Responsible Innovation Maturity in Smart Health

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List of acronyms

ICT   Information and Communication Technology

RI   Responsible Innovation

RRI   Responsible Research and Innovation

WFO   Watson for Oncology

1. ICT and Responsible Innovation

Global society depends on advancement in technologies in order to find solutions to its biggest challenges (such as climate change, population growth, urbanization, limited resources, among others). To achieve this and to innovate in a way that is responsive to societal needs and expectations, all societal actors, including researchers, policy makers and businesses as well as citizens and civil society organizations must work together.

The European Union and academia already call for innovations to become more responsible, especially in the highly controversial field of Information and Communication Technology (ICT). However, there is barely any documentation of case studies on responsible innovation in the ICT sector. This paper fill the gap and analyses recent technological innovation cases that feature the up and coming concept of 'Responsible Innovation' (RI). As a result, an analysis has been carried on a set of ICT companies rated in 2016 as the top 15 in global ICT to provide a basis for future research in this field. Each selected company has been observed according to a criteria framework that stems from recent ICT and RI literature.

On the one hand, the analysis references the development sectors listed in the SDG ICT Playbook and the corresponding Sustainable Development Goals. Thus, exploring the contribution of ICT companies to a development sector through innovations that foster sustainable growth and prosperity. On the other hand, the analysis relied identifying a company's core business engagement by developing four responsibility dimension criteria (See Figure 1). This qualitative selection and review filtered the analysis to 17 cases featured by 8 of the top 15 ICT companies. Three of these seventeen cases, which specifically address the topic of "smart health", are collected and discussed in this paper.

Based on picture by dotschock

2. What does Responsible Innovation even mean?

Responsible Research and Innovation (RRI) is a rather new concept that can be defined as "a strategy of stakeholders, including earlier and better public engagement, to become mutually responsive to each other and anticipate research and innovation outcomes underpinning the 'grand challenges' of our time for which they share responsibility while considering implications of a right to privacy". (Von Schomberg 2013, 1)

Even though the private sector is considered to be at the heart of this strategy, the concept of RRI has been barely applied beyond publicly funded research so far. When looking for a guideline to analyze innovations for their responsibility, four principles that are mentioned repeatedly throughout the RRI literature, namely anticipation, reflexivity, inclusion and deliberation, and responsiveness. From this and other RI literature, four responsibility dimension criteria that constitute the building blocks for reviewing Responsible Innovation management were developed:

1. **Ethical acceptability:** Is the innovation itself ethically acceptable? (cf. Pavie et al. (2014, 33): "responsible innovation [...] to ensure that societal ethical stakes are preserved") An innovation that would not be ethically acceptable would for example be an innovation that causes health or environmental issues.

2. **Predictive measures and mitigation actions:** Are predictive measures taken into account in order to be able to improve the future impact? (cf. Owen et al. (2012) and Von Schomberg (2011; 2013): "RRI can be seen as a strategy to intervene from the beginning of the innovation process and integrate societal design principles in order to anticipate opportunities and threats and better manage future impacts already in the beginning of an innovation life cycle.")

3. **Stakeholder inclusion:** Is a broad diversity of stakeholders involved in the innovation process? (cf. Von Schomberg (2013): "RRI can be viewed as a strategy of stakeholders, including earlier and better public engagement".)

4. **Sustainability Design:** Does the innovation not only improve technology but also incorporate sustainability design? (cf. Adams et al. (2016): "Sustainability-oriented innovation (SOI) involves making intentional changes to an organization's philosophy and values [...]" and "[...] extends beyond the firm to drive institutional change"). This means whether the innovation follows a system thinking approach and that it may not only be considered as a single product (e.g. where technology is improved) but it should rather be looked at from a broader perspective and fostering institutional change.

Figure 1: The four dimensions of Responsible Innovation considered for the analysis

2.1   And what's in it for the company, other than providing social and environmental value?

Lubberink et al. (2017) argue, that RI, like social and sustainable innovation, aims to address the global challenges considering social, environmental and economic impacts and demands to involve multiple stakeholders. The 'Responsible Innovation' approach incorporates, to some extent other familiar concepts, namely 'CSR', 'social innovation', 'sustainable innovation' and 'inclusive innovation'. However, it is important to keep in mind that while those concepts are good for understanding and elaborating on the dimensions of RI, one should not identify or confuse RI with any of the other concepts. (Dreyer et al., 2017; Lubberink et al., 2017)

RI requests 'responsibility' beyond a social or sustainable innovation as it considers the whole innovation life-cycle. By engaging all the different stakeholders and the public in the early stages and throughout the innovation process, anticipation of impacts is pursued in order to prevent negative consequences, and take mitigation actions timely. This refers to the four dimensions (anticipation, reflexivity, inclusion and deliberation, and responsiveness), established by Owen et al. (2012), that are widely perceived as important building blocks of Responsible Research and Innovation within the RRI community.

Companies can benefit from applying RI in a variety of forms such as better understanding of customer needs. As a result, they are able to enhance customer satisfaction, reap reputational gains through better risk management and anticipate adverse effects. Thus, businesses can synergize beyond achieving economic growth: Despite uncertainty about possible impacts and externalities still being higher in the beginning of an innovation life-cycle, costs and efforts for changes significantly decrease compared to those incurring when changes have to be made later in the innovation process. (Chatfield et al., 2017; Van de Poel et al., 2017)

3.   Three cases on smart health

Van de Poel et al. (2017, 4) claim that "positive examples and engaging narratives that show how to put RRI into practice in a company context" are required and they call for the "need for experience with, and examples of implementing, RRI in companies" as guidance for industry to integrate RI in their business strategy. This call can benefit from the criteria framework for the analysis of innovation cases in the ICT sector described earlier.

As a result, this section concentrates on a set of three "smart health" innovations. Mostly, considering the increased question around health in the nearest future and its role in tackling bigger societal challenges. The following innovations showcase three top 15 ICT companies that respond to the abovementioned four responsibility criteria (See Figure 1). Each, for their attention to the topics of telemedicine, oncology and Amyotrophic Lateral Sclerosis (ALS).

3.2   Case 1: Watson for Oncology - IBM

The Watson for Oncology (WFO) tool is a commercial product for care centers treating cancer patients. WFO has been developed by IBM and is trained in cooperation with the US Memorial Sloan Kettering Cancer Center. Based on analytics, IoT and mobile devices it operates through a cognitive computing technology. It aims at interpreting patients' clinical information and identifying customized and evidence-based treatment options. As a result, it leverages the extensive amount of experience and research from the past. The tool learns as it is fed with information by Memorial Sloan Kettering Cancer Center physicians. By understanding natural language, the technology generates hypotheses based on evidence and learns continuously. Its information processing capabilities tend to resemble humanlike practices but at much higher speeds and efficiency.

Today, doctors face a big challenge in staying up to date with rapidly changing information on available cancer care –such as scientific medical evidence, treatment guidelines and even drug approvals. WFO can support this situation with a rapid update that is fed with much more information than a single human doctor would be able to process. It can analyze the data and find new patterns which can ultimately disclose cancer treatment options (See for example, Figure 2).
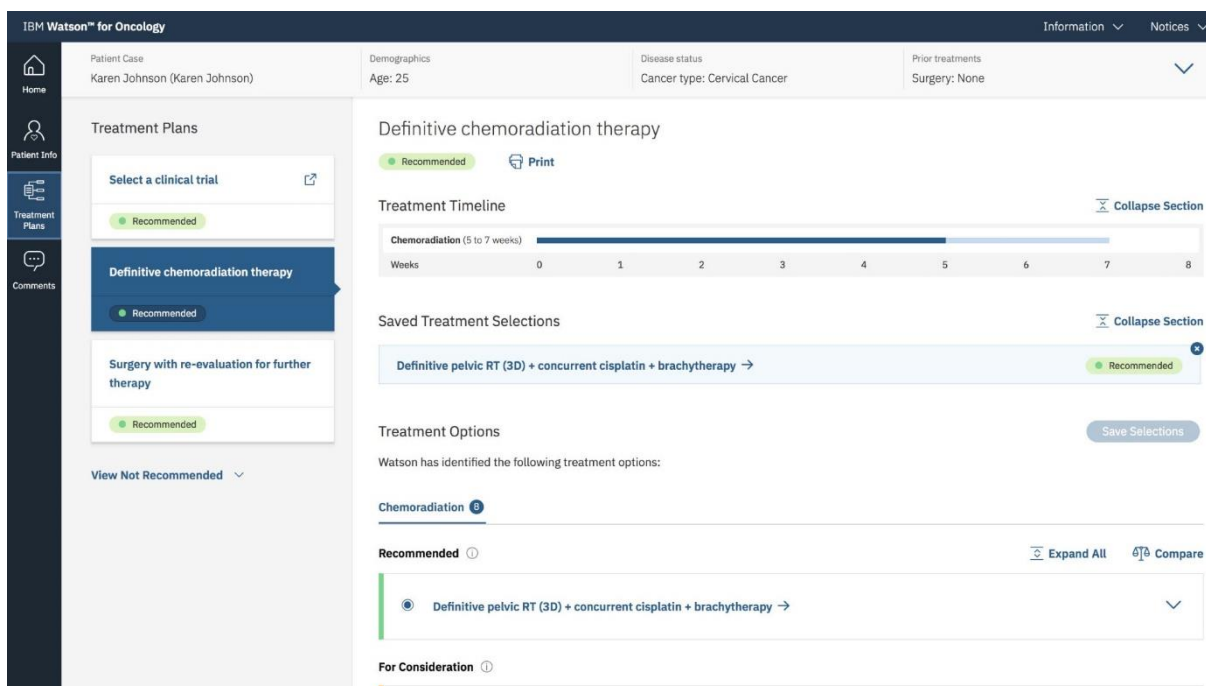

Figure 2: Watson for Oncology - Evidence and rationale for a selected treatment
Source: IBM

Consequently, a tool like WFO not only has the power to enhance knowledge about cancer care, but also to enable physicians to "quickly identify key information in a patient's medical record, surface relevant evidence and explore treatment options" (IBM Corporation, 2018f; Manipal Hospitals, 2018; Memorial Sloan Kettering Cancer Center, 2018; Somashekhar et al., 2018). When looking at reactions to the launch of the new technology of the oncology community, the only positive feedback came from a Mongolian Hospital: "At UB Songdo Hospital [..] doctors are following Watson's suggestions nearly 100 percent of the time. Patients who otherwise would have been treated by generalists with little, if any, cancer training are now benefiting from top-level expertise" (Ross & Swetlitz, 2017). All other comments found have been negative, in that "IBM relies on one institution and one relatively small group of physicians" (Gorski, 2017), Watson is "[…] based on input from physicians at New York City-based Memorial Sloan Kettering Cancer Center" (Cohen, 2017) and "the generally affluent population treated at Memorial Sloan Kettering doesn't reflect the diversity of people around the world. The cases used to train Watson therefore don't take into account the economic and social issues faced by patients in poorer countries […] researchers reported that the treatment Watson most often recommended for breast cancer patients simply wasn't covered by the national insurance system" (Ross & Swetlitz, 2017).

Furthermore, oncologists claimed that only engaging American doctors leads to a limited knowledge for WFO. Especially, if it reflects merely disease processes of US patients and the American way of practicing oncology. This also explains why there have been different concordance rates in different countries: "The reason that treatment recommendations in Asia differ so markedly from those in the US is because of differences in prevalence (which is much higher in Asia) and even biology" (Gorski, 2017).

Under the responsible innovation criteria "stakeholder inclusion" we here would expect doctors of different hospitals and even different nations as the product is intended to be a global product. In this case, information on stakeholder inclusion seems clearly limited. If it really was the case that only American doctors from a private hospital have been engaged in the innovation process this could be viewed critically from the inclusive side of the "responsible innovation" perspective.

Even though IBM collaborates with external stakeholders (i.e. doctors from the care center) there is little evidence of a wide move towards thorough systems building. While it engages with one US stakeholder, it overlooks the possible benefits of engaging with patients and care centers located all around the world. Stakeholder inclusion is not about engaging one or the other stakeholder, but aiming at a wide range of collaborators. It seems that the product has not been developed with an anticipation of the long-term consequences of incorporating or not international stakeholders. For example, observing the performance of the product outside of the US market. Additionally, one might think it would be useful to engage with the patients directly in order to address their needs and questions about such a tool. Especially, since patients are the ones need to embrace the benefits of the product for their treatment so that WFO can guarantee success.

Considering the ethical acceptability aspect, we have no detailed information about patients' personal data protection, which in this case would be particularly relevant. The information available only references WFO's use of the IBM Cloud Security system, which claims regulatory compliance and guarantees that data isn't handled by third parties outside of the organisation. Transparency in this regard is also key. Furthermore, information about predictive measures during the innovation life cycle is missing for the analysis. For example, what are the potential risks of this tool's application? This is, again, relevant in terms of cyber security and the misuse of the data collected and processed by tool.

3.3 Case 2: Virtual Health Templates - Microsoft

The Virtual Health Templates developed by Microsoft are extending the Skype for Business program towards a platform for virtual healthcare. These developer templates enable tele-collaboration, telehealth, and telemedicine. The virtual health solution, offered as a cloud-based digital service, is a non-commercial product.

As today's healthcare providers are increasingly looking for innovative ways to serve their patients and connect clinicians/care teams, this new solution aims at providing health services and coordination of care virtually –while it also takes some time to engage with patients. Additionally, to improving communication and collaboration between nurses, it is aimed at helping health organizations achieve economies of scale.

The new developer templates are an open source software based on Office 365, with Skype for Business Online. In order to use the services, patients are not required to get an Office 365 subscription. Furthermore, the templates can be easily customized by industry partners, developers, and enterprises to build health solutions tailored to their needs. These efforts include apps that tackle electronic health records, management and scheduling systems. Among others, it features solutions like GE Healthcare, Ring MD, Cambio and Careflow.

From the perspective of Microsoft, this technological innovation appears to have a significant contribution to healthcare systems: "Since introducing telemedicine, built on Office 365 and Skype for Business SDKs[1], we have seen a nearly 40 percent decrease in mortality rates in our Critical Care Telehealth Program. We currently see an average of 361 patients per day via Skype across all programs and are continuing to invest in our telehealth practice to meet the evolving needs of our providers and patients" —Lonnie Buchanan, director of Enterprise Architecture at Intermountain Healthcare (Microsoft, 2017a).

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[1] Software Development Kits or SDKs are software development tools available in an installable package.
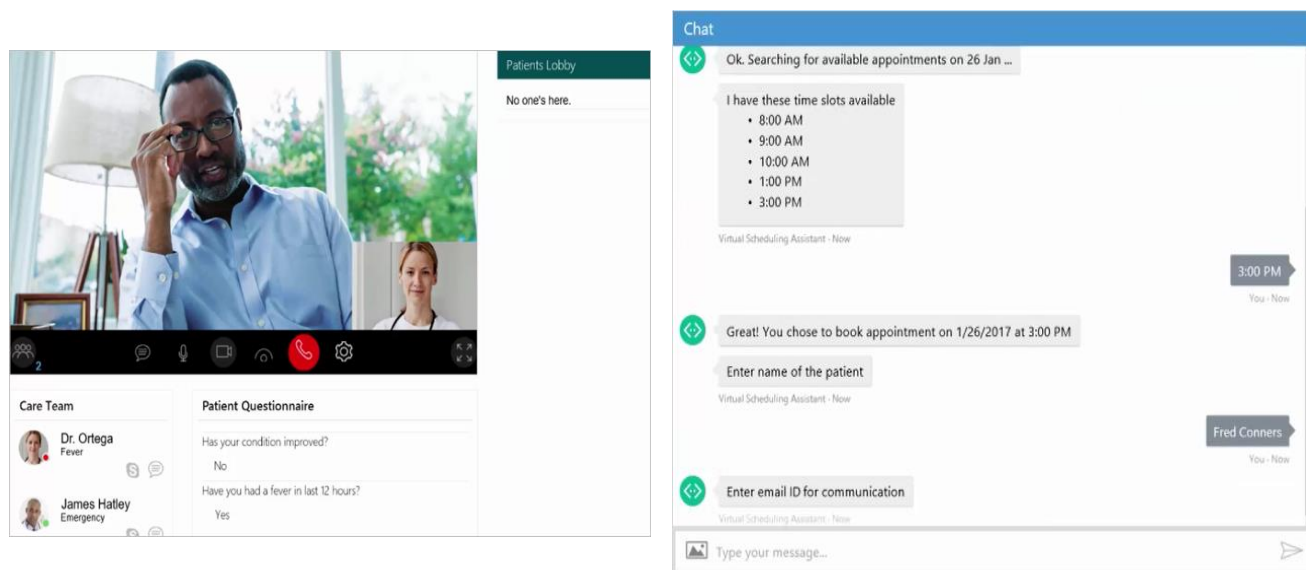
Figure 3: Virtual Health Templates - Patient Lobby and Appointment Booking Space
Source: Microsoft

There exists little to no documentation about stakeholder inclusion nor about predictive measures. The claims of inclusion focus on the contributions towards society thanks to a product that solves patient care, but most of it actually discusses the positive economic impact of these templates on healthcare institutions. While the open-source templates enable developers to further enhance the user experience, there is no mention of fostering the inclusion of potential or existing patients within the innovation process.

Similar to the case of WFO, there is limited information available about the protection of personal data. While there is no information to assess whether the templates are ethically acceptable or not, we can assume that this innovative product serves society by improving accessibility to healthcare. However, it seems to be focused on measures for preventive health rather than the focus on severe cases and complex treatments. Without any information on the innovation process made available by Microsoft and the developers using the software, it is hard to assess whether this tool can be seen as a "Responsible Innovation" (despite its potential in terms of stakeholder inclusion).

3.4   Case 3: ALS Mobile Analyzer - SAP

The ALS Mobile Analyzer is a mobile app for ALS patients that enables and mobilizes them to better track and log data about their condition. The application support the development of new treatment options while improving research around this condition.

ALS (Amyotrophic Lateral Sclerosis) is a progressive disease, leading to a continuous deterioration of the patient, which is varying depending on the disease process. The disease is still not well researched as reliable data from patients is often missing. While doctors only assess the patients every few months, the patients progressively lose their mobility and chances to reach the clinic for treatment. With this situation in mind, the new ALS Mobile Analyzer app aims at "enabling patients and caregivers to easily collect and upload relevant patient data to healthcare professionals and researchers on a daily basis" (SAP SE, 2017b), regardless of where they are located. For example, patients can fill out questionnaires about their ailments and about their bodily functions and general effects on their quality of life (See Figure 4).

The ALS Mobile Analyzer, which is a non-profit app and accessible through all kinds of mobile devices, supports enhancement of operations in the 'human health and social work activities' industry by providing digital services (SAP SE, 2017b). The information gathered is aimed at improving immediate patient care, while providing doctors and caregivers comprehensive

information for an timely response. Through better tracking of patient data, the app enables researchers to use the collected clinical data for developing new improved therapies for ALS patients.
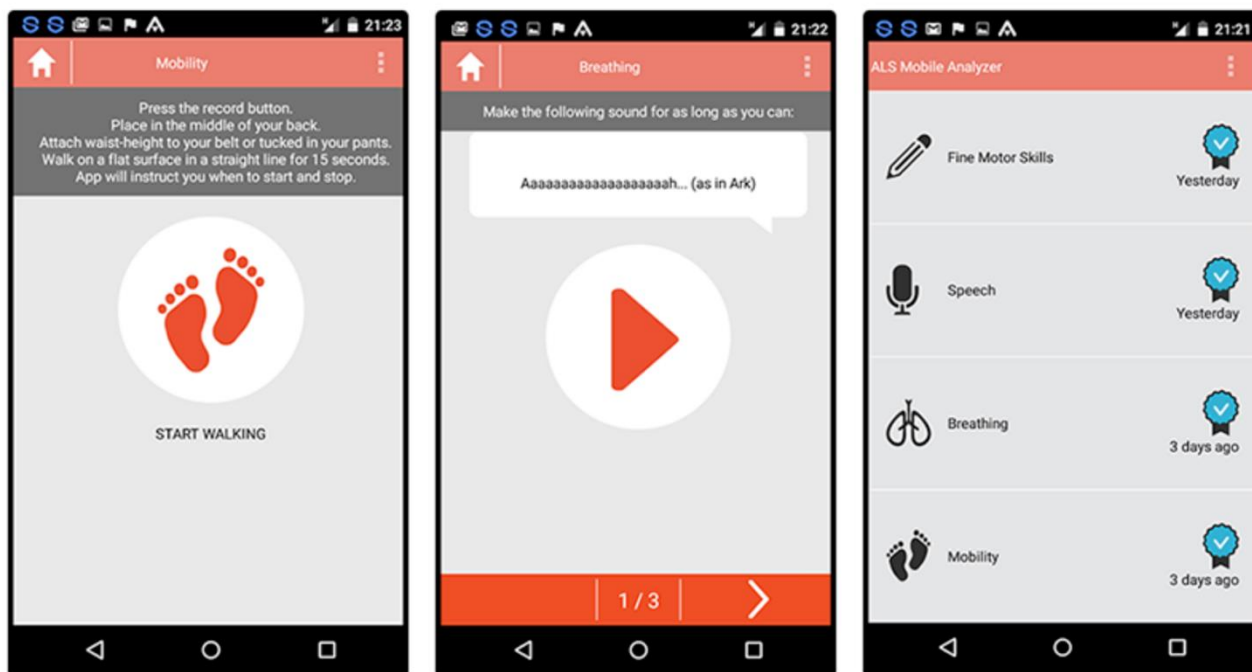

Figure 4: ALS Mobile Analyzer App – Overview of functionalities
Source: ALS Mobile Analyzer

Observing some of the biggest obstacles in the field of ALS this new technology promises a positive impact for ALS patients as well as for research: "I expect this app to revolutionize the way that we track ALS patients in the clinic and possibly, even more importantly, it will accelerate the clinical trial pipeline so that we achieve meaningful and effective treatments a lot sooner. I think that the app will expedite reaching a cure [...]" (SAP SE, 2017b).

While the app can be seen as a product innovation that does good for society, a possible orientation towards responsibility can hardly be assessed. Additionally, no documentation could be found with regards to ethical acceptability, predictive measures and mitigation actions as well as stakeholder inclusion. While it could be argued that the app fosters the advancement in ALS research and contributes to social development, it still remains unknown whether there are any measures taken with respect to personal data privacy and other potential issues. As with the previous cases, further investigation in the innovation lifecycle. Information needs to be made available by SAP in order to designate responsibility.

4. Documentation of Best Practices is key to promoting responsible innovation

Reflecting on the three cases discussed above there seems to be some traces of "responsible innovation" within the ICT sector. However, there is simply too little documentation about the innovation process in order to define them as success stories of a "responsible innovation" practice. Especially, if we focus on the compliance with all four of the analysis criteria raised for this specific research. Further in-depth research is necessary for all the cases analyzed in order to draw more reliable information about the innovation process. Especially if one wants to make a final statement on the potential of any of these cases to fully represent what "Responsible Innovation" is all about.

The analysis of these cases lead to the conclusion that there is hardly any stage to make innovation processes more transparent when it remains more or less difficult for companies to embrace the RI approach. This is because only when 'Responsible Innovation' is implemented within the commercial products and services that are at the core interests of businesses, RI will be accepted by industry sectors in the long term.

In order for the transition of the RI concept from academia into industry, best practice cases are essential. An important step towards such best practice cases is the transparent documentation of the innovation process either through including relevant information in the sustainability/CSR reports or making the information available to the public in approachable formats.

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