Interoperability and Convergence for Welfare Technology

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Abstract. Interoperability and convergence are two key features of any working sociotechnical infrastructure that includes a plurality and multiplicity of communities of practice using technologies. However, as information systems scale up and the heterogeneity of users increases, it becomes challenging to actualise interoperability and convergence. When it comes to welfare services, the development of interoperable information systems and converging communities of practice is key to the quality and efficiency of services, both for practitioners and users. This paper elaborates on these concepts and their practical relevance by presenting and discussing data from a research project on ageing and welfare technology in Sweden. A participatory approach is meant to act as methodological support for the actualisation of interoperability and convergence even though socio-organisational and political constraints cannot be fully overcome once for all.

Keywords: Communities of practice · Cooperation · Infrastructuring

1 Introduction

In this paper, I elaborate on the concepts of interoperability and convergence: why do they matter to welfare technology for older people? How can we actualise them? From an STS perspective (Science and Technology Studies), interoperability and convergence are important in order to guarantee the basic ability of computerised systems to exchange and share data while framing them as part of a wider ecology of artefacts, human beings, and practices [23]. Interoperable information systems and converging communities of practice are key to the quality and efficiency of technology-based welfare services and to developing a working sociotechnical infrastructure [19].

This article is based on an ongoing research project on ageing and welfare technology in Sweden. The project is meant to be the driver of a cooperation between researchers and public authorities. The research activities are conducted according to a participatory approach [21] aimed at engaging the elderly, professionals, and municipal personnel in developing a common action plan for leading innovation in welfare technology. I focus on interoperability and convergence as crucial aspects emerged during the interview with one municipal project manager responsible for leading the design and implementation of a remote monitoring service mediated by a night camera installed in the private homes of elderly. It should be noted that interviews are not

properly a participatory activity and, in this project, they have been limited to an initial explorative phase. Furthermore, the participation of the elderly as well as the activities conducted with them are not discussed in this paper, which is more focused on interoperability and convergence from the practitioners' point of view.

The paper is organised as follows. After an introduction of what 'welfare technology' is and how it is associated with the role of public authorities in Sweden, I draw from STS the concepts of 'interoperability' and 'convergence' and connect them with welfare technology. Then, I present the research project and the methodology by specifying which objects and people are involved in the development of the remote monitoring service and how they are related. Finally, I discuss how and why interoperability and convergence matter to welfare technology by articulating a reflection on how a participatory approach can support their actualisation. The conclusion opens up to a further reflection on the potentialities and constraints of applying a participatory design to develop a working sociotechnical infrastructure aimed at delivering quality and efficiency in welfare services.

2   Related Work

Nowadays, technology penetrates the lives of people in different ways and to varying degrees [14]. Networked computerised systems have a key role in enhancing connections, speeding up communication, and supporting data sharing. Such a technological development affects both individuals and organisations, and all type of industries, with healthcare and welfare being no exceptions.

In the Nordic countries, the digitalisation of health care and social services falls under the umbrella term 'welfare technology'. The Nordic Centre for Welfare and Social Issues [15] explains that the term 'welfare technology' is mainly used in Scandinavia (i.e., Denmark, Norway, Sweden) to improve the services provided by welfare society and increase their efficiency. This has been identified as one of the most pressing challenges to be addressed globally, given a rapidly ageing population. It is in fact estimated that by 2030, people over the age of 65 will represent about 24% of the population in Europe, 22% in the United States, and 12% in Asia and Latin America [4]. With this time horizon in mind, technology is frequently positioned as a promising response or even the solution to the increasing pressure on rising health and care costs and the efforts to achieve a more active and independent ageing [17].

In Sweden, welfare technology is limited to targeting the elderly in line with a more traditional assistive technology thinking [22]. The difference between the concept of welfare technology and assistive technology (AT) relies on the main role of public authorities in innovating and delivering services by using technological solutions which, however, are those we find in the literature about AT and e-Health. Regarding e-Health, the 'e' refers to a vast data collection, storage, and the performance of complex tasks quickly and reliably [6]. The concept of welfare technology fits with the field research conducted in Sweden and presented in the following pages. In Sweden, county councils and municipalities are obliged by the Health and Medical Services Act to supply people with AT [7]. Occupational therapists, physiotherapists, and physicians are responsible for prescribing different types of products by assessing the individual needs.

The assessment includes the need for home modification (for example, when installing a video camera or any other device) to ensure the person is able to use the device properly and safely, as well as informing, instructing, and training the user, and following up and evaluating the prescription [10]. The political strategies during the past decades have been targeted at enabling the elderly to age in their own homes by supplying them with home care services [18]. This welfare system combined with a longer life expectancy, a projected increase of people with chronic illnesses and ageing at home implies a financially dangerous future for Swedish public authorities [22].

The multiplicity of professionals and organisations involved in welfare care, the plurality of technologies used for delivering services, and the overarching welfare model generate a set of problems and opportunities that STS help to understand. In the following section, welfare technology is framed according to a sociotechnical perspective while connecting it with the STS discussion on infrastructure.

3 Welfare Technology as a Sociotechnical Infrastructure

In the field of STS, the concept of infrastructure refers to interrelated technical, social, and organisational arrangements involving people, technologies, standards, procedures, practices, and policies [3, 9]. This interrelation can be defined as sociotechnical as it includes both physical entities as well as the role of multiple and heterogeneous actors (human and non-human) [19]. Looking at welfare technology as a sociotechnical infrastructure goes beyond a view that matches a service only to its technological components, and opens up to an analysis of its social, organisational, *and* technological complexity.

With such a plurality, issues of interoperability and convergence should be on the minds of all actors, especially those taking decisions that might affect the quality and efficiency of the processes overall. However, interoperability and convergence refer to two different though related features of a working sociotechnical infrastructure. While 'interoperability' is defined as the "capability of various systems to share data or functionalities" [8: 33], that is, a pure matter of integration of information systems [25], 'convergence' refers to the process by which those systems and communities of practice are interrelated and together generate a working infrastructure [23].

A 'community of practice' consists of a group of people who share conventions, language, ways of doing, and technologies [11]. In the field of welfare technology, the use of information systems implies the interactions between different communities of practice. For example, a team working on designing a care service at the municipal level, and a team working for defining other aspects of the same service but at hospital, might represent two large communities of practice sharing knowledge, procedures, and tools. However, these communities might include many other communities of practice sharing specific knowledge, experiences, routines, and objects: for example, the technicians working on the technological side of the service; the community of home-care personnel that visits and takes care of the elderly at home; the medical staff that defines the rehabilitation plan. A community of practice cuts across formal organisations so that people can belong to different communities: for example, home-care personnel can be part of both a larger municipal team working on a specific care service, and also of a smaller group of professionals working in a particular area of the wider municipal territory.

Given the heterogeneity of communities of practice, the service development relying on their cooperation can face some problems associated with interoperability, transparency, and convergence. In fact, in health care, as well as in welfare care, interoperability is often a big challenge. [16] maintains that "the greatest challenge to interoperability is that there is not just one challenge (…) Exchanging health information between organizations (…) requires multiple systems and parties to cooperate simultaneously". Interoperability partially describes the situation to deal with, which, indeed, is also social and organisational in nature. The concepts of transparency and convergence are helpful to dig into these criticalities. It is noteworthy that what is 'transparent' [25] and taken for granted by the members of one community might not be equally clear or easy to use for others communities. Transparency is all the more problematic when the information systems of the service scale up from a single user to a community to more than one community. The level of complexity increases and a number of changes are required in order to keep the transparency while individuals and communities of practice are working together. However, due to such a multiplicity, transparency is inherently non-existent in the real world while convergence is possible through processes of negotiations and translations [23]. In order for an infrastructure to develop with people and processes converging, multiple translations are needed [12]. 'Translation' is a triangular operation that generates ordering effects. It involves a translator, something that is translated, and a medium in which that translation is inscribed. In other words, translation is a multifaceted interaction in which the actors construct – through the translator – common definitions and meanings and co-opt each other in the pursuit of individual and collective purposes. Convergence measures the extent to which the process of translation leads to agreement. A successful process of translation generates a shared space of knowledge and practices (i.e., it aligns), while an unsuccessful translation leads to a misalignment that finally compromises quality and efficiency and eventually the service users' satisfaction.

An important part of the process of translation is the definition of standards, rules, or conventions that limits the number of accepted translations and favours the convergence. All the codifying regulations are forms of coordination and they are integral parts of an infrastructure. Through them, members of different communities of practice can cooperate, converging around a common 'language' or *modus operandi* [24]. However, the sociotechnical infrastructure should remain open to further changes and then new translations.

4   Research Project and Methodology

The research project is meant to be the driver of a cooperation between researchers[1] and practitioners working on welfare technology in two regions of Sweden. The research activities are conducted according to a participatory approach [21] to engage the elderly,

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[1] The author is one member of this research group as well as one of the two principal investigators. The project spans from January 2017 until December 2018 and it is financed by Vinnova, the Swedish innovation agency. The research activities are also supported by local partners such as Samhällskontraktet and Regionförbundet Sörmland.

professionals, and personnel from two municipalities, one per region, in developing a common plan of action for leading innovation in welfare technology. Such a plan of action can be better described in terms of a sociotechnical infrastructure as it mobilises and relies on the cooperation between multiple and heterogeneous communities and individuals, technologies, standards, procedures, practices, and policies.

A number of semi-structured interviews have been conducted with the practitioners, as well as participatory workshops with them and older people in both municipalities in order to collect information and data relevant to the implementation phase. In this paper, I focus on interoperability and convergence as crucial aspects clearly emerged during the interview[2] with the project manager in one of the two municipalities involved (henceforth: the municipality). Here, I complement these data with other collected information about the technology-based service discussed on that occasion. The conversation touched upon the installation of 25 night cameras in the private homes of the elderly during 2018. The emerging reflections led to a more empirical discussion and, in line with a qualitative methodology, the relevance of these results allows us to extrapolate [1] and transfer [13] the findings to the wider field of welfare technology.

4.1 Field Work

At the time of the interview, the municipality was formulating its strategy to deliver a home-help service based on remote monitoring via camera during the night.

The Equipment. The equipment consists of a camera linked to a router, in order to get access to the Internet. The remote monitoring via the camera is described in a brochure, published in Swedish, English, Finnish, and Arabic, which correspond to the main languages in Sweden:

> Home-help staff use the camera to check on you at agreed predetermined times. You agree what staff should do if you are not in bed. When staff check on you via the camera, the green light flashes. The camera does not make any noise that could disturb you. The camera does not record or save any images, and it is not active between monitoring checks. Remote monitoring is suitable for those who want to be able to sleep in peace and safety, without being disturbed during the night by home-help staff unlocking their door and coming into their home. Remote monitoring is based on a decision for assistance in the same way as home-help services.

The functioning is also explained in a video[3] reporting the experience of an 85-year-old woman as the user of a night camera installed in her bedroom, which is also the home space where the device is most often installed (see Fig. 1).

The Home-Care Personnel. The functioning of the technical equipment is supplemented by the possible intervention of the home-help staff, who, as reported in the brochure, are equivalent to a night patrol team. Currently, there are ten teams of two people each, working in different geographical areas. As specified in the brochure, the

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[2] The interview (length: 1:49:13) was conducted in English, recorded, and then transcribed.

[3] Video (in Swedish): https://www.youtube.com/watch?v=2LHwv25pKPc Researchers have translated the video from Swedish to English. The interviewee is not among the people who appear in the video.

Fig. 1. Camera in a bedroom (from the website of the municipality)

"remote monitoring is based on a decision for assistance in the same way as home-help services" meaning that people interested in getting access to the service associated with the night camera have to apply online or call the assistance officer. The municipality contacts the applicants, and it is then the care officer who assesses and decides upon the case. If the night camera can be ordered, the users have to give their home keys to the municipal personnel.

It is noteworthy that the home-help service mentioned in the brochure refers to a security alarm system (about 2,300 already installed) that enables an alert to be sent in case of need and an immediate intervention to be carried out independently of the night camera, which represents the future improvement. The alarm is triggered by pushing a button applied to a pendant or bracelet. When a need for assistance arises suddenly, the person has to push this button. Then a signal is transmitted to an alarm group (*Larmgruppen*) working 24/7. The alarm group informs the care personnel who go to the patient's home as soon as possible and within 40 min. If required, the ambulance is also alerted simultaneously.

The Sociotechnical Processes. The interview with the project manager provides further details about the night camera, and how 'the social' and 'the technological' are currently interrelated.

According to the interviewee, the municipality is striving to compensate for the shortage of home-care personnel while reducing the stress especially for employees working at night:

> I [the manager] tried one time. I went during the night with the personnel and it feels like a weird job (…) I understand the patients' need, it can be something like psychological reasons, some people just wanted someone to check in on them, but they didn't need any help (…). Some people really needed help to stand up and go to the bathroom, but it was so weird to see those [the personnel] that just needed to just 'look up' and just check that they [the elderly] were

breathing (…) we think it will save a lot of time and [it will be better] also [for] those people who (…) don't need to be woken up […] so in the end, the sleep quality will be very much better, I think.

From the organisational perspective, the digitalisation of home-care is expected to reduce the workload of the personnel (with special regard to the night patrol team) and improve users' life quality. In other words, digitalisation is meant as a sociotechnical process that aims at interconnecting people (both carers and service users) and objects (technologies and other relevant devices) as sketched by the interviewee (see Fig. 2).
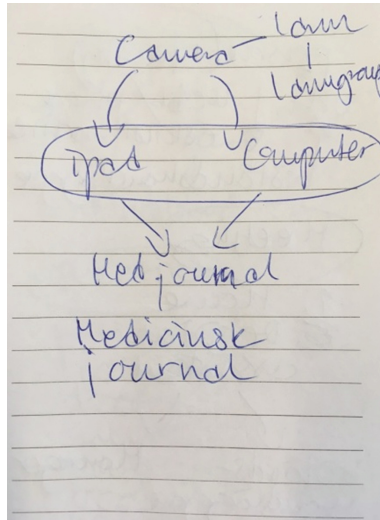

Fig. 2. The sociotechnical process

This representation makes clear that the night camera is interoperable with the existing alarm system, which, in case of need, alerts the nigh patrol or the alarm group if the alarm is sent via the alarm button rather than being recorded by the camera. In fact, as specified in the brochure, the camera "is not active between monitoring checks" while the alarm system is functioning 24/7, also independently of the night camera. The camera is also connected to an Ipad and a computer, which, in turn, communicate with the municipal information system. 400 iPads have been delivered to the municipal home-care personnel that regularly visit older people at home at night or during the day. The same personnel can use the computer at the office to manage the patients' medical records online (i.e., *Patientjournalen,* which the interviewee called *medicinsk journal* in her sketch and corresponds to 'EHR-Electronic Health Record' in the international literature). The personnel can log in to the system via iPad or computer and then update the patients' medical records.

However, the interoperability is limited to the municipal information systems and, as the interviewee said, this is relevant to understand the difficult cooperation between the welfare and healthcare communities of practice that assist the same patients.

Respondent: we don't have any national guidelines to be able to talk to different systems (…) we can't see what they do at the hospital [i.e. healthcare], they have to call us [i.e. welfare], actually the doctor (…) and then maybe the nurse that picks up [the patient] will write the medical record.

Interviewer: so, when you [i.e. welfare] need to collect information about a specific patient who is, let me say, within a different system, you need the intervention of a nurse [i.e. healthcare], for example, in order to complement and complete the information in your municipal system…

Respondent: yeah, yeah. It's a weird system.

The manager hopes that the new European General Data Protection regulation (GDPR), coming into force on 25 May 2018 (eugdpr.org), will be the push that is needed to translate and make interoperability in welfare and healthcare an imperative. Such a change would be another step forward to increase the quality and efficiency of the services as well as the personnel's commitment, which is crucial given the shortage of resources. The interviewee highlights the fact that interoperability ultimately influences the social and organisational processes, especially because there is no possibility of transferring information collected through the camera to the EHR yet: this gap risks causing a further overload for the personnel, at least in the first period of the implementation, and compromises the chance of making the different communities of practice converge in managing data.

We are trying to think about the motivation for the personnel (…) Even though they are positive, the implementation process may take longer (…) [For now, the personnel] still have to duplicate and write everything into our system. You feel like it's letting your personnel ['s motivation] down (…) It's as if [the personnel say] "Okay, so I'm doing two things now? It's supposed to be quicker you [the manager] said, but I'm doing two things" (…) if you add that, they [the municipal personnel] (…) have to maybe call someone to add the information because they can't access it within the general medical records [used by the municipality] (…), it's key to have the systems working together.

The research documentation and data enable us to elaborate on why the concepts of interoperability and convergence matter to welfare technology and how they can be facilitated. The discussion focuses on how such concepts can inform the development of a working sociotechnical infrastructure, though constraints cannot be fully overcome.

5   Discussion

Interoperability and convergence have been troubling STS scholars [e.g., 23, 25] as well as information scientists in human-computer interaction [e.g., 2, 5] for years. However, while the literature associates interoperability with aspects that are easily recognisable in contemporary digitised society (e.g., applications, database), convergence is often abstractly described (e.g., a process of mutual constitution, a result of membership) making it difficult to grasp its meaning while increasing the risk of confusing it with interoperability. Understanding why interoperability and convergence actually matter to sociotechnical phenomena, like the monitoring via camera, calls for the communities of practice to engage in a participatory sense-making process that allows them to clarify their perspectives and possibly reach a final consensus on how to translate interoperability and convergence into practice. Why interoperability and convergence matter to welfare technology and how to actualise them depend on the communities' plans of

action that ultimately are derived from the circumstances in which those communities work, including the resources they can rely on. For example, the working time allocated to the municipal personnel to work on welfare technology issues is crucial as it influences the actual engagement. From this perspective, interoperability and convergence are not cognitive achievements or exclusively the results of technical operations. Instead, they are context-dependent relational accomplishments.

In the case at issue, the European General Data Protection regulation might exert powerful leverage for pushing individuals and their communities to converge. However, such an external force does not necessarily trigger the process of translation that is needed for aligning and then generating a working sociotechnical infrastructure at local level.

With regard to the relation between infrastructuring and convergence, [25: 82] specifies that convergence "is the double process by which information artifacts and social worlds are fitted to each other and come together". The authors argue that infrastructuring processes correspond to "a lot of hard work involving smoke-filled rooms, and boring lists of numbers and settings" (50). Classifications and standards are the results of this hard work that makes infrastructuring possible. [23: 41] says that the "infrastructure simultaneously represents work and effortlessly supports it making possible collective accomplishment". A collective accomplishment – meant as the convergence to a consensus – is the final result of a complex process of negotiation between heterogeneous individuals and their communities. However, in such a scenario, the commitment to hard working cannot be taken for granted because of the contingencies and plurality of communities that in the worst case hinder even the possibility of starting to cooperate. This consideration applies both to interoperability and convergence, which are key to improving the quality and efficiency of welfare technology in practice. From this point of view, it is clear that generating commitment to collaborating is the ontological foundation of the interoperability and convergence as collective and practical accomplishments that in turn are constitutive of infrastructuring. In other words, the generation of collaborative spaces – materially and temporally speaking – is the prerequisite for the achievement of a working infrastructure. It is noteworthy that convergence, in particular, does not imply the erasure of pressures and tensions. Convergence is fully situated and it is neither natural nor unproblematic. Different perspectives and priorities are at work when multiple communities and objects interact so that the degree of alignment achieved becomes more subject to contention. Similarly, interoperability is much more than technicalities and the most knowledgeable insiders know it. For example, Rupp [20] of the Electronic Health Reporter quotes the CEO of an important American group in the field of healthcare technology and services markets who was asked how interoperability is critical to healthcare innovation:

> The best medicine is a good conversation. If you treat interoperability as a philosophy rather than a standards-based interaction between computer systems then we change our thinking about what a meaningful and useful conversation is. On the technical side, we start to find ways to compress the time it takes and even eliminate much of the unneeded conversation through the interaction of machines. On the people side, the resulting value frees up time to allow patients and providers to optimize wellness in the most economical way through a streamlined yet more meaningful engagement by both patient and the provider team. Changing the geometry of our

conversations to produce wellness rather than just treating an episode of disease is at the core of most patient engagement strategies evolving today.

In Sweden, welfare technology services and the related responsibilities are decentralised, which may provide a lot of benefits, allowing each region (and then the local public authorities) to acquire the type of system based on their own needs, but it can also cause a lot of technical, technological, and more nuanced socio-organisational problems. Facilitating the cooperation through a participatory approach can be beneficial to develop interoperable information systems that reasonably embody and make recognisable the communities' area of expertise, practices, and collective identity. As long as the final result of a cooperation process is not an unjustified compromise representing a power imbalance between the involved communities of practice, the possibility of generating a working sociotechnical infrastructure increases substantially because the individuals can anyway recognise themselves and their communities in the collective accomplishment.

6   Conclusion

The possibility that changes occur and that new processes of translation and negotiation are needed in order to keep the infrastructure working opens a discussion about the physiological uncertainty of organisational processes and how to deal with it. A partial commitment and fragile interoperability and convergence today can seriously compromise the future ability of the involved communities of practice to continue working together and collaboratively face unpredictable events and circumstances that slip out of their control but affect their plans of action.

A participatory process aimed at facilitating the cooperation between multiple and heterogeneous communities of practice should constantly frame such a purpose in the temporality, spatiality and relationality of the cooperation itself. Participatory design implies improving the participants' commitment to generate both short- and long-term situated cooperative practices of infrastructuring, that is, practices for generating, substituting, and maintaining interoperable information systems and converging processes relevant to specific communities. From this point of view, the result of a participatory process is in the process itself: not in the researchers' intentionality or in the individuals' participation, but it depends on both of them and on the contingencies that influence their interaction. Researchers have to be aware of possible disadvantages connected to a participatory design approach that is time-consuming, related to their capabilities of working with people, and ethically sensitive. In this regard, applying a participatory approach calls for the participants' contribution to be recognised and made visible. This is a matter that interrogates the nature of an infrastructuring process and how much it eventually embeds power dynamics. Especially in the field of welfare technology, participatory design can be meant as a means to radicalise and democratise influence and a critical view on health and wellbeing by bringing into the process different voices and the related multiple practices and organisational identities that are key to interoperability and convergence.

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