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Modes of innovation and responsibility within regional innovation systems:

Reflections from the Twente region

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Abstract

Increasing public investments in distributed platform infrastructures have created new opportunities for economic growth and social welfare but at the same time have been associated with growing societal distrust in the power of science to solve societal problems. The concept of Responsible Research & Innovation has been advanced as providing mechanisms to recouple science and society to ensure that research and innovation continues to uphold its duties to society. In this paper, we explore the extent to which it is possible to identify repertoires of responsible innovation behaviour within extant research and innovation networks. We distinguish between two kinds of regional innovation network, those based on science and technology innovation, and those based on doing, using, inventing innovation in the eHealth sector where there are substantive societal concerns regarding responsibility and innovation. We contend that it appears that the coupling of patients to innovation networks through their prior association with innovators (e.g. as patients) affects the scope for responsibility. We therefore contend that more attention is required for understanding the dynamics of citizen-innovator coupling in regional innovation networks if responsibility is to become a more common property of these systems.

Keywords: Responsible Research & Innovation, regional innovation systems, science and technology policy, regional economic development, e-Health

1 Introduction

Contemporary welfare growth has become dependent on creating growth platforms through public sector investments in increasingly complicated technological infrastructure systems (Asheim, 2012). New flavours of regional economic development instrument are emerging stressing this importance such as ‘smart cities’ (Kitchen, 2015). These investments have been enthusiastically embraced by policy-makers and multilateral organisations as suitable for creating the conditions for neo-endogenous growth in which regions become centres for growth occupying high-value positions within global value chains based on place-specific local value propositions (Hollands, 2008). These investments take place in public-private partnerships in which private partners may lack the necessary incentives to promote public value, creating the risks of public value failure thereby undermining public support for science and technology (Bozeman, 2002).

The idea of Responsible Research & Innovation (RRI) is currently emerging out of efforts to restore this trust, by creating a conceptual framework to ensure that scientists and innovations receive appropriate signals from society to sufficiently include these public value concerns as they steer their innovation projects (Stilgoe *et al.* 2012). Following a recent turn to practice in science and technology studies, scientists and innovators can be understood as undertaking their activities by continually taking choices related to future directions based upon anticipating how their peers will react (Soler *et al.*, 2014). These choices depend on the weak signals that they receive within their wider networks, and RRI processes therefore seek to proactively encourage scientists and innovators to ensure that they receive signal from societal audiences. This facilitates them to prospectively anticipate how various publics may respond to the outcomes of their research and innovation processes.

But at the same time, scientists and innovators are already embedded in their own networks upon which they draw to access the necessary resources to achieve progress (Lundvall, 1988; Kitcher, 2010). A critique is forming of RRI that its processes stand outside these existing networks which channel signals to scientists and innovators (Ribeiro *et al.*, 2018). This has the extent of making RRI something that is elective for innovators rather than essential for innovation activities, an additional set of tasks and pressures prescribed to those already under severe pressures of uncertainty, as well as a lack of knowledge, resources and time. Effectively achieving Responsible Research & Innovation therefore requires a re-internalisation of RRI norms within scientist and innovator practices, who make choices within their own micro-governance networks.

But regional innovation networks are often conceptualised in ways that accord value primacy to economic growth, leaving little scope for scientists and innovators to respond to these societal signals. We contend there is a need to understand how science and innovation networks create space for

responsible practices even as with regional innovation networks the primary logic for collaboration is economic. We here distinguish two distinct modes of innovation each with their own determining logic “science & technology” innovation (STI) and “doing-using” innovation (DUI) innovations. In this question we ask the question how do modes of innovation within regional innovation systems affect how responsible practices can become embedded in innovation trajectories.

We do this by considering two telemedicine projects in the east of the Netherlands, a virtual care home project emerging from practice and following a DUI mode in parallel with a living lab project driven by a university that follows a STI governance mode. We contend that it appears that the coupling of patients to innovation networks through their prior association with innovators (e.g. as patients) affects the scope for responsibility. We therefore contend that more attention is required for understanding the dynamics of citizen-innovator coupling in regional innovation networks if responsibility is to become a more common property of these systems.

2. Literature review

2.1 Regional economic development and regional innovation systems

There is an increasing recognition that we are living in a ‘knowledge economy’ where places’ ability to sustain welfare standards and ensure their citizens’ quality of life is in turn correlated with their capacity to receive, process, convert and exploit various kinds of knowledge capital (Temple *et al.*, 1998). A policy imperative has emerged where policy-makers place a primacy on economic growth, through which the idea of innovation has become restricted to primarily economic readings of change (Nieth *et al.*, 2018). Policy-makers seek to mobilise local knowledge resources to make them attractive to outside partners, to achieve a cross-fertilization of knowledge assets that in turn stimulates local growth, and providing a growth stimulus to other associated businesses. They seek to thereby shape the overall direction of economic evolution and by creating common tendencies in the behaviours of regional innovator actors, corresponding to networks in which knowledge spills over more easily between innovators.

The feature of places to build up these recurrent tendencies that facilitate and encourage particular kinds of innovation can be understood as creating place-specific innovation systems where those regularities become institutionalised (Lundvall, 1988; Rodrigues-Pose, 2013). A key mechanism here is that of knowledge spillovers, where particular kinds of knowledge activity create ‘something in the air’ that others can access through co-location. The importance of proximity to knowledge transfer and exchange has led to a recognition of the importance of the region as the nature scale for these knowledge spillovers (Lawson & Lorenz, 1999). This has been interpreted by Cooke (2005) to argue

that a regional innovation system consists of distinctive subsystems (knowledge producers, knowledge exploiters, intermediaries, policy-makers & regional culture) in which systemic institutional linkages build up that influence their knowledge processing capacity.

The systemic nature of regional innovation gives it a persistent perspective, and changing regional innovation outcomes requires altering the evolutionary trajectories (the paths) by which regions change (Kogler, 2015). Regional innovation may create new kinds of industrial pathways, it may revitalise mature declining pathways, it may break away from moribund industrial pathways, it may switch between low-value to high-value added pathways (Martin & Sunley, 2006). These changes in regional trajectories are produced by changes in RIS system which increase the attractiveness of local networks to external stakeholders, making regions more of a 'place to be' for particular (Yeung, 2009). Regional institutional entrepreneurs create changes in these networks (Garud, 2007), changing regional capacity to process knowledge and drive regional economic growth (Sotarauta, 2016; Benneworth *et al.*, 2017).

2.2 A micro-level perspective on knowledge actor dynamics

A RIS can be considered as a kind of semi-permanent network with persistent properties; these networks are in turn built up from individuals who regularly interact in seeking to innovate, and as familiarity and mutual knowledge builds up, new members may find it easier to access knowledge resources in the territory than those outside. There is a growing tendency to criticize those analyses of regions that focus on activities as if they were mechanical systems, thereby ignoring roles played by individuals interacting and changing the overall topologies of these systems through individual acts of institutional entrepreneurship (Sotarauta, 2016; Benneworth *et al.*, 2017). From this perspective, research and innovation networks serve as the immediate environment for these knowledge actors, shaping those actors behaviour dependent on the situation of the actor in this wider network.

In understanding the ways in which knowledge creators behave in these regional innovation systems it is necessary to understand the ways in which they individually take decisions. This reflects a more general trend in science and technology studies of what Soler *et al.* (2014) have called 'the turn to practice'. What provides research and innovation with its progressive nature is a form of distributed coordination in which key knowledge creating actors undertake acts of prospective anticipation. In choosing which of several uncertain futures to pursue, individuals shape their behaviours and decisions on the basis of their expectations of how they will later be judged on that, and then peers make the judgements on whether they are good or not (Gläser, 2012).

The overall effect of this is that research questions & technological problems are formulated and proposed, and resources allocated to solve those problems, on the basis of anticipated peer preference. This anticipation process is shaped by collective beliefs held in various kinds of epistemic communities (Haas, 1992) about what is good and bad, allowing those norms to shape progress. Those communities also form retrospective judgements about knowledge creation, and signal in various ways (e.g. through publication, but also through technological standards) what is considered good as well as who is a legitimate community member (Roberts, 2014). This dual signalling (prospective/ retrospective) allows these knowledge communities to evolve and progress on the basis of what these communities deem to be good (Kogan, 2005).

Amin & Roberts have pointed to the ways in which these communities become territorialised, and in which local communities of practice achieve more epistemic characteristics (2014). Innovation networks serve partly as neutral platforms for the exchange of knowledge between geographically-proximate partners. But it is important to note that they also serve for the passing of signals determining what constitutes 'good' solutions as the basis for prospectively selecting knowledge creation activities. The question of 'good' here is not defined exclusively, in terms of what will be economically profitable nor what is technologically interesting, but rather what this wider community deems interesting, acceptable and desirable (Fitjar *et al.*, 2018).

2.3 Towards a regional conceptualisation of Responsible Research & Innovation

This characteristic of regional innovation networks as platforms for transmitting value signals becomes increasingly importance in the context of Responsible Research & Innovation, which seeks to bring a new set of value signals to the consideration of knowledge actors. The definition we apply here of Responsible Research & Innovation is provided by one of the concept's architects within the European Commission, Rene von Schomberg, who defined it thus:

“a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products” (von Schomberg 2011: 9).

Owen *et al.* (2012) identify that there are three arrangements which serve to ensure the delivery of responsibility in research and innovation processes, namely democratic governance of the RDI systems, the institutionalisation of feedback into decision-making and acknowledgement of the collective nature of the risk and uncertainty of innovation processes. Building on this approach, Stilgoe *et al.* (2013) highlight dimensions to RRI, namely anticipation, reflexivity, inclusion and

responsiveness. Anticipation involves researchers seeking to systematically anticipate knowledge project outcomes and their wider societal implications; reflexivity involves researchers questioning the assumptions and normative ethical positions that underpin the knowledge activities; inclusion is the systematic approach of all stakeholders (not just the most powerful or visible) to receive feedback from them; finally, that inclusion should be substantive, and have the opportunity to influence the overall direction of travel of the knowledge activity (responsiveness).

However, it is clear here that these dimensions effectively represent particular messages to be given through the signals by which knowledge governance systems are constituted, and will operate in parallel to those signals that knowledge actors already receive within their wider epistemic communities. Knowledge actors are continually anticipating the outcomes of their activities albeit not always with an eye to the responsibility of the outcomes they produce. Likewise, reflexivity involves being explicit about what constitutes a 'good' outcome, and responsibility in reflexivity means systemically including the notion of responsibility as one element of 'good' knowledge processes in these wider decision processes, all issues shaped within these epistemic communities. Inclusion involves connecting with new stakeholders but at the same time knowledge processes already involve stakeholders and any kind of additional inclusion is changing the topology of the governance network rather than straightforwardly importing responsibility into decision-making.

In this paper we are concerned with the issue of how responsibility can become embedded within the practices of regional networks. Our contention is that a necessary precondition for this situation is that the dimensions and characteristics of responsibility as proposed by Owens *et al.* (2012) and Stilgoe *et al.* (2013) become embedded within the innovation networks through which these activities take place. We therefore contend that building responsibility within regional innovation networks requires a diffused effort within which these norms and efforts become taken up within the regional community. This would in turn allow responsibility to achieve an overall steering effect in which regional knowledge activities (creation and exploitation) would work towards responsible outcomes by building up shared ideas of what responsibility was in that particular context.

2.4 Responsibility in STI vs DUI governance networks

It is here possible to make a distinction in the way that regional innovation networks operate on the basis of the contexts within which knowledge is produced and the knowledge bases on which they draw (Gibbons, 2000; Isaksen & Karlsen, 2010; Trippl, 2011). We here distinguish two modes of innovation (cf Parrilli & Heras, 2016) and argue that these two modes of innovation may be associated with different approaches to building responsibility into their networks. The first is Science & Technology-based Innovation (STI), in which innovation is driven by the transformation and application

of analytic knowledge created by scientists primarily in knowledge creation contexts. STI-based regional innovation networks are shaped by the dominance of knowledge producers (typically universities and public research laboratories),.

The second are Doing Using & Interaction Innovations, in which innovation is primarily driven by the exploitation synthetic knowledge created by engineers primarily in knowledge application contexts. DUI-based regional innovation networks are shaped by the presence of knowledge exploiters (typically businesses and civil society organisations). This provides us with the basis to operationalise the ways in which responsibility could potentially become a significant decision-guiding signal within these regional innovation networks(see also figure 1 below).

In STI regional innovation, regional anticipation would involve knowledge producers thinking seriously about the potential impacts of their research in the future, involving local partners to tailor those future scenarios to regional contexts. Regional reflexivity would involve knowledge producers testing their ideas and developments against local norms and values. Regional inclusion involves listening to a wide range of stakeholder groups, and in particular, beyond vested interests and ‘the usual suspects’ to allow societal expression over these directions. Finally, regional responsiveness would involve knowledge exchange and co-creation with regional partners in which regional partners were able to actively contribute to the ongoing knowledge creation activities.

In DUI regional innovation, regional anticipation would involve establishing projects to create benefits for regional beneficiaries in ways that envisaged better futures for those beneficiaries after the completion of the innovation process. Regional reflexivity would involve partners thinking about innovation to create alternative forms of value and to drive shifts in value systems (social as well as technological innovation). Regional inclusion would involve ensuring that the desired beneficiaries of this improved future are connected to the innovation activities with the opportunities to express views on it. Regional responsiveness would involve regional partners contributing to innovation processes in various ways, such as lead users and testers, and their preferences and knowledge being incorporated into the innovation process thereby shaping its ultimate direction.

Table 1 Dimensions of responsibility in STI & DUI regional innovation networks

| <i>RRI dimension</i> | <i>Science & Technology-driven Innovation (STI)</i> | <i>Doing, Using & Interaction Innovation (DUI)</i> |
|----------------------|---|---|
| Anticipation | Knowledge producers consider research’s prospective impacts reflecting regional contexts. | Establishing projects to deliver better (more desirable) futures for regional beneficiaries |
| Reflexivity | Knowledge producers test their ideas & developments against local norms & values. | Creating alternative forms of value driving shifts in value systems (social as well as technological innovation). |

| | | |
|----------------|---|---|
| Inclusion | Knowledge producers listening to a wide range of stakeholder groups to allow societal expression of interest. | Ensuring desired beneficiaries have opportunities to express views on innovation activities. |
| Responsiveness | Knowledge co-creation allowing regional partners to actively contribute to knowledge creation. | Regional partners' preferences and knowledge incorporated into and shaping innovation process . |

Source: authors' own design

3. Methodology: studying RRI as governance

In this paper, we seek to explore the extent that particular research and innovation processes offer actors the opportunity to enact responsible behavioural repertoires, and the effects that this has on the nature of those research and innovation projects. This is an exploratory piece of research where we have proposed a process model, in which Stilgoe *et al.* (2012)'s repertoires may become evident in the ways in which knowledge actors take decisions in planning their research and innovation projects. We therefore seek to gather data at the level of the individual, to firstly map out their innovation decision-making, and then to focus on the responsibility repertoires evident in them. We have therefore constructed this as a qualitative case study approach in which we use the case study to gather data relating to these process, and then structure the data according to our proposed model to observe how these processes work in practice as the basis for reflecting upon the model and addressing our overall research question.

The case study was selected to provide an example of decision-making in innovation processes in e-Health and telemedicine; this sector was selected because as a sector it faces the challenge of understanding and hearing societal and patient voices in innovation processes that are both heavily institutionalised (as medicine) and also very technology focused (more detail is provided in 4.1). Because one of our variables is the model of innovation, and specifically differences between DUI and STI modes of innovation, we have selected one case study to correspond to each model of innovation. We included one case study that was driven primarily by practitioners and one in which a spin-off company had been established to exploit a technology created through a fundamental research project funded by European Research Framework funding (see 4.3).

We chose to investigate these case studies in the province of Overijssel because the Provincial government has identified e-Health and telemedicine as a strategic economic opportunity and has sought to stimulate innovation in this sector to drive innovation-led growth. We identified two e-health/telemedicine projects activities where there had been innovation activities in which efforts had been made to secure user and patient input. The case studies were carried out between February and August 2017, and involved gathering secondary material as well as a total of key informants interviews

with. Key informants were defined those who were actively involved developing the innovation, mediating between innovators and “public users” or who had specialist knowledge of the e-Health and Telemedicine sector in the east of the Netherlands. Interviews were undertaken from May 2017 onwards, and lasted between 60 and 90 minutes; the interview instrument was in Dutch, although the language of interviewed was pragmatically agreed between interviewer and interviewee; the majority of interviews were carried out in Dutch, with other interviews in English and German.

On that basis, we produced two stylised narratives of each innovation and research process, identifying the rationales for decisions made at various stages in the innovation process (section 4). We then identified potential responsibility repertoires within these stylised narratives along the four responsibility dimensions, linking them to the mode of innovation (section 5). These repertoires in turn provide the basis to answer the question, and to consider whether responsibility can be built into regional innovation processes. We acknowledge that this approach is stylised and about identifying general tendencies and lines of force within our case study, and does not allow us to make definitive statements about Responsible Research & Innovation. However, it rather provides the basis to interrogate the theoretically derived model for how regional research and innovation could potentially become more responsible proposed above.

4. Introduction to the case studies

4.1 eHealth

Healthcare practices delivered or supported by information and communication technologies are often framed as eHealth. Examples of applications range from online systems for managing doctor appointments and prescriptions, to technologies for sensing vital functions and monitoring a person’s lifestyle and fitness level, and to complex online communication and sensing platforms (Peeters et al, 2016; Kos et al, 2016). eHealth seeks to increase access to healthcare, to improve the quality, efficiency, safety and management of healthcare delivery, thereby driving cost reduction. eHealth also seeks to provide patients with electronic access to their medical data, thereby increasing patients’ capacities to self-manage their health and care, especially targeting patients with chronic diseases (Peeters et al, 2016; Dmitrova, 2013; Horn et al, 2016). e-Health & Telemedicine is particularly relevant for more aged populations: around 75% of the elderly have at least one chronic disease, with most of those suffering from multiple conditions (Dmitrova, 2013). This automatically makes elderly people potential users for eHealth innovations – a user group expected to increase significantly in coming years.

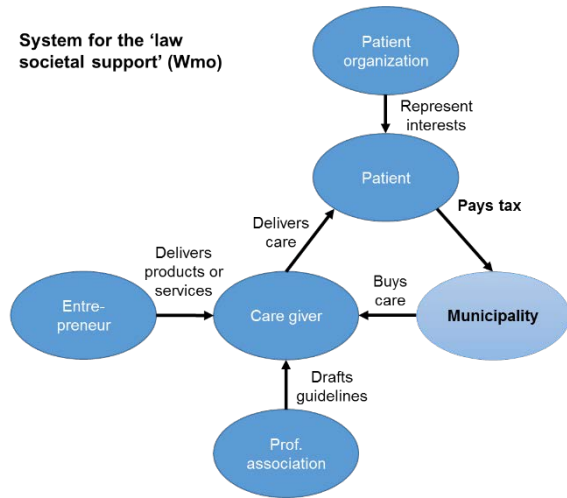
eHealth seeks also to improve the quality of life and productivity of the wider population. Healthy people are able to work for a longer time and therefore the employment and income opportunities for older people are improved. The overall increased productivity and labour participation that eHealth can bring are an important stimulus for eHealth innovation (Dmitrova, 2013). However, although policy-makers have enthusiastically advocated and promoted the idea of eHealth, that energy has not been matched by its uptake and use in primary healthcare (Peeters et al, 2016). Resistance has emerged, with potential users reporting concerns about safety, data security and privacy aspects. General practitioners have experienced problems with internet communication, lack necessary knowledge, technical infrastructure and financial support (Peeters et al, 2016). eHealth innovations presume smooth interaction with existing healthcare system is important, with straightforward dataflow between different actors: from emergency ward, to hospital, to social and home care givers (Dmitrova, 2013; Horn et al, 2016). eHealth also brings new roles and responsibilities within health care provision and changing arrangements between healthcare providers, patients and care personnel. Patients are confronted with an increased responsibility for self-care, with work being redistributed between professionals and patients, along with medical devices providing interventions previously provided by people (Oudshoorn, 2011).

4.2 Dutch healthcare system

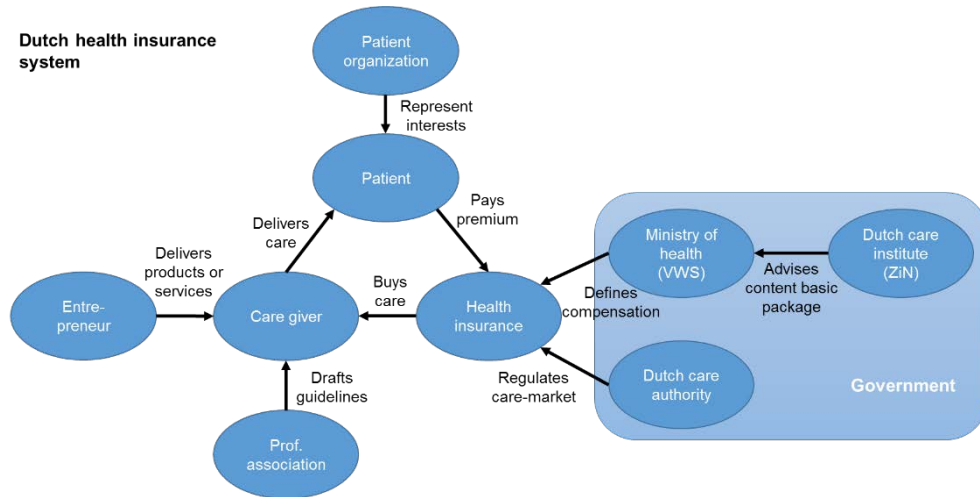
In the Netherlands, health insurance is accessible and universally compulsory; since reforms in 2006, residents purchase a basic insurance package covering general needs, whose contents is determined by the ministry of public health, welfare and sport (VWS) in consultation with the Dutch care institute (ZiN). Local policy makers, health professionals or intended users thus have little influence on health insurance coverage. However, health insurers also sell additional packages covering things that fall outside the basic package, such as physiotherapy, dentistry and opticians. The market is very competitive because care providers sell in bulk to insurance companies who then use those to develop their basic and additional packages. Coverage is universal with low wage earners receiving additional benefits to pay for their health coverage. In parallel with this is the law regulating home care services for people living at home and dependent on long-term care (such as household help, protected living, mobility aids, rehabilitation). Individual municipalities were given responsibility in 2014 for funding this care, selecting services and purchasing from providers, as shown below (Jansen, 2014). An important element in this situation is that the primary responsibility for providing home help services lies with people's friends and family and only when the absence of people to deliver suitable care can an elderly person access public home help funding; carers therefore are stakeholders in this process.

Figure 1 An overview of the parallel policy systems around Dutch health care

a. Social care for long-term dependent



b. Clinical health care provision.



Source: authors' own design

4.3 The two case studies

In this paper, we present examples of two innovation networks relating to DUI and STI innovation networks; we have pseudonymised the two cases and refer to them here as CareConnect (DUI) and Personalised Pooled Care (STI). More information is provided on these two cases below. Both of the cases are located in Overijssel, a Province in the east of the Netherlands, this provincial name literally means “on the other side of the IJssel”, denoting the province’s relative remoteness from the Netherlands’s main urban centres, the *Randstad*. The Province is relatively poor in the Dutch context, and is not one of the main national growth centres. Since the 1990s, the Province has sought to promote regional economic development through innovation, and since the 2000s has included health care technologies as sector eligible for public subsidy support.

The first case is CareConnect (CC), an online communication platform that creates a network around the client or patient, and between caregivers, family members and caretakers (more detailed information on the technical aspects of the development are provided in Schulze-Greiving *et al.*, 2019). CC emerged out of changes to Dutch care rules which funded fewer elderly care home places and this forced the closure of a care home in one village in Overijssel. Care providers came together to provide continuity of health care in patients own homes. This platform aims to support elderly and people with chronic diseases who need regular help and care to be able to live at home for a longer period.

CC is embedded in a website where the patient or his/her caretaker can ask a question, which is directly send to the other parties in the network who can answer this question in a short time. Parties in the network include pharmacies, homecare, physiotherapists, hospitals, general practitioners and the municipality. Typical messages sent via CC are updates on the used medication, orders at the pharmacy or questions about care. This way, the involved parties are all updated about the care of one particular person and about the actions of other actors with the aim to increase the quality and efficiency of the care.

The second case is Personalised Pooled Care (PPC), an eHealth product originating from the European Commission funded project “CareMonitor” (CM) supporting active and healthy ageing and independent living, in which the Twente partner was playing a leading role. The platform mainly targets elderly people and other patients with chronic diseases, specifically COPD (Chronic Obstructive Pulmonary Disease) and MCI (Mild Cognitive Impairment or incipient dementia). The product consists of a sensing environment, for example the home of the patient, which collects various data regarding the user and environment via medical and environmental sensors, with environmental control provided via actuators. Patients can directly interact with the environment by using audio/video devices and sensors; the sensing environment monitors patients’ daily activity and medical condition (e.g., pulse, oxygen saturation etc.) their sleeping patterns and the quality of the sleep. The environment is designed to motivate patients to reach their daily fitness goal, containing educational and cognitive gaming, and a calendar with reminders for daily medication and meals. Domotics are used to control the home environment. Recorded data is processed and stored in a pooled data sharing service, with doctors, family members, care recipients able to access these data in various configurations. The Twente case was developed by a hospital, focusing on the COPD elements of the system, in which they had experience because of the above average incidence of and mortality from COPD in Twente (Volksgezondheidszorg, 2018).

5. The regionality of the innovation networks

The first step of the analysis was to consider the extent to which the innovation activities constituted a regional network, and the contacts that this gave to societal partners in ways that created resources that could support these responsibility repertoires. CareConnect emerged from an existing set of practices between connected partners, originally centred around a General Practice and a care home for elderly patients. This existing local practice network was transformed into an innovation network in response to wider changes in the health system, and achieved a degree of regionality when it attracted the support from the province as a potential model for cutting home care costs in the east of the Netherlands. PPC began as an international R&D network with a node in Twente because of the expertise of a local rehabilitation hospital. This expertise was derived from very strong existing patient networks, knowledge networks which whilst not related to innovation created a knowledge resource that helped to solve the impersonality of the overall innovation process. More information on these two networks is provided below.

5.1 Regional innovation networks in the DUI context – CareConnect

The CareConnect innovation project involved the care providers from the patients previously served in the care home, and in particular a local health care practice who had close contact with their clients and previously had coordinated amongst themselves and with carers' relatives when providing care to residents. They came together to develop a digital communications platform to replace the coordination and oversight that had previously been provided through informal exchanges in the Health Center between GPs, nurses, physiotherapists and a pharmacy. A foundation CareConnect was provided to oversee the development of a communications platform, and that Foundation received several small subsidies to help with establishing the platform. The software was sourced from a company whose founder had had a disabled daughter and who was inspired by his own situation to develop a technology platform to help deal with the coordination problem that he had heard of from others in his wider peer network. The software was launched then adapted in response to user feedback, before being upscaled and sold to customers elsewhere facing similar situations.

The innovation was notionally led by the Foundation CareConnect, but the purpose of the Foundation was to develop a service for the lead users, the GPs and the nursing service. Funding to help develop the service was provided by the municipality (out of their care fund) and the Province (as an innovation subsidy). Outside of the region, the insurance companies played a very important role in setting the rules for the kinds of services which were eligible for reimbursement. A key issue in this network appeared to be tensions between GPs and the nurses, apparently reflecting different approaches to treatment within each professional group. Both of these professionalised groups were

much better organised than the carers, and there was evidence related in the interviews of some ambivalence towards carers. They certainly talked in ways that recognised the services that carers provided to patients, but also were seen as a potential source of interference in care provision. The Foundation therefore chose to pay particular to ensuring that the interests of the patients and carers were visible in the overall innovation process. The challenge in constructing an effective innovation network was in ensuring the platform reflected the interests of carers and patients were visible in parallel with meeting the technical and professional needs of doctors and nurses.

5.2 Regional innovation networks in the STI context – Personalised pooled care

The PPC product emerged from a European Framework project developed in a consortium involving partners from across Europe who had prior experience of co-operation and expertise in developing technologies for chronic sickness management. The regional partner was a regional hospital created in 1948 specifically for the rehabilitation of troops injured in decolonisation actions in what is today Indonesia, that has subsequently developed as a leading centre of expertise and excellence in rehabilitation (see Benneworth & Hospers, 2007) for more information. The Twente hospital partner assumed the responsibility for the work package on Chronic Obstructive Pulmonary Disorder (COPD), a life-limiting lung disease associated with exposure to airborne particulates (such as in industry or from smoking). The Twente team drew on their existing links with COPD patients to develop a comprehensive intervention system to support COPD patients, including monitoring physical signals and sleep, providing stimuli for activity, coaching behaviour and communicating with care providers. The company PPC was founded at the end of the process in Belgium to try to raise capital to commercialise the platform, which was applicable to COPD, mild cognitive impairment (early stage dementia) and Age Related Impairment.

The regional innovation network was drawn upon in various ways during the innovation process. During the proof of concept, the hospital developed a set of patient profiles based on their existing knowledge of COPD patients in Twente, and used those to develop a set of use scenarios for a platform. Although focus groups were held to create a product specification for a visual interface, they were not held in Twente, and the visual interface developed at the hospital reflected the feedback provided by focus groups in Denmark, Italy and Austria. The hospital were responsible for developing the visual interface and after negative feedback from the four countries (including the Netherlands) a local visual designer was hired to create an attractive front end. This prototype was then tested with 28 COPD patients in Twente, drawing on their existing contact networks. These patients used the system for 4 weeks at home, to provide data on which elements of the system were

used; the trials were too short to meaningfully develop data on the efficacy. Once the decision to upscale via a spin-out company was taken then the regional user influence largely disappeared as the company was created in Brussels. Even though the hospital were involved in the upscaling project, and the Twente scientist part of the newly formed country the focus was on rewriting the software to improve functionality and convert it to a smartphone application. From this point, regional innovation networks were not evident in the innovation process.

6. Responsibility within regional innovation networks

The second analytic step was to stylised the loci of responsibility repertoires (or their absence) within these regional innovation networks. In both the cases, the pre-existing networks formed the basis for shaping reflection, and therefore can be regarded as providing a resource that stimulated Responsible Research & Innovation. However, the use of these existing networks brought a hybridity to them, being related both to innovation as well as to the provision of care to extremely vulnerable patents. This created tensions for delivering RRI, and indeed the complexity of these networks led to both cases needing external pressure to look beyond their immediate innovation networks and reflect on potential wider communities. These findings are summarised in table 2 below, and more information is provided on these repertoires and their regionality thereafter.

Table 2 The dynamics of regional Responsible Research & Innovation repertoires in DUI and STI innovation networks

| CareConnect (DUI) | Personalised Pooled Care (STI) |
|--|--|
| Transformation of existing network: characteristics of 'patients' persisted in the new network – facilitates reflection. | Attention for an above averagely occurring regional disease |
| Existing networks limits inclusion outside the network; limits of strong ties | Regional patients provided signals directly through prototype practices |
| Construction of new organisation to provide responsiveness | Importance of external party in forcing hospital back to regional patients → hybridity |
| Importance of external stimuli in driving/ shaping changes | Hybrid nature of network not comfortable for patients seeking health provision |

Source: authors' own design

6.1 Responsibility repertoires in the DUI context – CareConnect

In the case of CareConnect, it is possible to consider the extent to which this innovation was responsible, reflecting the initially proposed framework. The innovators themselves were very busy with trying to solve an immediate urgent problem to anticipate long-term trends; it was only the

health insurance companies who were attempting to find solutions to rising health costs that anticipated these changes. In terms of reflection, the patients were not the most important users of the innovation, and it was only through a degree of self-awareness of the care providers that allowed them to ensure that efforts were made to ensure that the innovation delivered against patient needs. Inclusion was provided by the existing informal micro-networks by which care providers and carers intervened to support individual patients; there was no effort to widen this to include patients unlike those in the existing cohort, something quite important considering the relative homogeneity of the patient group. In terms of responsiveness, there were relatively few opportunities to allow patients to shape innovation; what responsiveness there was, was second order, with care providers practices shaping the innovation (they should also be primarily focusing on patients) and the Foundation put considerable effort into ensuring that the client rather than providers were central to the innovation process.

The final element of the analysis reflects the extent to which the “regionality” was visible in these responsibility repertoires. The innovation took place in a village in the rural part of a peripheral region, with a high degree of resident homogeneity and high personal contact and continuity in health services (in contrast to policlinics in the West of the Netherlands). Firstly, the innovation sought to reproduce an informal network as a technological intervention, and therefore the regionality is highly evident in the efforts to foreground the patients (rather than care providers) as the users for the technology, with these local networks influencing reflection practices, foregrounding patients. At the same time, this homogeneity undermined the inclusion practices, because they reduced the idea of ‘patients’ to those patients currently benefiting from it, something not immediately applicable once the technology started to travel. Thirdly, it was necessary to construct a new body (the Foundation) to ensure a degree of (second-order) responsiveness. Finally, the clear power imbalance to determine the rules of the game led to regional partners being extremely reactive, handing the power of anticipation to health insurers, who outside of this project have been criticized in Netherlands for prioritising cost reduction over patients’ needs.

6.2 Responsibility repertoires in the STI context – Personal Pooled Care

In terms of the responsibility repertoires, anticipation of user interests was included primarily through the creation of personas, scenarios and user cases, from literature and from prior experience with patients, after the funding was in place; the choice of project was primarily led by technological opportunity. In terms of reflection, it took an intervention from the European Commission mid-term review to ensure that users were consulted around the interface; prior to that there was relatively little reflection beyond the project team. Inclusion in the project was extremely pragmatic, with those

users being included and represented in various ways based on their past acquaintance with the researchers, giving it sometimes an ad hoc nature, although views and interests were heard in various ways of patients but also of care providers. The responsiveness of the innovation process was limited by the fact that by the time that users were actively consulted (in the interface development) there was relatively little space to adapt the interface to user needs; the complexity of the innovation process made it hard to include user voices in the overall project development.

In terms of the regionality of these repertoires, we here highlight four dimensions, reflecting that in providing attention for a common local disease and using local knowledge, this created a hybridity in the innovation networks with patient networks, something with which not all patients were comfortable. Firstly, in developing the COPD protocols, the hospital drew on its prior knowledge of COPD and this clearly reflected the fact the preponderance of COPD cases regionally (although the hospital's patients were drawn more widely than just the Twente region alone). Secondly, regional actors provided preference data from the 28 installed prototypes, in terms of revealing which of the applications were more or less popular, and also the feedback from the users and their carers on the interface.

Third, regional agency was not actively visible in the initial approach, and it took the intercession from the European Commission for them to take the user interface back to users, giving the network a hybrid patient-innovation characteristic. The user data from the testing treated the users as subjects and whilst it might have reflected some degree of regional preference, was strongly shaped by the technological decisions. The third element material here was the uncomfortable fit of the two roles expected of the users, as vulnerable patients struggling with an emotionally burdening condition, and as representatives of societal interests in the innovation process. This left the regional 'societal interest' evident and present although strongly framed and conditioned by the overall setup of the project; there was no strong user-producer network that was able to influence a project and spin-off strongly shaped by the international governance of the scientific network.

7. Discussion & Conclusions

In this paper we have sought to address the question of how modes of innovation within regional innovation systems affect the ways in which responsible practices can become embedded in innovation trajectories. We have identified in both cases that the regional innovation networks were dependent in various ways upon pre-existing practice networks, which were in turn coupled to these innovation networks. It appears that the strength of the coupling of those users to the innovation networks as a consequence of the transformation from practice into innovation network affected the

scope for responsibility repertoires within these regional innovation networks. This relationship between preexisting networks and the coupling of user interests to innovation interests, appear to play a substantive role in defining the space available for responsibility repertoires.

Our first finding was that an important driver in shaping responsibility was the dependence of innovation networks on prior health practice networks, whether directly as in providing first order users for the innovation prior to upscaling (CC) or indirectly by providing knowledge based from which to develop interventions (PPC). The regionality of these networks was defined by the “coupling” between health care providers and their patients around innovation activities, beyond straightforward “user-producer” relationships. The innovation networks depended in various ways on relationships of care from medical staff to vulnerable patients, and this clearly influenced the responsibility. In both cases, this brought the duty to the patients into innovation considerations, which worked to boost reflection and responsiveness, but at the same time circumscribed inclusion to the existing patient group to whom there was this duty.

The first visible distinction between the two modes of innovation comes in the the strength of the coupling of the patients to the innovation network. In the DUI system, the patients could be regarded as being ‘strongly coupled’ in the innovation network because their interests were paramount, increasing responsiveness and anticipation by knowledge creators. Even if the view of ‘patients’ was limited to the immediate user group of the platform, the overarching concern was in ‘what worked’ for patients. Conversely, in the STI system the patients were a means to an end, and the hybridity was more uncomfortable. The knowledge creators were primarily concerned with undertaking a piece of scientific research and harvesting the knowledge of patients for inclusion in their research process, even if in their other relationships with these patients they were concerned with their health and rehabilitation.

This coupling property also affected inclusion practices, with stronger coupling being associated in our two cases with weaker inclusion and reflection. In the strongly coupled case, we see that prospective reflectiveness and inclusion were restricted to the immediate patient circle of the care home. The homogeneity of that patient group shaped the ways that innovators reflected on the impacts of their innovations and precluded extending considerations of user needs to other more diverse societal groups. In the weakly coupled case, we see that this lack of coupling facilitated these processes; the reflection process was deliberately synoptic, defining particular kinds of potential user scenarios as the basis for defining the product specification. This ensured it was not tightly coupled to the needs of regional patients, indeed to the point where this lack of coupling was raised as becoming a weak point because of this lack of responsiveness highlighted above.

These case studies suggest that responsibility within regional innovation networks appears related to the underlying practice networks which couple users to innovators, and the strength of that coupling.

Coupling appears of itself to be advantageous in providing pathways for user signals to be received and incorporated. Strong coupling appears to be associated with improving responsiveness whilst reducing inclusion and reflectiveness; weak coupling appears to be associated with stronger anticipation and reflection but correspondingly weaker responsiveness. This provides a potentially interesting model for further exploration of responsibility within regional innovation systems.

We acknowledge that this as a relatively small scale exploratory study which sought to style and explore responsibility repertoires in regional innovation networks. Therefore we acknowledge we should be modest in making more general claims about the nature of responsibility within regional innovation networks and systems. At the same time, this issue of coupling does come some way to identifying a potential mechanism by which non-economic considerations can be included within regional innovation systems. This could potentially provide a means for regional innovation to serve both economic growth as well as societal satisfaction and help concerns of public value failure.

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