cognitive stimulation. There are even some rudimentary in house care robots, such as vacuum cleaner robots, or “pet” robots.

In health care itself, some technologies are making it more efficient, such as software that optimises nurse visits, medical interventions for dementia care, stem cell treatment, regenerative medicine, and early diagnostics. These are sometimes rudimentary but show the possibilities for future technologies. Data sharing and open platforms are becoming more available, with academic research data becoming available to the public, and more publicly accessible research results.

“Generic entry points” are also already available, with tablets, touch screen TVs, mobile phones, and other devices providing “app stores”. However, many of these are not developed sufficiently or understand the market properly.

#### **4.7.2 Desirability**

The utopias are obviously desirable, but it is important to note the desirability of the absence of the negative aspects.

#### **4.7.3 Factual basis**

Well-documented.

#### **4.7.4 Plausibility**

The plausibility of a combination of these scenarios is fairly high. It is unlikely for either “side” to be fully realised, however.

#### 4.7.5 Novelty to policy-makers

Use of scenarios and ideas of future worlds can be helpful to determine what sort of society is desirable.

#### 4.7.6 Interests at stake

This signal is of particular interest to industry, citizens, government, and research.

#### 4.7.7 Emotional aspects/critical aspects

These are discussed above, in 3.7.1.

#### 4.7.8 Changeability

If we look at using RRI methods it is likely that the utopia scenarios are more likely to arise than the dystopias. However, it is also possible for people to change their minds about how society ought to be, which could change the utopia/dystopia scenarios.

## 5 Weak Signals

Weak signals found within the analysed data will be described here. The weak signals were derived from the analysis of the primary signals – issues briefly touched on but rarely significantly described that could have a significant effect on future development of technologies in this area. They were then categorised according to broad themes: **future elderly, future technologies, future companies, future environments** and **innovation motivation**. These categories and their signals are further described below.

### 5.1 Methodology of Identifying Weak Signals

A further round of searches of social media, technology blogs, and news sites will attempt to support these weak signals with current discussions on their feasibility. Weak signal searches will be based around a set of search terms to do with disruption of future health innovations and future ageing technologies, as well as modifiers for the weak signals themselves. Since we are interested in future health care for ageing populations the basic queries below were chosen to investigate whether the in-depth weak signals correlated with anything being discussed online. These queries were developed by hand using appropriate similar words to allow for results that broadly fit the signal category, while trying to be open enough to allow for edge cases to be caught (as many of these signals are by definition “weak”). A small Python program was written to assist with Twitter searches by automatically polling the Application Programmer Interface (API). Due to the nature of the Twitter API polling process, which only allows a small number of recent responses to be returned, the results are a

snapshot of the time in which they were requested, rather than an exhaustive assessment of opinions or discussion around the subjects. Irrelevant results, such as spam, were filtered out, as were duplicates (such as “retweets” or repeated press releases).

Additionally, fictional representations of future worlds were removed as science fiction was considered outside the scope of this paper (though it could be useful to use as future thought experiments/scenarios). It is important to note that weak signals are those which are touched on by primary/secondary signals, but not discussed particularly extensively, and followed up to consider plausibility: they are not explicit predictions but a basis upon which to reflect on the current trajectory of technology development in this area.

### 5.1.1 Queries

**Future technologies:** “future health technologies” and “future health innovation”

**Innovation motivation:** “motivation health innovation” and “innovation motivation”

**Future companies:** “future health companies” and “future technology companies”

**Future environments:** “future health environment” and “future health spaces”

**Future elderly:** “future ageing”

These queries were meant to open up the scene, and not be necessarily restricted to the category they were devised under – many of these issues are cross-cutting or complementary. In some circumstances further queries were made (and are referenced below) in order to gain a further understanding of attitudes toward particular aspects.

### 5.1.2 Search Engines

**Twitter** In Twitter, most of the tweets discovered on the search topics were links back to news or blog articles. There were only minor discussions between people about issues. It seems that without more significant data mining with more context-sensitivity Twitter is really only useful as a source of external links (sometimes with simple commentary).

#### **Hacker News**

Hacker News is a startup community that has a broad reach across innovators. It has discussions about cutting edge technologies which can be searched through keywords. There were many external links but some with good discussion as well. These are included in the discussion with appropriate footnotes.

#### **The Conversation**

Searches brought up several articles by academics in the areas of interest, along with comments below the articles. These are included in the discussion with appropriate footnotes.

## **Reddit**

Searches brought up several articles linked externally and sometimes discussed within the subreddits. Most of the discussions that were found were in the “subreddit” r/technology. These are linked to in appropriate footnotes.

## 5.2 Findings

### 5.2.1 Future Technologies

Weak signals that come out of the primary signals point toward potential disruptions for future innovations. Questions like how far monitoring should go - is an invasion of privacy worth having illness detected and diagnosed for you (for example, frequent toilet visits ending in a diagnosis of bladder infection)? and questions around when a particular health care technology is “finished” - how much time will people need to maintain and update their technology, and will it provide the right kinds of information in updates, especially with regard to privacy affecting aspects? Informed consent is a major potential disruptive aspect of future technologies - at the moment it is not taken particularly seriously with unregulated devices, but in future devices that integrate medical care there could be some serious issues with the manner of giving consent. Innovations that provide large amounts of data that could be misinterpreted. Innovations are also likely to cross hardware/software divides, and this comes with particular responsibilities for engagement across different aspects of software and hardware engineering and making for more complex projects. Innovations could also run into trouble when it comes to the differences between generification and individualisation, with potential for either a digital divide (between those with the means for individualised care vs. those who can only afford the base model of technologies) or technology that is inefficient and tries to do too many things. Additionally, the conflict between active ageing and ageing in the home: stereotypes of users could easily mean for unintentional consequences such as housebound elderly reliant on technologies that won't allow them to leave home.

Discussions about future technologies on Twitter were mostly concentrating on some of the specific technologies, such as blood transfusions from younger people, which Twitter participants found to be “creepy” and “vampiric”. Similar discussions were had on Reddit, with users talking about a bionic heart predicting “blood flow as a service” and “Terminator-like” post-apocalyptic worlds based on the science-fiction nature of this technology<sup>2</sup>. Other Reddit

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<sup>2</sup>[https://www.reddit.com/r/technology/comments/2z9lcq/a\\_new\\_piece\\_of\\_healthcare\\_technology\\_a\\_bionic/](https://www.reddit.com/r/technology/comments/2z9lcq/a_new_piece_of_healthcare_technology_a_bionic/)

discussions concentrated on the new innovations that are still cutting edge, such as high tech spoons for people with degenerative conditions<sup>3</sup>, and disruptive technologies, such as analytics, 3D printed organs<sup>4</sup>, mind control devices, exoskeletons, and nanobots<sup>5</sup>. This shows the levels of interest in new and emerging technologies amongst younger people (the largest age groups in Reddit being between 18 and 49<sup>6</sup>). Many of these innovations cross the hardware/software divide, as mentioned above, or could remain only within the realm of the rich for a long time, as they are reliant on significantly advanced technologies and extensive support. A Conversation article also touches on these emerging technologies, and particularly biotech, infotech, nanotech and cognitive science technologies and how they are likely to rapidly change society, and even accelerating technological processes “into something we have difficulty imagining.”<sup>7</sup> Indeed, the sci-fi nature of all of these technologies and “real life tricorder” enabled futures are concerning to Redditors too, but in a different way, with commenters stating that “it would suck to die just before anti-ageing/biological immortality was invented”<sup>8</sup>. Concerns about privacy, profit motives and hacking are more prevalent in discussion than informed consent (although it could be argued that informed consent is part of most of these issues), with articles on The Conversation talking about hacking and profit motives<sup>9</sup> and Redditors concerned about anonymity for Facebook’s upcoming social networking support for healthcare (as opposed to Facebook’s requirements for real names)<sup>10</sup>.

There was not much discussion about ageing in place or active ageing, and on startup forum Hacker News, active searches for “ageing in place” or “active ageing” brought up only one relevant link with no discussion surrounding it<sup>11</sup>. Perhaps this is because this nomenclature is not used in the startup world – there are certainly multiple areas of innovation that Hacker News denizens

<sup>3</sup>[https://www.reddit.com/r/technology/comments/2g1ode/google\\_has\\_acquired\\_the\\_maker\\_of\\_a\\_hightech\\_spoon/](https://www.reddit.com/r/technology/comments/2g1ode/google_has_acquired_the_maker_of_a_hightech_spoon/)

<sup>4</sup> <https://theconversation.com/its-not-just-hype-3d-printing-is-the-bridge-to-the-future-43493>

<sup>5</sup>[https://www.reddit.com/r/technology/comments/2qgpqe/disruptions\\_that\\_will\\_change\\_the\\_future\\_of/](https://www.reddit.com/r/technology/comments/2qgpqe/disruptions_that_will_change_the_future_of/)

<sup>6</sup> <http://www.theatlantic.com/technology/archive/2013/07/reddit-demographics-in-one-chart/277513/>

<sup>7</sup> <https://theconversation.com/tomorrows-technology-will-lead-to-sweeping-changes-in-society-it-must-for-all-our-sakes-36023>

<sup>8</sup>[https://www.reddit.com/r/technology/comments/2vx0tz/how\\_silicon\\_valley\\_is\\_trying\\_to\\_cure\\_ageing\\_death/](https://www.reddit.com/r/technology/comments/2vx0tz/how_silicon_valley_is_trying_to_cure_ageing_death/)

<sup>9</sup> <https://theconversation.com/why-apple-is-pitching-for-the-health-market-27781>

<sup>10</sup>[https://www.reddit.com/r/technology/comments/2i61w8/facebook\\_is\\_plottng\\_its\\_first\\_steps\\_into\\_the/](https://www.reddit.com/r/technology/comments/2i61w8/facebook_is_plottng_its_first_steps_into_the/)

<sup>11</sup><https://hn.algolia.com/?query=%22aging%20in%20place%22&sort=byPopularity&prefix&page=0&dateRange=all&type=story>

contribute to, such as smart homes. It seems more reasonable to assume that the lack of discussion is due to nomenclature, but related searches did not bring up any suggestions for alternatives. Perhaps it is because the startup world looks more at individual technologies and their capabilities than working from a top-down perspective such as a definition of “active ageing”.

Finally, there are some warnings that technologies may not be able to deliver on their promises, and could in fact push society backwards with regard to certain other technologies – particularly energy efficiency technology as the increase in numbers of new technologies are going to require more energy to run<sup>12</sup>.

### 5.2.2 Innovation Motivation

The most important finding in this area is that the everyday mundane technologies that people in their middle-age take for granted now – the internet, mobile phones, tablets, smart fridges, etc. will be the technologies that they have integrated into our lives in the future, despite them likely to be “old fashioned” by then (cf. landline telephones, newspapers). Perhaps this means that innovators should concentrate on integrating, at the very least, the *idea* of their technologies at an earlier age, if they want them to be used as a “standard” in the future. However, the studies showed that those who were more technologically-savvy, or interested in technology, or with a background in technology or engineering tended to be more interested in new technologies, so perhaps more education about technologies at an early age will allow for more engagement with them at an older age as well. This, however, is quite a long time for an innovation to consider for a life cycle. There is no argument that integration of today’s technologies in life are any different from previous generations’ technologies (e.g. the car, telephone, or any other past society-changing technology) – but that it takes an extra level of desire to understand the workings of or building technology to inspire specific interest in new gadgets. This issue could affect companies’ motivations to innovate – but a mitigating factor could be if they undertake proper stakeholder engagement to determine whether their technology can really help to solve a problem, rather than just be a solution looking for a problem or a solution for families to force upon their older relative.

Another disruptive aspect to innovation in ageing could be the funding policies by large health services that buy technologies for their citizens, for example, the UK National Health Service (NHS). One interviewee mentioned that although there may be new innovations for an existing problem, if the solution that is currently being used is “good enough” it may be that the upgrade to the latest innovation is not considered worth the investment. This could mean that only

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<sup>12</sup> <https://theconversation.com/dream-homes-of-the-future-still-stuck-in-the-past-21169>

those who can afford to pay for newer technologies will be able to access them, even if their specific case might benefit dramatically from an upgrade. This might affect motivation for innovators if they are seeking to enter national health services with their inventions; once again it is important to engage with the stakeholders significantly before sinking investment into new projects. Finally, there are concerns that the way society handles health could significantly change due to more data being available to individuals and health services that could lead to a reliance in self-monitoring or self-diagnosis in a way that is detrimental to the individual. Misinterpretation of health data has already caused problems in the viability of projects such as 23andMe (genetic testing) whereby users sent off samples to be tested for genetic potential for disease and led to users self-diagnosing with the potential for breast cancer and other genetic-related disorders, which could lead to dramatic consequences. However, as can be seen from this example there is good regulation in place in the medical field whereby such sample tests are considered medical devices and need to be regulated – in 23andMe’s case by the US FDA – but for more general devices such as physical activity or heart rate monitoring there is less regulation but still the possibility for people to self-diagnose in a harmful fashion. This could affect the motivation for innovators as either they may have to go through stringent approval by a regulator for their innovation, or people may harm themselves (or find previously-undiagnosed disorders that could have psychological effects).

Twitter discussions about innovation motivation seemed to mostly focus on employer-employee relationships, with the importance of company values and providing top-down good leadership in terms of human values providing motivation. This links in to some of the “future companies” discussions. Additionally, this idea of current technologies being the future came up as well, though from a slightly different perspective with @TrishDyne tweeting, “Wish technology companies would come up with a new slogan “future is here” is getting old and is clearly not possible!”<sup>13</sup>

The Conversation and Hacker News communities discussed “hype cycles” and the fact that often much lauded technologies on the cutting edge don’t amount to much in the end<sup>14</sup>. In fact, security concerns make Hacker News denizens extremely concerned about “throwing technology” at things<sup>15</sup>. Other interesting aspects to this discussion is around regulation for the Internet of Things, with many arguments about whether self-regulation, legal regulation, or other (or none!) would work best to ensure security in connected devices. No consensus is achieved, but one protestor saying that they would have to employ security professionals and sink costs into auditing is told off: “It’s almost as if that’s the

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<sup>13</sup> <https://twitter.com/TrishDyne/status/629236910657900544>

<sup>14</sup> <https://theconversation.com/predicting-the-technology-future-from-disillusionment-to-enlightenment-30601>

<sup>15</sup> <https://news.ycombinator.com/item?id=9088549>

entire point...”<sup>16</sup> The idea that innovation isn’t automatically for the good, and that technology does not emerge in a vacuum is reinforced in another article<sup>17</sup>.

Patent law is also likely to remain an issue, as this is already a problem in ICT and health areas<sup>18</sup>. This could limit innovation, or increase it, depending on who you talk to (patent holders or those who want to use techniques that are patented).

Welfare pressures seem to be providing motivation for innovation, but there are problems with not using the technology to its full potential, and concerns about digital divides between those who can afford new technologies and those who can’t<sup>19</sup>.

### 5.2.3 Future companies

Given the changes in technologies, it is reasonable to believe that companies themselves are likely to change. Just as there has been a shift to start-ups in the technical world, with the open-access that social media offers to discuss and interrogate companies it could be that companies adjust their priorities to include more of what the public expects of them, as these could affect shareholder return or investment potential. Some companies, such as that of Interview 5, are starting to be concerned explicitly with values, with the value of “good for humankind” being “a part of our [company’s] soul and our spirit”. The general shifts toward social responsibility and public accountability could mean that more companies find their “souls” and this can only be beneficial to the users of medical technologies. This may be a good thing in the era where more and more technology is being embedded in everyday items (the “Internet of Things”), environmentally and contextually aware (ambient intelligence), and with great power to change peoples’ behaviour, habits, and daily life. With such power comes great responsibility, however – companies will need to be aware of the impacts of their technologies, however small, in a largely technically saturated environment, lest they run the risk of poor reception or feedback via social and other media.

Twitter discussions about future companies reflected this need for companies to “have souls” – the relationship between companies and social media was also highlighted. Additionally, there were some discussions about disruptive technologies and the future of business models – that non-agile businesses

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<sup>16</sup> *ibid.*

<sup>17</sup> <https://theconversation.com/responsible-development-of-new-technologies-critical-in-complex-connected-world-38195>

<sup>18</sup> <https://theconversation.com/a-crowning-glory-patent-law-and-public-health-15259>

<sup>19</sup> <https://theconversation.com/pension-woes-abound-but-our-tech-future-is-just-as-pressing-22360>

would not be able to stay on top of technology. Internet of Things was mentioned in this regard specifically. This was reflected on Hacker News, where it was decided that due to the Internet of Things it was likely that future companies will need to be more heavily regulated, particularly when it comes to security<sup>20</sup>. The impacts of technology “disasters” on company reputation seem to be more concerning to Hacker News participants than the effects on the users however.

#### 5.2.4 Future environments

Weak signals in the future environments category point to the contextualisation of technology, and the fact that technologies are no longer used in isolation but as a wider saturated technical environment. It is in this environment that the context in which healthcare is given will become more important – when technologies are used for the majority of any part of health care, there is a danger of letting people “slip through the cracks”. Heading up this future environmental feature of ubiquitous technologies is the conflict between individualised medicine and generification of medicine – these are both desirable (for different reasons) yet are difficult to get to co-exist. Add into the mix the requirements of national medical services (see the discussion of Innovation Motivation) and private for-profit industry and this is likely to be a significant future conflict.

Another significant signal that comes out of the analysis is the constantly changing nature of the “demographic reality”. This goes beyond the definitional problems we described in section 4.1 and encompasses the difficulty that future companies will have with the generification vs. individualisation problem: identifying the market and its needs, and then developing *for* them could become increasingly problematic as more stakeholders are included in design and development. Not only that, but as technology becomes more ubiquitous, care workers that are replaced or partly replaced with technology are likely to protest, and this could put people off using the technology. The question there would be whether the technology does a better job – but given the push for technology to fill funding gaps in healthcare and reduce the burden on welfare it’s likely that financial considerations will play a larger role. Given that successful technologies are likely to increase life expectancy and healthiness in later life, there could be some knock on effects such as shifts to later retirement ages and associated questions about expectations for retirement (such as who pays for it; who deserves it; etc.). Arguments about retirement could cause major shifts in society: technology needs to acknowledge and be thoughtful about its role in this sort of societal shift.

Some other aspects of the environment that will need to play a larger role in the future is the issue of mortality – and indeed some companies are already dealing with this in social media, such as Facebook for example – users will die, and their

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<sup>20</sup> <https://news.ycombinator.com/item?id=9088549>

data needs to be dealt with in an appropriate, respectful manner. This also affects other users – on social media, for example, it can be upsetting to see dead friends on contact lists or suggested people to “tag”. In other end-of-life areas, developers of popular or useful legacy systems that are the “old fashioned” technologies of yesterday will need to address maintenance and upkeep issues, even if society has moved on to the next big thing. Abruptly removing technologies that people rely on can be potentially problematic if the technologies have been successfully integrated into daily life. Recalling that “today’s technology is the technology of the future” for today’s mid-life citizens and committing to supporting that technology will be key for future integration and use of technology in older peoples’ lives.

Most of the discussion about future environments was within the startup community Hacker News. They are constantly after new markets, and think about future technologies integrating with the wider social environments. For example, on an article about concerns about China’s ageing population, one commenter asked “Is [sic] there any businesses targeting this demographic online? I don’t have much idea how to create markets for a very sophisticated demographic that’s averse to new things yet it’s probably the richest demographic in many countries if not all.”<sup>21</sup> Similarly, on an article about Japan’s ageing population, where concerns about ability to support increasing human populations, one commenter wonders why older people might even care about the environment they’re in: “Why would they care about innovation or ecology or whatever common good? They would only care about getting their cut of social security. This way they can easily throw a society off the cliff if it happens tomorrow. They don’t care about tomorrow.”<sup>22</sup> This comment is voted up by other commenters quite highly, but one respondent isn’t convinced by the comment, asking if the commenter is “an idiot” for suggesting this. At any rate, the general concerns amongst the commenters appear to be around potential future overpopulation, and caring about people as individuals rather than “net negative parasites on the planet”. Discussions about more technological environments are restricted mostly to the Internet of Things, which is considered to be particularly unsafe security wise, with suggestions that security be certified and regulated for such devices<sup>23</sup> (though there are many people who protest this in the comment thread too!). Concerns that we are “rushing headlong” into IoT, with a highly voted commenter stating that “I continue to fail to see how connecting appliances or small electronics to a network adds actual value. Simply throwing technology at a thing doesn’t automatically make it better.”<sup>24</sup>

Poor security environments are also a concern for children and grandchildren of elderly people being scammed and hacked, with specific requests for assistance

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<sup>21</sup> <https://news.ycombinator.com/item?id=2696787>

<sup>22</sup> <https://news.ycombinator.com/item?id=7043335>

<sup>23</sup> <https://news.ycombinator.com/item?id=9088549>

<sup>24</sup> <https://news.ycombinator.com/item?id=9088549>

in safeguarding older people. It seems that not only can people potentially “slip through the cracks” of enabling technologies but also can lose out without proper education on how to use these increasingly complex technological environments<sup>25</sup>.

Retirement is interesting in the Hacker News environment – searching for “retirement” returns several stories about how retirement is “the #1 killer of old people”, talking about the “dark side” of retirement and that it “brings grief”<sup>26</sup>. This ties into the weak signals identified, and reflects the largely American-influenced startup culture of hard work often with little gain. The Conversation has an article that puts many of these fears to rest, but discussions in the comment section suggest that older people actually enjoy “feeling useful” anyway<sup>27</sup>, so perhaps concerns about retirement ages rising are only problematic amongst the middle aged who idealise the notion of extended holidays.

As far as end-of-life of applications is concerned, Hacker News commenters discuss life-cycles of innovations for older people, with one describing his father having to remove a battery from his hearing aid in a way that could lead to him falling. “Thinking about the entire life-cycle of a product and how the customers are going to use it is always worthwhile.” However, the emphasis on social networks is inadvertently also discussed, with one commenter talking about how they have to visit their elderly relative and change the clock on her VCR for daylight savings. Even technology that is considered “simple” to this commenter requires extensive social and family networks for elderly relatives, which shows the value of these networks for assistance<sup>28</sup>.

Other concerns outside Hacker News include the challenges for remote populations, as older people are not always going to be living in urban and suburban areas, particularly in places like Australia and the US. Here the importance of the community is brought up, which ties into the above needs for offline social networks as well as online ones<sup>29</sup>.

Finally, infrastructure is important for emerging aged healthcare environments. Not just information infrastructure, but secure, affordable housing that can be adapted to use modern technologies for the life-time of the person. Without basic infrastructure like this (and the UK is currently undergoing a housing shortage), older people will be concerned about whether they have a secure, home for life

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<sup>25</sup> <https://news.ycombinator.com/item?id=9869585>

<sup>26</sup> <https://hn.algolia.com/?query=retirement&sort=byPopularity&prefix&page=0&dateRange=pastYear&type=story>

<sup>27</sup> <https://theconversation.com/retirement-a-trigger-for-distress-or-welcome-relief-from-the-rat-race-8437>

<sup>28</sup> <https://news.ycombinator.com/item?id=8996318>

<sup>29</sup> <https://theconversation.com/indigenous-ageing-walking-backwards-into-the-future-7355>

well before they worry about having a smart home<sup>30</sup>. This is echoed in a Hacker News comment on an article about curing ageing, where one commenter suggests that “perhaps [Silicon] Valley should figure out it’s [sic] housing problem before exacerbating the issue”<sup>31</sup>.

### 5.2.5 Future elderly

What might the elderly of the future look like? The weak signals here point to the conflict between a healthy ageing population and the social expectation of retirement at a certain age. However, as mentioned earlier, as life expectancy increases, is it entirely realistic for the state to support healthy people who might be able to work? When does someone “deserve” to retire? These questions could lead to very valid discussions about what it is to be “working age”, perhaps instead focusing on capabilities rather than strict age. Other definitional concerns in this area once again are around what “ageing” is, since it currently inherently negative, indicating vulnerability and decline, but with modifiers such as “active” or “healthy” can be made positive, or staved off by “ageing well”. This ties into this understanding of the demographic and their capabilities but treads a fine line between positive capability identification and treating problems rather than people, which is less desirable.

Future elderly people are likely to have a healthy scepticism about commercialisation of essential healthcare – unless they have been accustomed to it throughout the rest of their life. Scepticism may even extend to irrational rejection of technologies, as has happened with genetically modified organisms, if people feel patronised, not communicated with enough, not included in the development, or dehumanised by technologies.

On the flip side, there is likely to be the emergence of the patient-consumer, eager to acquire and brag about the latest technology they’ve acquired, or happy to invest in crowd-funded innovations that might make their lives easier or more luxurious. Some of the more advanced technologies, like robots, advanced hearing aids, active ageing technologies may come under this banner, as has been seen with Apple’s Watch currently.

Finally, there seems to be an impression that today’s healthy young people won’t be resistant to new technologies later – but there is no evidence that this is likely to occur and is simply another stereotype. Today’s young people are still likely to be conservative about their choices in technologies, but will gravitate to those they “grew up with” – which are far more advanced than those their parents or grandparents grew up with, and so on.

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<sup>30</sup> <https://theconversation.com/suitable-affordable-housing-is-key-to-our-population-ageing-well-38644>

<sup>31</sup> <https://news.ycombinator.com/item?id=9052880>

In discussions online, we have already dealt with issues of retirement above – with most commenters indicating that later retirement is not necessarily a bad thing, and those retired explaining how they like to “feel useful”. This is reinforced in a Conversation article that says that while raising the retirement age may not be popular with some workers, there is room for it to be done flexibly because many people do actually want to continue working<sup>32</sup>. Additionally, it’s been touched on that older people have trouble with their technology, even things considered “simple” like VCR clocks. This could become more problematic with further integration of technology in older people’s health care, because if the level of digital literacy is low people are more likely to be scammed<sup>33</sup> and reliance on family and other community social networks are important. Thus, argues this Conversation article, it is important to “bridge the technology gap” for “Dr Google” to be helpful in improving older people’s health<sup>34</sup>.

On Hacker News, the idea of ageing being something that “can be cured” is strong. Increasing life expectancy is something that some commenters take for granted; others feel concerned by this, such as one commenter: “The only thing we should try to cure is our self-delusion and our fear. It only wastes what little time we have. If some of us start living to 120, we’ll still moan that it isn’t enough. It’s never enough”, and that life extension is escapist and lets us “ignore the problem” of death. Others think it is less controversial, considering mortality “the #1 bug of human hardware” and ageing “just one more of the imperfections of nature that we are trying to fix”<sup>35</sup>. But one warns that “any serious life extension will have to come with a similarly extended lease on quality”<sup>36</sup>. These perspectives on ageing reinforce the negative associations with it – except for the latter comment which implies that there is potential for quality of life with extended lifespans.

Finally, there is an article about designing for the elderly where co-designing is considered the most important aspect. The comments on Hacker News talk about opportunities “for building consumer electronics for older people”, and anecdotes about necessity being the “mother of all invention”, which points to the problem of younger developers not really necessarily understanding what the actual problems are that older people have to deal with until encountering them<sup>37</sup>.

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<sup>32</sup> <https://theconversation.com/75-is-the-new-65-so-we-should-all-keep-working-for-longer-26985>

<sup>33</sup> <https://news.ycombinator.com/item?id=9869585>

<sup>34</sup> <https://theconversation.com/dr-google-can-improve-older-peoples-health-if-we-bridge-the-technology-gap-37580>

<sup>35</sup> <https://news.ycombinator.com/item?id=9052880>

<sup>36</sup> <https://news.ycombinator.com/item?id=9052880>

<sup>37</sup> <https://news.ycombinator.com/item?id=8996318>

## 6 Discussion

The discussion links the findings of the horizon scanning exercise to the RI project and aims to identify areas where RI can benefit from these insights or where they raise require further activities. The discussion focuses specifically on ICT for an ageing society, as this is the focus of the Responsible-Industry project in general and this deliverable in particular. Whether and to what degree broader conclusions can be drawn about RRI in industry in other fields will be determined at a later stage of the project.

In order to structure the link between this horizon scanning document and the RI project, this section focuses on second draft implementation plan as published in D2.4 “Second Draft Implementation Plan”. This draft implementation plan has benefited from the input of all RI project activities and represents the current state of the art of RRI in industry in the field of ICT for an ageing society. In the table below, the main components of the implementation plan are combined with the main findings of this horizon scanning exercise. The populated fields in the table highlight questions or insights that are worth further investigation or inclusion into RI activities (e.g. case studies or focus groups) or outcomes. There are numerous empty fields in the table, which indicates that the present horizon scanning report did not produce insights that are relevant to the specific field in the draft implementation plan.

The table was constructed by reading the various components of the horizon scanning before the background of the implementation plan with a view to identifying overlaps, gaps, or interesting relationships. During the construction of the table it became clear that in many cases similar comments could have been made to several aspects of the implementation plan. For the sake of readability each point was only made once. This means that alternative readings and representations of the horizon scanning issues in the context of the implementation plan would be possible. As the purpose of the table is to identify where and how the RI project can learn from the horizon scanning report, the possible ambiguity of the table is unproblematic.

		Need for RRI framework		Framework for implementing RRI					Incentives		General comments
		Why worry about RRI?	Why embrace RRI?	Who is responsible and for what?	RRI along value chain	Impact analysis	Voluntary tools	Consequences of adoption	Policy options	Communication	
Primary signals	Definition of ageing and the elderly	A lack of clear definition can render successful technology development difficult		Who sets the agenda? Who defines what counts as good ageing?							Definition is important but societal debate is often beyond the organisation's ability to influence
	Concerns about future ageing technologies					Include "othering" and emotional aspects (mortality) in impact analysis		RRI may help overcome fear of new technology, where unfounded			Broader aspects like dehumanising nature of technology are difficult to address
	Assumptions and stereotypes about older people			Who defines the characteristics of users that are relevant to the technology?	Stakeholder engagement can lessen stereotyping.						Stereotypes are present in society, but companies can reflect on them, make them visible.
	Ageing in a wider social context					Consider potentially negative impacts or lack of impact			Promote a wider view of benefits and costs, beyond financial considerations		

		Need for RRI framework		Framework for implementing RRI					Incentives		General comments
		Why worry about RRI?	Why embrace RRI?	Who is responsible and for what?	RRI along value chain	Impact analysis	Voluntary tools	Consequences of adoption	Policy options	Communication	
	Operational issues <ul style="list-style-type: none"> <li>• Barriers</li> <li>• Enablers</li> <li>• Issues of concern</li> <li>• Issues not of concern</li> <li>• RRI failures</li> </ul>		Enablers listed here can be used as arguments for engaging with RRI. (e.g. sustainability, good practice, CSR, customer relations, avoiding of negative consequences)	How to integrate known issues (privacy, legal compliance, security) is well covered					At present the downsides of RRI and barriers are not addressed  Known issues of concern can be a starting point for integrating RRI.		Barriers, i.e. problems for RRI may need to be addressed more clearly. Larger questions like the neutrality of technology are not addressed  How to learn from lessons of failure?
	Designing technology for ageing				How can user feedback be incorporated into various steps of R&D?	How can the question of user need be integrated? Does the technology solve a problem?					
	Future technologies for aging societies <ul style="list-style-type: none"> <li>• Future utopias</li> </ul>			How can specific concerns relating to only some technologies		How can impact analysis incorporate positive and			How can societal issues be incorporated, e.g. digital divides?		

		Need for RRI framework		Framework for implementing RRI					Incentives		General comments
		Why worry about RRI?	Why embrace RRI?	Who is responsible and for what?	RRI along value chain	Impact analysis	Voluntary tools	Consequences of adoption	Policy options	Communication	
	<ul style="list-style-type: none"> <li>• Future dystopias</li> <li>• Current technologies still developing</li> </ul>			be captured and fed into RRI processes?		negative issues?					
Weak signals	Future technologies			How will informed consent be implemented?							What counts as innovation?  How can unrealistic expectations be managed
	Innovation motivation		<p>How does RRI sit with profit motives?</p> <p>Can RRI be used to render problematic technologies acceptable?</p>								Do technologies solve pressing social problems or are they just looking for a market?
	Future companies		Can RRI be integrated into new types of								

		Need for RRI framework		Framework for implementing RRI					Incentives		General comments
		Why worry about RRI?	Why embrace RRI?	Who is responsible and for what?	RRI along value chain	Impact analysis	Voluntary tools	Consequences of adoption	Policy options	Communication	
			companies (or will it remain rhetoric?)								
	Future environments			How is security of technologies incorporated?	How will long-term support be ensured?						<p>What is the impact of other regulation, such as patent law?</p> <p>How individual is technology going to be? Will it be for the rich only?</p> <p>What about knock-on effects (e.g. later retirement, shifting employment )</p> <p>What are consequence for communities ?</p>

		Need for RRI framework		Framework for implementing RRI					Incentives		General comments	
		Why worry about RRI?	Why embrace RRI?	Who is responsible and for what?	RRI along value chain	Impact analysis	Voluntary tools	Consequences of adoption	Policy options	Communication		
												How does technology innovation relate to other social issues (e.g. affordable housing)
	Future elderly					When will people retire, what will be normal expectations about a working life?						What will be the relationship between patient and consumer?  How does technology touch on existential issues such as death?

**Table 1: Comparison of issues raised by horizon scanning with RRI in industry aspects as highlighted by the 2<sup>nd</sup> draft implementation plan.**

## 7 Conclusions

The comparison of the findings of the horizon scanning exercise with the main items highlighted by the second draft implementation plan demonstrates the value of the horizon scanning exercise. It shows that the implementation plan has picked up on numerous issues and concerns that are discussed in the various sources that informed horizon scanning of RRI in the industry of ICT for ageing societies. More importantly it furthermore shows that there are aspects that we need to be taken into consideration in the further development of the implementation framework.

Horizon scanning is oriented towards a slightly different level from that of the implementation plan. The Responsible-Industry project consortium decided to develop the implementation plan in a way that this specific to the ICT industry. It is therefore focus on the immediate questions and concerns of companies, starting with the question why RRI would be of relevance to them and focusing on detailed questions of who should be doing what in which way. The horizon scanning analysis, on the other hand, looked at a more general and abstract level. This broader level was covered in the implementation plan under the incentives section but the comparison shows that these broader levels are of high importance for RRI to become relevant on a societal level.

There are numerous issues, items and aspects that are not within the scope or reach of individual organisations but that are crucial for RRI to become relevant. This starts with conceptual questions, such as the definition of ageing or the elderly. While it may be within the responsibility of an individual organisation to identify and eliminate stereotypes that can negatively interfere with a beneficial use of technical innovations, these stereotypes normally do not originate within the company. Moreover, broader societal debates about who deserves which sort of treatment on what grounds, what counts as a normal working life or which time of technical interventions are legitimate goal far beyond the reach of even the biggest company. For the company this means that an awareness of broader societal debates is important but it also means that policy needs to be developed with a view towards identifying and problematising such conceptual issues.

Even more important are broader societal debates about the way in which we want to use technology to address social issues. In particular with regards to healthcare technology this raises the question of the distribution of roles of state, society, economy and the individual in healthcare. Even within Europe there are vastly different traditions of providing healthcare. It is not clear what will be perceived as legitimate in different contexts. In addition there is likely that these views of legitimacy of distribution will change over time. If healthcare is seen as a predominantly individual concern that is to be regulated by market mechanisms, then a strong reliance on markets to identify preferences of

consumers may be the way forward. However, if a society perceives healthcare is a public service to be administered for the greater good of all, then the development of technologies will presumably take a different trajectory. Companies will still play a role, but this role will be different and stakeholder concerns are unlikely to be met through market mechanisms.

To put it differently, the use of technology for healthcare purposes is likely to benefit some more than others and have disadvantages for certain groups. The way in which these benefits and downsides are distributed is dependent on the role and practice of healthcare within the society. Companies wishing to act responsibly have to do so within the framework of the society in which they exist. A framework for responsible research and innovation aiming at the level of the company needs to be aware of those societal constraints.

For the Responsible-Industry project this means that broader sensitivity to societal issues needs to be incorporated into the implementation plan of framework. At the same time the project should aim to identify how other stakeholders, beyond the individual company, can contribute to a responsible way of researching and developing novel healthcare ICTs and how this can be put in practice.

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## Appendix I: First Round Sources

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