USER PARTICIPATION IN INFRASTRUCTURING: EXPLORING THE SPACE FOR ACTION

Research paper

Dæhlen, Åsmund, University of Oslo, Oslo, Norway, aasmunkd@ifi.uio.no

Grisot, Miria, University of Oslo, Oslo, Norway, miriag@ifi.uio.no

Abstract

This paper addresses participation in the design and transformation of an information infrastructure in healthcare. Recent work on the transformation of health information infrastructures shows that bottom-up user-driven processes are preferred, however, the role of users in infrastructuring remains under researched. This study addresses this gap by investigating user representatives' work in the design of an infrastructure. Grounded in the Scandinavian tradition of Participatory Design, this study conceptualise participation as space for action. This study is based on empirical research conducted on a project developing a digital application for sharing patient data in patient handovers. The context of the study is primary care services in Norway. Our findings show how user representatives engage local organizations as both facilitators for their own design process, i.e. designers preparing and transforming their local services, and as participants into design of the infrastructure, i.e. designers shaping technology. We contribute to literature on infrastructuring by showing how user representatives explore possbilities for action shaping the infrastructuring process.

Keywords: User Participation, Infrastructuring, Information Infrastructure, Design.

1 Introduction

The health sector is currently undergoing large-scale digital transformations with the potential to fundamentally transform how health care is provided. Realizing large-scale digital transformation of health care – i.e. digital transformations that go beyond single health organization and localities - is regarded as one of the challenges of the twenty-first century as cost containment in health care rise (Aanestad et al., 2017). Research has shown how challenging such processes are, in particular when dealing with digitalization of infrastructures on a national level (e.g. national ePrescription solutions or the digitalization of primary care services) (Aanestad et al., 2017). The healthcare sector has a complex socio-technical installed base which is often not conducive to change (Aanestad et al., 2017). To face this challenge, research advocates a bottom-up gradual approach to large-scale digital transformation. This has been conceptualized for instance as 'coping', 'cultivate' or 'grow' the existing socio technical configuration (Hanseth and Bygstad, 2017; Klein and Schellhammer, 2017; Modol, 2017; Mozaffar et al., 2017; Vassilakopoulou and Marmaras, 2017). However, most research looks at macro level strategies at the level of the organizations and the powerful actors, and rarely considers how users participate in these processes.

In this paper, we investigate how user representatives participate in infrastructuring – the work to design and put infrastructures in place (Ribes and Finholt, 2009; Edwards, 2003) - in the digitalization of primary care services. While user participation is recognised as a critical resource for the transformation of healthcare, it remains an under-stated and under-researched topic (Garmann-Johnsen et al., 2020) Research on user inclusion into infrastructuring shows the complexity of such process both in terms of which users should be involved, how to organize the participation and which knowledge to value from a user perspective. For instance, Hanseth and Aanestad (2003), argue that in order to successfully engage users 'user preferences' of a small group of motivated users need to be met first. Sim-

ilarly, Pipek and Wulf (2009), argue for a thorough technological support structure to engage users into the infrastructuring process. Problem-driven design which addresses 'real' and urgent user problems shows to require knowledge of users' information and communication practices (Grisot et al., 2014). Also, Aanestad and Jensen (2011), show that stakeholders' mobilization, and how this is conducted, is critical for successful implementations in the digitalization of healthcare. With our study, we want to contribute to this stream of research, and further our understanding of user participation from a user perspective. Our aim is to improve our understanding of how users' capability impacts the process of infrastructure design, what is their 'work' in such processes and how they can be motivated and mobilized not just to inform design, but in shaping it. With this aim, we ask the following research question: *How can we understand user participation in infrastructuring?*

To address this research question, we have conducted a longitudinal case study on the design of an application for patient handover in Norway's largest municipality. The application is expected to support data sharing across health organizations as patients move in their care journey. Currently, data about patients are fragmented in different Electronic Patient Records (EPRs) within each organization, and registries, and information sharing is based on electronic messages, phone calls and paper-based documents. Specifically, we focus on the design activities in the Digital Patient Handover (DPH) project, where two municipal agencies, four city districts, and a rehabilitation centre take part. We investigate how user representatives (health workers) from the city districts engage in technology development and in defining novel data practices. Our analysis shows that users' representatives play a critical role in exploring a space for action as they engage their local organization and the larger infrastructure design process. Our research contributes to foreground the work it takes to motivate users and mobilize organizations in infrastructuring.

The paper is structured as follows. In section 2 we present literature on infrastructuring and user participation in infrastructure design. In section 3 we describe our theoretical ground based in the Scandinavian Participatory Design (PD) tradition. In section 4 the case and project background is presented followed by the research methodology section describing research design, data collections and data analysis. In section 6 we present the findings from the study which we discuss in section 7, where we present implications for research and practice. Conclusions are presented in section 8.

2   User perspective in infrastructuring

Infrastructuring is a process perspective on information infrastructures. Rather than taking infrastructures as well defined and developed IT artefacts, this perspective focuses on the work to design and put infrastructures in place and in use. The concept of infrastructuring has been developed across a number of technology related research fields, such as Information Systems (IS), Science and Technology Studies (STS), Computer Supported Collaborative Work (CSCW), Human Computer Interaction (HCI) and PD. In these fields, what infrastructuring entails and how such processes are characterised differ, albeit not in a clear-cut way. Yet, they share an interest in foregrounding and understanding the work to establish infrastructures, the role and practices of infrastructural workers, and the efforts to create durable novel connections across time and space (Ribes and Finholt, 2009). Also, infrastructuring generally relies on a sociotechnical understanding of infrastructures, meaning that infrastructuring is understood as a process articulating materialities with institutional actors, legal regimes, policies, and knowledge practices that are constantly in formation across time and space (Edwards, 2003).

One core aspect of infrastructuring is that infrastructures grow incrementally (Edwards et al., 2009), and are shaped and formed by the contextual characteristics in which they are situated (Hughes, 1993). Hanseth and Lyytinen describe the evolution of infrastructures as being both enabled and constrained by the 'installed base' (Hanseth and Lyytinen, 2010). The installed base encompasses contextual characteristics as well as previous design decisions, IT capabilities, use practices in addition to legal and professional regulations (Aanestad et al., 2017; Lanzara, 2014). Accordingly, infrastructures are never built by system builders from scratch, but rather shaped by the installed base and inherit strength and weaknesses from it. Researchers have studied how to 'deal with' the installed base, suggesting concepts such as 'coping with', 'cultivate' and 'grow' the installed base (Aanestal et al 2017). For in-

stance, Hanseth and Bygstad (2017) note that the shift from a "classical specifications driven approach", to a cultivation driven approach of coping with the installed base was pivotal for the success of a large ePrescription project in Norway. Similarly, Hibberd et al show how a flexible and evolving approach was necessary for ePrescription to come into existence in the UK (Hibberd et al., 2017).

Infrastructuring is also concerned with long term durability and sustainability (Ribes and Finholt, 2003). Thus, infrastructuring implies also a reconceptualization of technology design as an ongoing design process which includes continuous work of maintenance and repair (Jackson, 2014). Metaphors such as growth and cultivation conceptualise design of infrastructures as actions that influence how infrastructures evolve over time in contrast to actions of control and planning (Ciborra et al., 2000; Hanseth and Lyytinen, 2010). Within this body of literature, a stream of research has also been interested in understanding the role of users in such processes. In a seminal article, Hanseth and Aanestad (2003) denote 'bootstrapping' an infrastructural design process that is user-driven. They argue that in order to bootstrap infrastructures, one should start with a simple, cheap, and flexible solution that addresses specific users' needs, few motivated users, and set-in motion a gradual process of user enrolment. In this approach, users are motivated to participate because they see how the solution being designed addresses their own concrete problems (Hanseth and Aanestad, 2003). Grisot et al., (2014), conduct a similar analysis on the design of a patient-oriented hospital portal, and show how the direct usefulness of the solution attracted users' participation in the design process, and how this in turn contributed to further developing the portal in ways that were not yet envisioned. User participation is however difficult to organize on a large scale. Roland et al., (2017), show how user engagement becomes more representative as the system scales. In their study they describe how users maintain a working relationship with local development, while user representatives engage with the core of the platform (not local). In doing so, they show how participation is affected by the tension between local and global in infrastructuring. As infrastructuring indicates processes that are distributed, last over a long period of time, and draw together diverse practices, tensions and interdependencies about divergent goals, needs served, inclusion are inevitable (Ribes and Finholt 2009). In this study we are interested in developing an in-depth understanding of how users explore the space for participation in infrastructuring. In the next section we present our theoretical grounding for the core concepts of participation and space for action.

3　　　Participation: creating space for action

In order to investigate how user representatives participate in infrastructuring, we ground our work in the Scandinavian Participatory Design tradition, and its rich history of conceptualizing participation. PD has its roots in Scandinavian workplace democracy movements in the 1970s, where various Scandinavian research projects engaged trade unions (Sandberg, 1979), and started conceptualizing the democratic cradle of user engagement in systems development (Kyng and Mathi assen, 1979; Nygaard, 1979). We build on PD's view on participation as action-oriented, individuals' power to affect technology design.

The Scandinavian PD tradition had long been focused on concretizing the concept of participation into the design process. Schön and Wiggins (1992) described the design process as a process where the designer "sees, moves and sees again.". Seeing is the act of detecting possible consequences for a move, judging or appreciating the quality of the existing, or possible future configurations of the world. Bjerknes and Bratteteig (1995) argue that, "User participation refers to the involvement of users in work activities during systems development—the forms and degree of involvement vary (representative or direct involvement, consultants, or collaborators)." Bødker et al. (2004) suggest 'genuine' participation to indicate users who not just inform design but take the pen in hand and create. Kensing and Greenbaum (2013) describe this as the "fundamental transcendence of users' role from being merely informants to being legitimate and acknowledged participants in the design process". The act of participation in design, is also a process where users are being empowered to explore and to take the part of the designer in 'making design moves'. In the power to explore lies the power to image: to see possible configurations of the world users need to be able to see the space in which they can take

action. Bratteteig and Wagner (2014, p. 16) says that, "it is through imagining that we generate choices that can be examined, made material, and evaluated.". Further, Bratteteig and Wagner post that the choices made in design as the process moves are connected in decision-linkages, meaning that complex interrelationship emerge as design progresses.

The concept of space is frequently used in the PD tradition to talk about the physical or metaphorical frames that users can act within. Bratteteig and Wagner use the concept of 'space' to argue that "users' voice should have *space* and weight" in design (Bratteteig and Wagner 2014). Users should be given space to indicate that "participatory designers are committed to sharing power with users and facilitate a design process where users are able to take part in all phases of a design project" (ibid.). Muller and Druin (2007) conceptualize a 'third space' where participation occurs. The third space is conceptually in-between the knowledge of designers and users, but also in a physical stage of design sessions (Muller and Druin 2007). Sanders also explored 'new spaces' for co-designing where "visual toolkits allow people the time and space to listen to each other's ideas and dreams, thereby facilitating more effective collaboration" (Sanders, 2000). PD researchers in general often conceptualize a broader design space, "Many of these methods have a playful component; engaging users and designers in joint explorations of the design space, [..]" (Mörtberg et al., 2010, p. 124). Dorst and Cross (2001) use "notional design 'spaces'" to define the co-design process as a mutual exploration of a problem space and a solution space.

Exploring the space for participation is thus central in PD. In this study, we investigate the work of user representatives as a process of exploring the space for action - focusing on the exploration of seeing, moving, then seeing again, and of mutually exploring the problem space and solution space.

4   Case

This paper reports from research conducted on the Digital Patient Handover (DPH) project, which is part of an ongoing digitalization effort of the public health services in one of Norway's largest municipalities. The municipality is structured as a parliamentary government with 15 city districts. The Home Care Agency is the main coordinator of the project and in charge of elderly care, rehabilitation and end-of-life care. In addition, the project stakeholders are the Home Care Services of four city districts and the Health Agency, heading the municipality's health-related technology department, and the governing agency of three acute health institutions (and more recently in charge of Covid-19 vaccination). The project can be described as organized in three levels (see table 1): the steering group consists of Agency and district leaders, city administration officials, project leader and head of technology department; the reference group consist of health professional service leaders, such as leaders of city districts home care and other care facilities; and lastly the core project team, consisting of the project leader, and one participant from each health service provider.

Steering Group	Project Owner Representatives (4), Steering group lead/service owner (1) District Heads and Service Owners (5), Head of Technology Department (1)
Reference Group	Leader of Rehabilitation Facility (1), City Districts Health Department Directors (4)
Core Team	User Representatives (5), Project Leader (1)

Table 1. The three levels in the project.

This paper focuses on the participation of user representatives in the DPH project. The user representatives are health workers who currently work, or have worked, in the care services. Some have an additional formal education in change management, but most have a user representative role based on previous experiences with the development of health services locally. We use the term 'user representative' to emphasize their role as representatives of their local co-workers, more specifically, health workers. Five user representatives (each per user organization) have acted as informants in our study.

However, during our observations this role has been taken by different people as some have left, and new ones have joined the project.

4.1 Project background

The DPH project started in 2018 as an initiative by the Home Care Agency after the central city government issued a directive to standardize the operation, and the city district's use of Rehabilitation Facilities for the elderly. The mandate described the core issues as follows: "Today we spend considerable resources in the cooperation of patient handover between districts [Home Care], Health Care Agencies services [Rehabilitation Facilities], and hospitals. This is making patient handover and tracking of patient journeys challenging; often with large risks, bad quality of care, and a great use of resources. It is well documented that the patient handovers are the greatest risk for the patients." (Mandate for concept phase, translated by authors)

The long-term goal of the project is to develop an application for sharing patient information across the district's care services. Information about elderly patients is produced in eleven different health services (Hospitals, Acute Emergency central, Health House(s), Home Services, General Practitioner, Emergency Room, Apothecary, Welfare, specialist service/private, rehabilitation facilities, and laboratories). In 2018, the municipality built a prototype system based on Microsoft Azure to test capabilities in the handover of patients between one district and its Rehabilitation Facilities. Building on the experience from the pilot project, the Home Care Agency and Health Agency launched, in 2018, a joint project together with three city districts, one Rehabilitation Facility and two municipal acute care centers. One additional district joined in the fall of 2019, because of its experience of collaboration with the Health Agency developers in a previous IT project, and because of its ongoing digitalization initiatives. During 2020, the project developed a data platform for the sharing of data based on Microsoft Azure, and worked on defining novel data practices in the health services. One of the initial challenges was to access data stored in the different EPR solutions in use in the health services. The main EPR system in use in the municipal services, Gerica, is a substantial legacy system owned and developed by a private third party.

Previous to the Covid-19 pandemic, the project followed a milestone-based cooperation structure, where the development department in the Health Agency received payment at set milestones. The first milestone was the initial pilot implementation, due to start in Feb 2020 and then postponed due to the pandemic and consequently lack of progress. Up until March 2020, the data sharing platform and the application had been developed in a conjoined effort. The cooperation between the two agencies saw an abrupt break as the Health Agency, in charge of development resources, pulled out. The project then faced a major decision on whether they would continue to be dependent on the Health Agency or find an alternative arrangement.

During this time the core team of user representatives and project leader continued working in design sessions centred around the development of local data practices. However, four of the participants and their organizations have in various levels taken a passive stance, waiting for further progress in the central government. By 'passive stance', we mean that they were not engaging in the project's development sessions. The only participating organization with one full time employee delegated to digitalization continued their efforts of service development during this time. The technology design restarted in November 2020 when the project hired a developer. The project still relied on the development department but worked out an agreement where the new developer would also spend one weekday assisting in developing the application. Since November 2020 the project has re-established cooperation with the development department and is set to start the implementation in June 2021.

5 Research methodology

This study followed an interpretive (Walsham, 1995), longitudinal case study design. Data collection consisted of (on-line) observations of meetings, (on-line) interviews, document collection and two observation sessions of work practices. From February 2020 to February 2021, we have attended the

weekly project meetings. In these meetings the core project team has worked on designing data practices and technology. The meetings have been video recorded, and selectively transcribed. From September 2020, to February 2021, we have conducted (27) semi-structured interviews with the project leader and one user representative on a weekly basis. Inspired by the concept of the reflective practitioner, and reflection on action (Schön, 1938) - the process in which the worker is engaged to reflect on practice - we asked the informants to reflect on the highlights of the week, the ongoing discussions in the project meetings and the progress of the project. Reflections on practice that was not visible to us initially, such as meetings we have not observed, was important in understanding the larger context. We have also conducted interviews with user representatives from three city districts as they worked to engage their local organization into the project after the first wave of the pandemic in august 2020. In addition, we have conducted semi-structured interviews with the head of the Health Agency's department for development. During these interviews we tried to understand the larger con textual dependencies, investigating how the work of user representatives was situated in the larger context. See table 2 for an overview of methods, activity and data gathered.

Method	Activity	Data
Observation	Observation (41) of meeting scenarios and stakeholder constellations. Two contextual observations of health workers practices.	Information sharing and cooperation regarding technology design and service development; strategizing, sharing information, organizational development, etc. Insight into service practices "before" digitalization
Interviews	Interviews (30) with project manager, user representatives, and head of development.	Reflections on the development of service and technology; reflection on action (Schön, 1998)
Documentation	Access to the project portfolio.	Project portfolio: system design, presentations, work descriptions, working documentation, etc.

Table 2. Overview of methods, activities and main category of data.

5.1   Data analysis

Data analysis consisted of three steps. A first step of data analysis took place right after each meeting and interview, where we (researchers) met to discuss highlights, themes to follow up, and point to relevant aspects to user participation. For instance, we noted early that user representatives work tried to facilitate the participation of other health workers in developing novel practice. We took individual notes of these preliminary data analysis. In a second step, we conducted a systematic data analysis based on selected transcripts of interviews and observations by use of Nvivo. We have conducted a thematic analysis according to Braun and Clarke (2006) and guided by our preliminary results of the first analysis step. Some of our main themes after this process were the following: 'building a local network', 'free-up resources', 'understand organizational affordances' and 'distributed decision-making'. At this stage, both authors familiarized themselves with the data by reading the transcripts, and the first author conducted the initial coding process, which has been then iterated upon to create themes in joint discussions using the collaborative digital online sketch board Miro. This initial coding process resulted in the identification of various challenges user representatives faced when participating in the design process. We specifically noted challenges related to the complexity of the design process as an infrastructuring process. The third step of the analysis has been to 'writing through codes', inspired by Crang and Cook (2007), where we wrote through our themes by "summarising 'theoretically saturated' arguments, putting them in a logical order, quoting appropriate passages, and doing so over and over, pile by pile, until they 'work as arguments: individually and as a whole." (p. 158). We started this process by describing the challenges we had identified earlier. It was only when

we started writing that we developed the theoretical conceptualization of user representatives' work from a more general notion of 'design practice', to seeing their work as exploring a space for action.

6   Findings

In this paper we focus on how user representatives participate in shaping a space for action. As mentioned, user representatives are health workers in the city district primary care services and take part in the DPH project as representatives of their district. We give an account of their exploration of a space for action and distinguish analytically between two kinds of spaces for action. First, the *local* space for action where user representatives participate as design facilitators by engaging their co-workers, but also themselves, into the design of the data practices by exploring the capabilities of the local organization. Second, the exploration of the *infrastructural* space where the user representatives participate in infrastructure design and deal with infrastructural interdependencies. We show how these two spaces are intertwined and inform each other, and we foreground the work of dealing with challenges.

6.1   Exploring local space for action

The local space for action is the space where the user representatives engage with their co-workers and local organization in the city districts. Engaging users has shown however to be a challenging process where user representatives struggle with limited resources and limited legitimation. Their exploration is about understanding how to engage users in the project activities. For instance, one such activity is the mapping of work procedures and data practices. Mapping current work procedures is important in order to develop an understanding of 'what is' to build a foundation for 'what could be' and develop novel data practices. Participation is critical because health workers have direct knowledge, expertise and experience of how care work is done in practice, and implicated data practices.

Early on user representative faced the challenge of health workers availability. User representatives said that when they tried to involve workers from the local health services, it became evident that care work was always the priority. They said that "when pinned against daily operations, the development-oriented thinking loses 9 out of 10 times." Care work would always be prioritised against participation in the design activities. This was especially relevant in the first phase of the Covid pandemic when health workers were even pulled out of their normal care tasks to address the medical emergency caused by the pandemic. User representatives were themselves, to a varying degree, also assigned to other roles. In relation to this, health workers had raised a concern about the project resulting in additional work to their already busy work schedules. This was not only due to how central their work was during the pandemic, but also to the nature of the project itself. Health workers expected the IT solution to be ready-made. Differently, the project required them to invest time into design activities. One user representative said in an interview that workers had expressed a heartfelt sigh when they found out "that this is not a ready-made solution". A user representative said that if you are "a nurse with a coordination task, or if you work in a receiving team [..], they have their things they have to go through each day, how much time is left to think about development?" The heartfelt sight was also because they envisioned that the new solution would require them to register data in yet one additional system to the ones they already were using "[..] and then at the same time using two systems, ...at the moment we do not just switch one system for the other, we have to do both in a period." A user representative also described this challenge as "a hard sell" to convince health workers to participate in the project. The representative expressed that one team in particular had been part of several digitalization projects, and this had built up a negative experience: "a lot of things have been piloted with them, and they are just tired you know, as soon as you say [project name] in there you could just see them rolling their eyes [..] that is not a good starting point for development work."

User representatives are aware that the project is not just about technology design but requires envisioning a novel way of working, and a novel approach to data practices. This shift is challenging for health workers. For instance, a user representative said that "for many in the home service - and now I am generalizing - I think the health workers in the home services have a digital anxiety". He further said that "as a health worker, with 30 years of experience, you have a different starting point than if

you have recently graduated and have digital experience." This was a challenge not only in relation to the level of digital literacy, but also in relation to the experience of being a participant in technology design. An informant said that "then it becomes almost a little anxiety-provoking to know that this is something you should be involved in developing… so it can be like "thank you for saying that", because I think we are not used to working like that". These concerns and contextual factors made it challenging for user representatives to mobilize health workers into the space for action in the early phase of the project.

The most prominent strategy of user representatives to engage their local organization has been to explore the limits of the organization and its individuals. This meant to see what is possible, then move on that information, and create a space for their organization to take action in shaping data practices. In one of the health service design sessions, a user representative described the problem as "dragging down a lot of loose balloons", meaning that it was a process of trying but failing to get various stakeholders on board, and further, that people he needed to be engaged were not able to do it. In response, the project leader said: «you need to have a team around you that you can draw on [..] which is partly why you have the reference group for, where you can have my backing through them." However, the user representative expressed that even with their backing, they felt inadequate in their attempts. Other user representatives also expressed that they had experiences from other projects where local networks of project leaders were established to share experiences.

In the process of mutually developing technology and local service, the user representatives have expressed that it is hard to convey what the project and technology affords to health workers and their local organization. One representative expressed that mobilizing health workers was challenging because they often feel inadequate to answer questions that health workers had regarding technology and development of data practices. They explained that "I only know a little bit, and it's very superficial. [..] But, you become lost for words when trying to convey such complex things to other people, and it often occurs that to some questions the answer is "sorry, I don't know". During our first observations in 2020, before Covid, two team leaders were engaged into a technology design session. When they challenged the core team to suggest how they, as team leaders, could argue for their case locally, the core team struggled with clearly articulating immediate benefits. In the following project sessions, the focus turned to articulating benefits. This work of developing both immediate and long-term benefits has been an important part of mobilizing health workers, team leaders and management. In early 2021, one user representative explained that their health service team leaders had expressed that "they need the time to become an ambassador and find out why we have made the choices and why we are here, get a sense of ownership to the project'. The representative conceptualized the digitalization process as a having a "rippling effect", "because they [team leaders] are meeting the next node in the network, and again it takes them time to become good ambassadors."

Another challenge faced by user representative was the lack of resources. A user representative planned to have two health workers working actively with mapping how their teams provided care in order to develop novel work procedures. The representative made the two health workers, in different teams, ensure that their teams spent some time during their daily team meetings to discuss current practices, and potentials for improvement. However, they soon found out that this would not work because of the extra work and cost of managing shift workers. The representative said: "it became completely unruly for the service and for them [health workers] [..] so after having tested it out we just had to say: 'that did not work, what now?'" The user representative felt that their organization underestimated what was required of the organization and its individuals—and at the same time that they did not have the competence to convey what was needed. The representative explained that "it became evident that if this is not grounded, read out loud and anchored all the way to the top and economically, so we can free up workers responsibilities, unless we actually set aside money, it won't become anything". In the project the efforts of freeing up workers responsibilities have been referred to as 're-deeming', and it has been an important goal in engaging health workers. Strategies to redeem health workers have included inviting the project leader to talk about the affordances of the technology, and possibilities using data and standardization across services. User representative have expressed inadequacy to do these talks themselves. In the case of the representative, struggling with shift workers, she

was able to convince her organization to free up resources and engage the organization in transforming how they worked, only after having tested her plan, seeing it not work due to shift work, and then having the organization participate into a seminar on agile development, and invite the project lead to talk about affordances.

User representative faced also a similar challenge in relation to their own role and responsibilities. One user representative said that the decision of who would take the project responsibility and user representative role in their organization came more as an impromptu decision of "who can around here put up with this?", and when questioned about how they balanced their responsibilities, said "I can't define my work balance; I just have to balance it, these four projects". Another representative called himself a "multi artist" and explained that "the problem is that I have worked here for 12 years, when you have worked with so many things the organization does not forget what you have done and pulls you in [to other projects] all the time." This has proved a general challenge for the representatives, as the boundaries of their work are often undefined, and they more generally work with the digitalization of their districts. Interestingly, the only user representative committed to the project is the only one to have been continuously active in all development activities. The other four representatives and their organizations have all, in various stages, taken a passive stance towards the project as they struggle with juggling their busy days and mobilizing their local organization.

We find that user representatives' work in exploring the local space for action is about navigating their local organizations, exploring means of making space for action, so that health workers can contribute to shape knowledge about the problem and solutions spaces. Engaging health workers resulted from a process of exploring the capabilities of the organization by seeing, moving, and seeing. In this exploration, user representatives are facilitators of a design process, trying to find out how they can engage their organization and its users into formulating the problem space, and problem solution. In the next section, we present the findings related to how the user utilized their knowledge gained in exploring local space into exploring a infrastructural space for action.

6.2   Exploring infrastructural space for action

The infrastructural space is the space where the user representatives participate in infrastructure design and deal with infrastructural interdependencies beyond the local context of design. In exploring a space for action in this context, user representatives have to work with infrastructural interdependencies and leverage knowledge gained locally, exploring the local space. They have done this in various design sessions where they develop technology and health services. In these sessions, the user representatives work to shape technology and care services in a mutual development process.

One of the main goals of this project has been to design an application for patient handover. Patient handovers take place across organizations, which have different care practices, priorities, and different data practices. Thus, it is important that all organizations are represented in the design activities. When one of the main actors is absent, this creates limitations to the imaginative power of the whole team. For instance, since summer 2020 the rehabilitation institution had no representative. This has led the team to exploring the problem space with a partial approach. For example, when a user representative presented an idea for how to start implementing the application, and how they had trained personnel for the use of one of the data fields in the application, the representative said: "this also accounts for rehabilitation facilities I think." In another instance, in one technology design meeting, a user representative, a developer, and the project leader were investigating data errors on some patients and they concluded the discussion with the representative saying: "I can check this with the case workers on Monday for example, what health service [the data field in question] is it they usually add at the different rehabilitation facilities". This became a common recurrence after the start of the pandemic when participation became especially fragmented.

Exploring infrastructural space meant also to draw on external and internal professional expertise. One activity in the design meetings has been to design core functionalities that can support the initial implementation process in multiple use cases. Some of these core functionalities have been built based on user representatives creating a space for action through inviting external actors. External actors

could contribute with specific expertise. External professionals have for instance contributed to the design of new data practice standards that work across different use cases. In a discussion on how to represent 'resuscitation' in the application, one user representative said: "we have just had the legal expert take a look at it and it has to be set by the General Practitioner." In a weekly interview the project leader exemplified this process of bringing in expertise saying: "[..] they pulled a pharmacist from the city district, they pulled an ergo therapist from one district, and some team-leaders from the home services, and they are the ones who know who can contribute with useful competence into what we are discussing now." Bringing in external expertise in the design activities shows also the wide range of issues discussed. The user representatives have to explore the space for action through different means, one of which is to reach out to specific expertise.

Involving experts presents however some challenges. Some experts for instance have expressed the need to have a more fundamental understanding of the technology being designed, and this reflects on user representatives and their understanding of the current practices and novel ones. For instance, a core issue is how to transition from the existing legacy systems to the new application. Exploring the infrastructural space for action in this case mean to take into account the existing systems and create data practices that can work while transitioning between systems. During a health service design meeting in the fall of 2020, the team was ideating strategies for implementing the technology in a transitional phase, using legacy systems to start establishing data practices that could carry over to the new system. A user representative had presented an idea for a "user status" template to be used in the legacy EPR, which would also be visible in the new system and that incorporated two of the most essential functionalities of the new system (two standardized measurements for patient wellbeing). This would ensure immediate benefits as they could start implementing training sessions for the two new standards with immediate benefits, even before a possible transition. In addition, this would make sure that no system, old or new, suffered in the transitional period as both systems will eventually have more, or better more information. This example shows the need for representatives to understand the technology design process beyond just what the new technology affords but considering the entire process.

It also became evident at the start of 2021, that some actors entering the project needed to further understand the problem and solution space, and how they had been explored. A newly replaced user representative tried to understand how to handle the transitional period using both systems. She asked how the legacy EPR would talk to the new system: "do we have an overview of how things are converted from the EPR, what functionality communicates with the EPR, because this has impacts on routines, double registration, the EPR is our documentation system, so I am struggling a little with making a plan for implementation in regard to what is communicating with what." This made it clear for the others that they had taken for granted their earlier decisions when new actors entered. This event made the team open up the meeting as a place for the new representative to ask questions. The project lead then shared a document showing the different data elements in the architecture, how different applications communicated, what data from the various functionality would be saved during the transitional phase.

After this session, the project leader said that they had described in text how to introduce the project to externals and new people. The fragmented participation in design sessions showed the challenge of being able to explain what has happened in the project to new or returning team participants. The newly replaced representative had no means of knowing how the project had developed over time, what choices had been made and, for instance, how they planned to manage the transition to the novel system. They lacked insight into what the others took for granted. One of the local team leaders participating in the same meeting had expressed the same lack of understanding, but for a different reason. As a team leader, they felt they needed to understand "why we have made the choices and why we are here, to get a sense of ownership of the project". This is because, as a team leader, they need to be able to facilitate the exploration of how their team would implement the system.

Our findings show that the project participants use various means of exploring the space for action. For instance, by circumnavigating the lacking participation of other representatives. In addition, our findings also show how the team dealt with fragmented participation. Fragmented participation is not necessarily a challenge. Considering the nature of their primary care work, representatives, team lead-

ers and health professionals cannot be expected to participate in all design sessions. However, our findings also show that the exploration of what is possible happens in an inevitably complex environment, where the problem space and solution space are not necessarily related to a single context but bound up in larger infrastructural interdependencies. In this case, user representatives are not just "traditional" participants in a design process, but facilitators of their own, and their local districts' efforts. When they explore a space for action, seeking out a problem and a solution space, they have to know and take into account larger infrastructural interdependencies, as well as the earlier project efforts.

7 Discussion

In this study, we asked: "how can we understand user participation in infrastructuring?" We have approached this question by investigating user representatives' work in exploring spaces for action as they engage their local organization and the larger infrastructure design process. We have made an analytical distinction in the user representatives' work towards exploring a local space for action, and an infrastructural space for action. 'Space for action' is a conceptualization of a participatory design space. By analysing the space for action, we have investigated a bottom-up infrastructuring process from the perspective of user representatives (health workers). We contribute with an understanding of the work of user representatives as paramount in exploring the space for action in infrastructuring, bridging the efforts of the local and global interdependencies of infrastructures.

First, we have found that user representatives explored a space for local action through iteratively seeing what was possible in their local context, then moving on that information, strategizing and figuring out how to create a space where their local organization can be engaged in the creation of data practices. In this work user representative have been important actors in motivating health workers through mobilizing local organization for action. Second, we have showed how these local processes are mutually building on user representatives' exploration and understanding of infrastructural interdependencies. For instance, one of the challenges the user representatives have had to solve is how to transition their local organizations from the older legacy systems to the new data platform. This has required an extensive process of exploring the space in which they can engage health workers into creating new data practices—both as a process of preparing the local by aligning practice, but also as a mutual process informed by larger infrastructural interdependencies. In exploring the space for action, the user representatives have in many ways conducted what Pipek and Wulf (2005) describe as establishing 'technological support for infrastructuring'.

An important part of the work for user representatives has been to mobilize their local organization. In exploring the space in which health workers could participate to define novel data practices, user representatives have found that they needed to free up resources, 'redeem' workers' responsibilities. In exploring this space for action, the user representatives worked with what Hanseth and Aanestad (2003) call 'user preferences', such as how to motivate the workers through engaging the organization. In this work the representatives work as facilitators of a design process, exploring a space in which a problem space and solution space for local practice can be identified. This work of exploring a problem and solution space is also framed by infrastructural interdependencies, i.e., the user representatives needed a thorough understanding of infrastructural interdependencies and combine that knowledge with their exploration of the local. For example, in working on exploring a space for new data practices, the user representative needed to understand architectural dependencies, i.e. know where data is located and how it is stored. The implementation of the new system will require to use both systems for a period, both internally in organizations, but more importantly across organizations. Titlestad et al., (2009) describe the role of mediators between different actors, specifically focusing on mediation between the global development, local development and the use cases. Differently our study shows that user representatives are not just mediators, but also designers exploring how to shape practice and technology that can work in the complex intermediate phase of the infrastructure, where old legacy systems are used alongside new applications.

Our findings about motivating health workers and organizations confirms previous literature on bottom-up processes, which often revolve around strategizing. For example, Hanseth and Aanestad

(2003) show that a requirement for successfully implementing a telemedicine network was highly motivated users. Aanestad and Jensen (2011) find that in order to successfully motivate participants, the projects needed to create a solution centred on perceived problems and offered solutions targeted to these. Our findings expand these insights by showing the work of user representative in creating the space for action in which the problem space and solution space can be defined.

Our research thus contributes to foreground the work it takes to motivate users and mobilize organizations. This is important as it helps to understand how for example challenges faced regarding fragmented participation impacts the design trajectory of the infrastructure. While fragmented participation is not in itself an issue in smaller scale design projects (Bratteig and Wagner, 2014), it can become one in infrastructuring because of the interdependencies between contexts. Fragmented participation does not necessarily become a challenge because the representatives, team leaders and health professionals cannot be a part of all design sessions, but because the exploration happens in a linkage of design moves. This understanding of the work of health workers in infrastructure design calls for more research on health workers role in design processes and the new competence requirements.

8   Conclusion

In conclusion, we have investigated the participation of user representatives in an infrastructure design process. We contribute with an understanding of how user representatives can engage health workers in creating novel data practices by exploring a space for action. Our findings show how user representatives are both facilitators of a design process as they tackle challenges related to the interdependencies of an infrastructure design process by exploring possibilities for action on how to include health workers in defining novel data practices. This aligns with earlier work emphasizing and strategizing user inclusion into infrastructure design and contributes with a perspective on how user representatives (health workers) participate in the design process through exploring possibilities for action.

References

Aanestad, M., Grisot, M., Hanseth, O., Vassilakopoulou, P., 2017. Information infrastructures for eHealth, in: Information Infrastructures within European Health Care. Springer, Cham, pp. 11–23.

Aanestad, M., Jensen, T.B., 2011. Building nation-wide information infrastructures in healthcare through modular implementation strategies. The Journal of Strategic Information Systems 20, 161–176. https://doi.org/10.1016/j.jsis.2011.03.006

Bjerknes, G., Bratteteig, T., 1995. User Participation and Democracy: A Discussion of Scandinavian Research on System Development 7, 27.

Bødker, K., Kensing, F., Simonsen, J., 2004. Participatory IT Design: Designing for Business and Workplace Realities (MIT Press).

Bratteteig, T., Wagner, I., 2014. Disentangling Participation, Computer Supported Cooperative Work. Springer International Publishing, Cham. https://doi.org/10.1007/978-3-319-06163-4

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qualitative Research in Psychology 3, 77–101. https://doi.org/10.1191/1478088706qp063oa

Ciborra, C., Braa, K., Cordella, A., Dahlbom, B., Hepsø, V., Failla, A., Hanseth, O., Ljungberg, J., Monteiro, E., 2000. From control to drift: the dynamics of corporate information infrastruc tures. Oxford University Press on Demand.

Crang, M., Cook, I., 2007. Doing ethnographies. Sage.

Dorst, K., Cross, N., 2001. Creativity in the design process: co-evolution of problem–solution. Design studies 22, 425–437.

Edwards, P., Bowker, G., Jackson, S., Williams, R., 2009. Introduction: An Agenda for Infrastructure Studies. JAIS 10, 364–374. https://doi.org/10.17705/1jais.00200

Edwards, P.N., 2003. P. Edwards 1 Infrastructure and Modernity Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems.

Garmann-Johnsen, N.F., Helmersen, M., Eikebrokk, T.R., 2020. Employee-driven digitalization in healthcare: codesigning services that deliver. Health Policy and Technology 9, 247–254. https://doi.org/10.1016/j.hlpt.2020.03.001

Grisot, M., Hanseth, O., Thorseng, A., 2014. Innovation Of, In, On Infrastructures: Articulating the Role of Architecture in Information Infrastructure Evolution. JAIS 15, 197–219. https://doi.org/10.17705/1jais.00357

Hanseth, O., Aanestad, M., 2003. Design as Bootstrapping. On the Evolution of ICT Networks in Health Care. Methods of Information in Medicine 42, 385–391. https://doi.org/10.1055/s 0038-1634234

Hanseth, O., Bygstad, B., 2017. The ePrescription initiative and Information Infrastructure in Norway. Information Infrastructures within European Health Care 73–87.

Hanseth, O., Lyytinen, K., 2010. Design theory for dynamic complexity in information infrastructures: the case of building internet. J Inf Technol 25, 1–19. https://doi.org/10.1057/jit.2009.19

Hughes, T.P., 1993. Networks of power: electrification in Western society, 1880-1930. JHU Press.

Jackson, S.J., 2014. Rethinking Repair, in: Gillespie, T., Boczkowski, P.J., Foot, K.A. (Eds.), Media Technologies. The MIT Press, pp. 221–240. https://doi.org/10.7551/mitpress/9780262525374.003.0011

Kensing, F., Greenbaum, J., 2013. Heritage: Having a say, in: Routledge International Handbook of Participatory Design. Routledge, pp. 21–36.

Klein, S., Schellhammer, S., 2017. Medication infrastructure development in Germany, in: Information Infrastructures within European Health Care. Springer, pp. 151–170.

Kyng, M., Mathiassen, L., 1979. A" New Systems Development": trade union and research activities. Sandberg (1979) 54–74.

Lanzara, G.F., 2014. The circulation of agency in judicial proceedings: Designing for interoperability and complexity, in: The Circulation of Agency in E-Justice. Springer, pp. 3–32.

Modol, J.R., 2017. Navigating towards self-care: the Catalan public patient portal, in: Information Infrastructures within European Health Care. Springer, pp. 173–192.

Mörtberg, C., Bratteteig, T., Wagner, I., Stuedahl, D., Morrison, A., 2010. Methods that matter in digital design research, in: Exploring Digital Design. Springer, pp. 105–144.

Mozaffar, H., Williams, R., Cresswell, K.M., Pollock, N., Morrison, Z., Sheikh, A., 2017. The challenges of implementing packaged hospital electronic prescribing and medicine administration systems in UK hospitals: premature purchase of immature solutions?, in: Information Infra structures within European Health Care. Springer, Cham, pp. 129–149.

Muller, M., Druin, A., 2007. Participatory Design: The Third Space In Hci, in: Sears, A., Jacko, J. (Eds.), The Human-Computer Interaction Handbook, Human Factors and Ergonomics. CRC Press, pp. 1061–1081. https://doi.org/10.1201/9781410615862.ch54

Nygaard, K., 1979. The iron and metal project: trade union participation. Computers dividing man and work 12, 94–107.

Pipek, V., Wulf, V., 2009. Journal of the Association for Information Systems Special Issue Infra structuring: Toward an Integrated Perspective on the Design and Use of Information Technol ogy*.

Ribes, D., Finholt, T., 2009. The long now of infrastructure: Articulating tensions in development 10, 375–398.

Roland, L.K., Sanner, T.A., Monteiro, E., 2017. Architectures of large-scale participatory design 33.

Sanders, E.B.-N., 2000. Generative Tools for Co-designing, in: Scrivener, S.A.R., Ball, L.J., Wood cock, A. (Eds.), Collaborative Design. Springer London, London, pp. 3–12. https://doi.org/10.1007/978-1-4471-0779-8_1

Schön, D.A., 1938. The reflective practitioner. New York 1083.

Schön, D.A., Wiggins, G., 1992. Kinds of Seeing in Designing. Creativity and Innovation Manage ment 1, 68–74. https://doi.org/10.1111/j.1467-8691.1992.tb00031.x

Titlestad, O., Staring, K., Braa, J., 2009. Distributed development to enable user participation: Multi level design in the HISP network. Scandinavian Journal of Information Systems 21, 27–50.

Vassilakopoulou, P., Marmaras, N., 2017. Cultivating the Installed Base: The Introduction of e Pre-scription in Greece, in: Information Infrastructures within European Health Care. Springer, Cham, pp. 89–108.

Walsham, G., 1995. Interpretive case studies in IS research: nature and method. European Journal of Information Systems 4, 74–81. https://doi.org/10.1057/ejis.1995.9