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Designing an infrastructure for sharing of data generated by welfare technologies.

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Abstract. The analysis of WT-generated data holds significant potential to enhance care quality, well-being, safety, efficiency, and decision-making in healthcare settings. This ongoing research focuses on investigating the key challenges associated with designing an infrastructure for sharing WT data in Swedish municipalities. Our findings highlight various obstacles, including conflicting stakeholder needs, limited experience in data analysis and visualization, unclear ownership of data and systems, and the complexity of the technical environment. The implemented WT systems consist of alarm solutions with additional optional features and a data platform that presents information to stakeholders based on the providers' chosen aggregation and interface. To effectively utilize WT-generated data, a viable approach for municipalities is to assume overall responsibility for a governance model encompassing both social and technical aspects. This approach aligns with the perspective of service innovation and service logic (Lusch and Nambisan, 2015), which emphasizes the value derived from usage and focuses on the processes of serving rather than product exchange.

Introduction

European countries face challenges due to an aging population and limited resources, jeopardizing existing care systems. To address these challenges,

governments have prioritized digitalization in elderly care. Welfare technologies (WT), such as digital safety alarms, monitoring devices, and sensors, are now widely implemented (Scott & Mars, 2013; Heine & Winther Wehner, 2012), generating vast amounts of data that often remain underutilized in care institutions. Effectively managing WT-generated data represents the next phase of development, with the potential to enhance care quality, safety, and efficiency, as emphasized in strategic EU documents (European Commission, 2018) and national initiatives like Sweden (SKR, 2022).

Existing research on WT for elderly care primarily focuses on technological aspects, addressing physical issues and individual safety (Frennert & Östlund, 2014; Yu et al., 2018; Liu et al., 2020). However, there is limited understanding of value creation and the use of WT-generated data to support decision-making at the organizational level. Bridging this research gap is crucial as analyzing WT-generated data has the potential to enhance care quality, well-being, safety, efficiency, stress reduction, and decision-making in both practice and management.

This research-in-progress aims to explore the challenges in designing a data sharing infrastructure for WT-generated data in Swedish municipalities. Elderly care in Sweden is government-provided, based on a state responsibility model that emphasizes equality, social inclusion, and the universality of public services (Dykstra, 2018). Sweden exhibits a high level of digital development at a macro level, with relatively high digital literacy among older adults. The Swedish government has actively promoted the digitalization of the care sector.

Digital infrastructures

An infrastructure serves as a community resource (Ribe and Finholt, 2009) by enabling local practices through a larger-scale technology that can be readily utilized (Star and Ruhleder, 1996) to fulfill user values. Infrastructures exhibit characteristics such as openness to diverse users, interconnected modules and systems, and an evolving range of services within an ecosystem shaped by existing systems and practices (Monteiro et al., 2012). Key qualities of an infrastructure include adaptation to its environment and longevity in an ecosystem by fulfilling a specific role over time (Henfridsson and Bygstad, 2013).

Referred to as digital infrastructures (Henfridsson and Bygstad, 2013; Constantinides and Barrett, 2015), information infrastructures (Hanseth and Lyytinen, 2010), or e-infrastructures (Ribe and Finholt, 2009), these infrastructures are characterized by a shared, evolving, and heterogeneous installed base of IT capabilities among multiple user communities, based on open and/or standardized interfaces (Hanseth and Lyytinen, 2004). A key aspect of such infrastructures is their incorporation of both social and technical components (Hanseth and Lyytinen, 2010; Vaast and Walsham, 2009). Therefore, the design

of an infrastructure for sharing WT-generated data must consider both the technical and social aspects, which we explore in this study.

Research design

This research-in-progress is part of a larger project conducted in collaboration with practitioners using an Action Research (AR) approach (Susman & Evered, 1978; Davison et al., 2004) in Sweden. The focus of this paper is on the initial step of the AR project, referred to as the Diagnosing phase, which aims to understand and define the problem of utilizing WT-generated data for improving quality, safety, and efficiency in elderly care.

Following the principles of AR, this study involved in-depth qualitative research conducted in close collaboration with various stakeholders, including managers, therapists, nurses, residents, carers, IT department, and landlords. Qualitative methods such as document analysis, focus group interviews, individual interviews, and observations were employed to collect data, enabling a comprehensive understanding of the technical and social challenges related to sharing and utilizing WT-generated data. Data was collected at both the micro-level (care institutions) and macro-level (municipality).

Two specific WT implementation cases were followed in the studied municipality: Tena Identifi and Oxevision. These implementations were observed over periods of one month and six months, and data was collected through interviews with nurses, occupational therapists, and care institution managers, as well as through focus group interviews, observations, and document analysis of technical descriptions, statistics, policies, and work descriptions.

Tena Identifi is a sensor-based solution that aids incontinence assessments by recording an individual's urine leakage over a 72-hour period. The system generates a detailed report that provides insights into individual leakage patterns and urine volumes, which can be used to inform decision-making regarding care activities, customization of care according to residents' needs, selection and use of incontinence protection, and staff planning.

Oxevision, on the other hand, is a sensor-based solution incorporating a regulated medical device with an infrared-sensitive camera. It helps staff visually confirm patient safety, measure pulse and breathing rates, and respect residents' privacy and sleep. The system can be customized to meet individual needs and generates various types of data, including activity reports and statistics. These reports enable staff to understand residents' movement patterns and plan activities accordingly, supporting care planning, medication administration, and overall care provision.

Current socio-technical infrastructure

In the investigated municipality, there are 25 nursing care homes operating independently. Landlords are responsible for the physical infrastructure in the buildings, including door opening systems, fire alarms, and analogue networks. All care homes have alarm systems for resident safety in emergencies. Currently, 22 out of the 25 care homes use an outdated analogue alarm system.

Alarm system providers are now transitioning to digital systems with advanced features like camera monitoring, door unlocking, positioning sensors, and fall prevention. Consequently, the outdated alarm system in most care homes will soon need replacement. However, the municipality lacks a unified strategy for the replacement process, leading care institutions to take individual initiatives. Three care homes recently implemented new digital alarm systems from different providers.

Figure 1 illustrates the socio-technical infrastructure of one care home that implemented the Oxevison system, representing the overall situation in the municipality.

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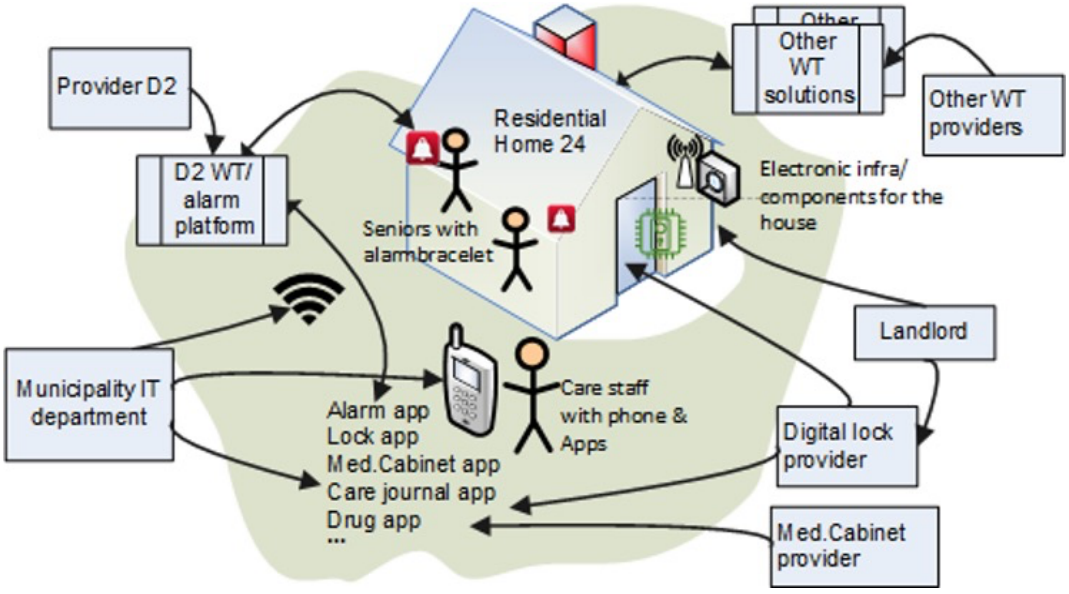

Figure 1. The socio-technical infrastructure at one of the care homes

As mentioned, the landlord handles the building's physical infrastructure, while the municipality's IT department manages the technical infrastructure, including WiFi, administrative systems, and mobile devices for staff. The IT department is not responsible for primary maintenance of the new alarm system (D2 WT/alarm

platform). Instead, each care home collaborates directly with the alarm system provider (Provider D2). Care home managers currently face challenges in formulating requirements and procuring the new alarm system due to limited technical understanding and integration needs. Additionally, besides evolving alarm systems, other WT solutions like Tena Identifi (mentioned as "other WT solutions" in Figure 1) offer opportunities to enhance care quality and resource management.

Based on the analysis of the existing socio-technical infrastructure in the municipality we have identified a number of challenges for designing an infrastructure for sharing of data generated by WT on both social and technical levels as for instance:

- Diversified and complex technical environment.
- Inflexible technical infrastructure provided by the municipality, which hinders the addition, modification, alteration, and removal of wearable technologies (WTs) to meet different needs.
- Lack of standardized functions for data aggregation, interface, and visualization.
- Unclear responsibility and ownership structures.
- Unclear legal requirements regarding the sharing of WT-generated data.
- Lack of knowledge and understanding among key stakeholders regarding the potential use of WT-generated data to enhance care quality and efficiency.
- Lack of a tradition in using WT-generated data for decision-making purposes.
- Lack of tradition of using of WT-generated data for decision-making

Future work

To enable the municipality to utilize WT-generated data, a recommended approach is to adopt a governance model that encompasses both the social and technical aspects in line with the service innovation and service logic perspective (Lusch and Nambisan, 2015). This model should include standards for WTs and infrastructure, define roles, responsibilities, and processes, and provide guidance and contracts for interorganizational cooperation and interfaces.

The service logic emphasizes the concept of "value in use" and focuses on the serving processes rather than the output in form of a product. This perspective aligns with the values of public sector care for the elderly. Service innovation complements the socio-technical perspective and supports the design of a socio-technical infrastructure by shifting the focus from user-specific solutions within separate organizations to value creation within a community of actors with a shared worldview.

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