Socio-Technical Challenges in Implementation of Monitoring Technologies in Elderly Care

Ella Kolkowska[1(✉)], Anneli Avatare Nöu[2], Marie Sjölinder[2],
and Isabella Scandurra[1]

[1] Örebro University School of Business, Örebro, Sweden
{ella.kolkowska, isabella. scandurra}@oru.se
[2] SICS Swedish ICT, Kista, Sweden
{anneli,marie}@sics.se

Abstract. Although new monitoring technologies (MT) supporting aging in place are continuously developed and introduced on the market, attempts to implement these technologies as an integrated part of elderly care often fail. According to the literature, the reason for that may be the prevailing technical focus applied during development and implementation of monitoring technologies in real settings. The aim of this paper was to investigate the socio-technical challenges that arise during implementation of monitoring technologies in elderly care. We used a qualitative case study and semi-structured interviews to investigate socio-technical (S/T) challenges in implementation of monitoring technologies generally and social alarms especially. Based on our findings we suggest a framework for classification of S/T challenges arising during implementation of monitoring technologies in elderly care and in this way this paper contributes to a better understanding of these challenges.

Keywords: Monitoring technologies · Social alarms · Assistive technologies · Socio-technical aspects · Elderly · Security · Safety

1 Introduction

Utilizing monitoring technologies (MT) the caregivers can receive information about activities and the status of different entities in the home where an elderly person lives alone [1]. Continuous monitoring gives the caregivers the opportunity to quickly react in case of emergency and in this way increase their own and the elderly person's sense of safety and security [2]. The rapid development of MT and technologies generally supporting aging in place creates possibilities for new and more efficient solutions enhancing elderly people's quality of life through improved outcomes in safeguarding, living standards, social interaction and independence [1]. Such solutions also reduce workload for caregivers and decrease the costs for elderly care for the society [3]. Nevertheless, MT are not commonly adopted as a part of elderly care of today [4].

According to recent literature [4–7], the reason for that might be ignoring socio-technical (S/T) aspects in development and implementation of MT into everyday life. Various scholars [5–7] argue that MT, developed with a techno-centric perspective, are not able to address the needs that arise in complex social environments.

This is a common reason for the failure of many projects attempting to implement such technologies as a part of elderly care [6, 8]. Others [4, 5] argue that real-life implementations can be successful if we better understand potential S/T challenges in this context. Unfortunately, literature reporting on lessons learned regarding implementations of MT in real-life settings is still very scarce [4, 8, 9].

Against this backdrop, the aim of this study was to investigate the S/T challenges in implementation of MT in elderly care. By proposing a framework for categorizing S/T challenges that arise during implementation of MT in elderly care, this paper contributes to an increased understanding of S/T challenges in this context.

2   Related Research

Applying the S/T approach means that social and technical aspects are equally important in development and implementation of technology [10, 11]. Therefore, such development processes do not only focus on technical aspects, but also consider social, organizational and human needs [12]. In short, the S/T approach focuses on how individual and social requirements can be met by the design of technology.

In the paper "The Sociotechnical Challenge of Integrating Telehealth and Telecare into Health and Social Care for the Elderly", Eason et al. [5] investigated why common adaptation of telehealth has proven to be difficult and why, although having a great potential, the new technology does not contribute to improved healthcare in the community. The authors studied 25 health communities in England and found that most of the attempts to implement telehealth and telecare as an integrated part of elderly care failed. The authors concluded that the obstacles for a successful implementation of telehealth and telecare were not only of a technical nature, but equally important was the consideration of S/T aspects [5].

Other authors [1, 6, 8] also emphasize the importance of considering S/T aspects in implementation of technology in elderly care. McKenna et al. [1] investigated deployment of social alarms (Personal Emergency Response Systems) in elderly people daily lives and found that one of the major problems experienced by elderly was unclear decision-making around social alarms activation. Regarding the results, a technical focus in development and implementation of assistive technologies results in poorly designed solutions that do not address user needs, or are not suitable for the task they were meant to support [6]. Vichitvanichphong et al. [8] and Peek et al. [9] identified factors influencing adoption of technologies among elderly people through two separate literature reviews. Vichitvanichphong [8] found that some of the factors were related to technology, but there were also many social and individual factors such as *compatibility with seniors' values or compatibility with the life style* that affected adoption of technologies among the elderly. Peek et al. [9], identified 27 factors influencing adaptation of technologies supporting aging in place in the pre-implementation stage. The authors divided the factors into six themes: (1) concerns regarding technology (e.g., high cost, privacy implications and usability factors), (2) expected benefits of technology (e.g., increased safety and perceived usefulness), (3) need for technology (e.g. perceived need and subjective health status), (4) alternatives to technology (e.g., help by family or spouse), (5) social influence (e.g., influence

of family, friends and professional caregivers) and (6) characteristics of older adults (e.g., desire to age in place). Additional factors identified by the authors in the post-implementation were for example satisfaction with technology and affect towards technology. As we can see most of the factors were of a S/T nature. Therefore, although literature on implementation of technology for aging in place is generally scarce [4, 8], we found some publications showing that the complexity of S/T relationships cannot be ignored in this context. In this study, we investigated S/T challenges in implementation of MT in elderly care in general and implementation of social alarms in particular.

3   Research Method

The empirical part of this study was conducted in two stages applying a mixed method approach [13]. Our ambition was to include a broad range of stakeholders to be able to study S/T challenges from different perspectives. The two stages and related empirical data methods are presented in Table 1.

Table 1. Empirical datasets

	Stage1	Stage2
Focus	To identify S/T challenges in implementation of MT in elderly care generally	To identify S/T challenges in implementation of indoor and outdoor social alarms
Method	Semi-structured interviews, focus group interviews	Case study, Open-ended interviews, focus group interviews
Subjects	Municipalities officers, home care personnel, relatives, users, IT department staff	Municipalities officers, IT-department, users, relatives, home care personnel, alarm operators
N	9 semi-structured interviews, 4 focus groups (approx. 10 in each group)	16 open-ended interviews, 3 focus group interviews (approx. 5 in each group)

3.1   Stage 1: Identifying Socio-Technical Challenges in Implementation of MT in Elderly Care

In the first stage, nine representatives of stakeholder groups that were involved or affected by implementation of MT were interviewed with focus on challenges related to implementation of such technologies in real settings. In this stage we also conducted four focus group interviews with potential users and their relatives. The focus group method allowed the respondents to build upon responses from other group members and in this way topics were discovered that otherwise may be missed [14]. According to literature, modern technology is often experienced as complex and abstract by elderly people [15]. To reduce this feeling, each focus group was invited to a Research and Innovation Apartment where some examples of MT were demonstrated. Individual interviews and focus group interviews were structured on similar themes. The informants were asked to describe their expectations, feelings, ideas about MT's role in

elderly care, whether they see any benefits and/or problems related to use of such technologies. During the interviews, scenarios were sometimes used to aid the communication. Each individual interview lasted approximately one hour, focus group interviews lasted approximately two hours.

3.2   Stage 2: Identifying Socio-Technical Challenges in Implementation of In-Door and Outdoor Social Alarms

In the second stage, the work was conducted as a collaboration between SICS Swedish ICT and four municipalities in Sweden (see Table 2) [16]. The municipalities in the case study were selected to reflect the social alarm field from diverse needs and different circumstances. A traditional social alarm is an alarm device that is installed in a user's home and makes it possible for a user to call for help in urgent situations at home. In order to identify S/T challenges it was important to understand attitudes towards the alarm and how the entire alarm chain (it starts when an alarm holder presses the alarm button and ends when staff from home care visits the alarm holder) was working. We also investigated needs and attitudes among all relevant stakeholders and the interaction between stakeholders. Another thing that is important in this context is the process of procurement and requirements around social alarm. Open-ended interviews were conducted with managers in the municipalities, personnel at alarm centers, and alarm holders. Furthermore, alarm operators and other personnel were interviewed at alarm centers. Approximately 2–3 alarm holders, in each municipality, 1–2 managers, staff members, and alarm operators were interviewed. During all interviews, the researchers took notes.

In this stage, we also investigated needs among elderly users and their relatives regarding outdoor social alarms to identify S/T challenges. An outdoor alarm communicates typically via mobile networks and has a GPS receiver to locate a person. The material was gathered in two ways, through focus groups and open-ended interviews. Focus groups were used to gather new ideas from a broad perspective. The objective was to encourage the participants to evolve new ideas together with others. Interviews were chosen to detect phenomena, properties, and meanings of using outdoor social

Table 2. The case study in four municipalities

Municipality	Location	No of citizens	No of social alarms	Alarm centre
Botkyrka	Suburb to Stockholm	85 000	800	Connected to a large central alarm centre
Värmdö	Municipality in the archipelago (rural and urban)	38 000	275	Connected to a large central alarm centre
Örnskölds-vik	Small town and rural	57 000	1 300	Local alarm centre
Pajala	Rural area	6 000	144	Connected to a large central alarm centre

alarms with respect to safety. In the interviews, 15 participants from three user categories were included: elderly, middle-aged next of kin who took care of their elderly relatives, and younger people who assisted a grandfather or a grandmother. During the focus group and the interviews, the researchers took notes.

3.3 Data Analysis

Data collected during the two stages were analyzed in five steps. *Firstly*, we identified all S/T challenges highlighted by our respondents in relation to implementation of MT in elderly care (stage 1). *Secondly*, we read through all statements several times in order to identify the initial categories. We found that the S/T challenges were related to three levels: community level, organizational level and individual level (see Fig. 1). In step *three* we categorized the S/T challenges according to the three levels. In step *four* we identified S/T challenges concerning implementation and use of social alarms (stage 2) and categorized them in relation to the three levels. In step *five* we continued our categorization process utilizing content analysis [17] in order to find patterns and themes within each of these tree levels. The emerging categories were identified based on careful examination, interpretation and constant comparison. The identified categories were then labeled (see Sect. 5).

4 Challenges in Implementation of MT in Elderly Care – Empirical Investigations

We used the framework presented in Fig. 1 to classify the S/T challenges identified in our empirical studies. As defined in Sect. 2, S/T challenges consider both technical and social aspects. The social aspects in our study were divided in three levels: *community, organization* and *individual*, illustrated as three outer nodes in Fig. 1. Each of the nodes was related to the fourth node in the middle - technology. In our case the technology node illustrates MT implemented and used in elderly care generally and social alarms especially. The *community node* was related to norms, culture, laws, and roles as well as inter-organizational aspects that came up in implementation and use of MT. Many private and public organizations were involved in this context. Implementation of MT often meant that different organizations needed to interact with each other in new ways at various organizational levels. *Organization* is about organizational structures, processes, policies, regulations as well as human resources that are affected by implementation and use of MT. The last node, *individual,* represented the users: the elderly people and their relatives. This node dealt with aspects such as attitudes, beliefs, feelings, competence, and preferences, with regard to the implemented MT. In order to identify S/T challenges in implementation of MT in elderly care we needed to investigate the relationships between the three outer nodes and the technology node. Below, analysis of the empirical material structured according to the three levels as illustrated in Fig. 1.
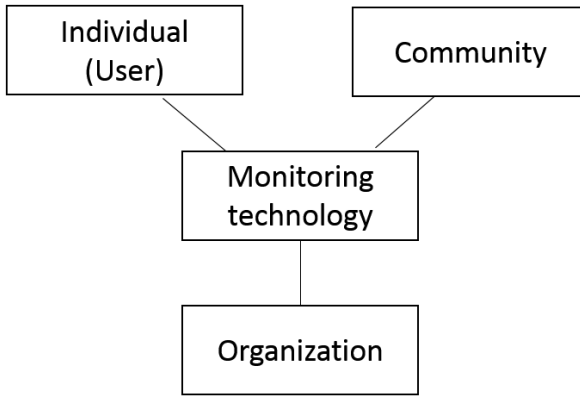
Fig. 1. Analytical model

4.1   Relationship: Community - Technology

In the relationship Community- Technology, the respondents highlighted the impor-
tance of including technology as a part of elderly care without decreasing its quality
and with preserved freedom of choice for the elderly. *There must be alternative options
for the elderly to choose from, the municipality must offer various possibilities. The
technology can be one of them. No one should feel to be forced to choose technology if
he/she does not want to.* One of the challenges highlighted in relation to this necessity
was the need to change negative attitudes of technology existing among elderly and
personnel who fear that implementation of technology will replace personnel and
reduce possibility for human contact for the elderly. *It is important that technology is
not solely seen as an efficiency measure but that technology might be a complement to
existing care services and in this way it can increase the quality of the elderly care.*
Municipality officers especially emphasized the significance of involving different
stakeholders in the implementation of technology as a part of elderly care. *All the
interested parties (organizations, individuals, representatives for unions and others)
must be informed and aware about the new technical possibilities and involved in the
process of implementation of these solutions in the real life!*

Other problems highlighted in relation to this category were lack of laws and
regulations dealing with the issues arising in the new context as well as difficulty of
applying existing laws and regulations in the new context, as one of our respondents
explained: *Limiting measures are prohibited by law. However it is unclear how to deal
with MT, whether it should be classified as limiting measure or not. Indeed, we need to
interpret the law given the new technology.*

4.1.1   Examples from the Case Study "Social Alarm" in Relation
to This Category

One challenge was to define responsibility structures when the analogue network is
replaced with the digital infrastructure. Currently, the municipalities are responsible for
social alarms and they are also responsible for providing a working solution for the

users when the phone company 'turns off' the analogue telephone network. *The technology shift that occurs from analog to digital alarm solutions affects the municipality. There is not a total workable solution,* the respondents claimed. However it was unclear how the responsibility structures should look like in the digital infrastructure. Our respondents emphasized that responsibility for reliability in the digital infrastructure could not be the responsibility of the municipality only.

Another problem was that the municipalities had limited knowledge of products (social alarms) on the market and their functionality due to the complexity of social alarms. This lack of knowledge to procure the 'right' products for the users resulted in lower quality of elderly care. The solution to this problem could be cooperation across municipal boundaries, as one of the respondents argued: *It would be great if the municipalities could collaborate across municipal boundaries and work jointly in project to come up with better and more efficient solutions.*

Various stakeholders, such as homecare staff and operations managers in elderly care highlighted the need for outdoor alarms. According to them there were no concrete solutions regarding receiving and acting on alarms generated outdoors.

There were few municipalities that had the resources and procedures to deal with this type of alarm. New models for responsibility, for acting on alarm, for payment models etc., are needed to get this kind of complex structure to work. To find the right models for this challenge, the responsibility should be raised to a community level (not on a municipal level) where different organizations collaborate. An additional problem with current indoor and outdoor alarms is that they are based on different technologies and are not integrated into the same alarm solution. *"Cooperation among companies that develop social alarms, municipalities, home care, and end users are needed".*

4.2   Relationship: Organization - Technology

Challenges highlighted by stakeholders in relation to organization - technology consider homecare organizations, companies producing MT, municipalities and other organizations involved or affected of implementation of MT. Regarding homecare organizations, the stakeholders emphasized the importance of integrating technology as a natural part of business structures and processes. They found this very challenging because so far there is a lack of guidelines for how to do it. *The technical possibilities must comply with the procedures and processes existing in the organization. Technology must become an obvious part of the business and not something that exists outside!* Homecare personnel explained that introduction of technology, as a part of their work will probably change their way of working and thinking. They raised questions as: *Where should the collected data by MT be saved? Should it be a part of elderly's records or should it be saved somewhere else? For how long time should data be kept in the system and for what purpose?* They pointed out that these questions must be answered before MT can be implemented because otherwise there is a risk for the elderly's safety and a risk for violation of the elderly's privacy.

Homecare personnel were also concerned about how data collected by monitoring devices should be interpreted. They argued that elderly people are very different from each other and interpreting data on the basis of some standard might violate the

elderly's dignity. *The risk is that we will interpret a specific situation based on general assumptions. What is common? What is a norm? People are so different. It's easy to make a general interpretation and upset a specific person.* Insufficient technical skills and uncertainty in using technology among homecare personnel was another challenge pointed out during the interviews. *The technology must be introduced in the right way, many of the staff are not familiar with the technology, they have not chosen the profession to manage technology, so they can become stressed if the technology is too difficult to handle or too complicated.*

Examples from the Case Study "Social Alarm" in Relation to This Category. An example showed that routines within homecare do not always work as desired. *You are working with other things even if you are responsible for receiving alarms and for going to the person who alerted. It can mean that you suddenly have to finish what you're doing, and even leave the person you are visiting.* It is important to integrate the technology with the workflows in elderly care. Today homecare staff cannot speak with the user on the speaker phone (integrated in the base unit of the social alarm), since it is only the staff at the alarm center who have this functionality, i.e., can talk to the user who activated the alarm. Our respondents argued: *It would be great, if it would be possible to call the speakerphone and talk to the user.*

Managers, which are responsibility for social alarms within the municipalities, need more knowledge about the technology and need to be able to offer current technology to its citizens. In the case study we observed that municipalities often do not have any methods in order to include the needs of users in the procurement process of social alarms. The challenges are to improve the dialogue with users and to develop methods to meet the needs to successfully introduce new types of alarms.

Results from the case study show that municipalities need to solve organizational processes in different ways. On islands and in rural areas in certain municipalities they have organized local alarm chains, meaning that each user must have his/her own alarm chain. Neighbors, relatives, etc. can be included in such alarm chain. If there is an incident, a person in the alarm chain can call health professionals, ambulance, etc.

4.3   Relationship: Individual - Technology

Challenges that different stakeholders highlighted in relation to this category were mostly related to the need of personalization and adjustment of technology to the users' specific and diversified needs, as well as to the need of ensuring the elderly people's privacy. This regarded both when the technology was implemented and when data collected by the monitoring systems was interpreted. As one of our respondents explained: *It is important to always take into account the individual's special needs. Every individual is different and must be treated in a special way when the technology is introduced.* This means that technology developed for elderly needs to be adjustable to the elderly's different needs and preferences. It was also pointed out that the elderly should be involved when the technology was implemented and that they always should have the right to decide about the implemented technology and services as well as about the time and extent of monitoring. *The users should decide by themselves where*

the sensors can be installed and which services can be implemented. Others should not be allowed to decide these things above the head of the elderly. To be able to make such decisions, the elderly need to understand the consequences of the implemented services. Thus numerous respondents emphasized: *It is important to clearly explain to the elderly so they are able to understand the consequences of the implemented solution and specify their requirements.*

Examples from the Case Study "Social Alarm" in Relation to This Category. The social alarm was perceived as a security. *It is good both for my own part and for the family's sake to have a social alarm.* In interviews with managers in the municipalities it appeared that it was difficult for the municipality to identify and understand the user's needs. One important S/T challenge for the municipalities was to ensure that the quality of social alarms really addressed the users' needs, both with respect to alarm holders and personnel. One large problem was that the alarms had a very limited reach and were designed for indoor use only. *If I am too far away from the base unit, the alarm will not work.* In the analysis of the interviews a great need for an outdoor alarm was expressed. Currently, existing alarms cannot handle both traditional indoor alarm usage and outdoor alarm usage in the same solution. The problems of being unable to use the traditional alarm outdoors had the effect that some elderly people hesitated to leave their homes. One of our respondents argued: *It would be good with a longer reach between the alarm button and the alarm unit. It would also be great if there was GPS functionality, and that it was possible to talk via the alarm button.* Privacy regarding usage of social alarms was discussed with the participants in the focus group. The participants did not find the use of their geographical location as privacy invasive. The benefits were seen as far greater than the disadvantages to be located using GPS. The most important S/T challenge in this category seemed to be the possibility to offer outdoor alarms to everyone who wants it.
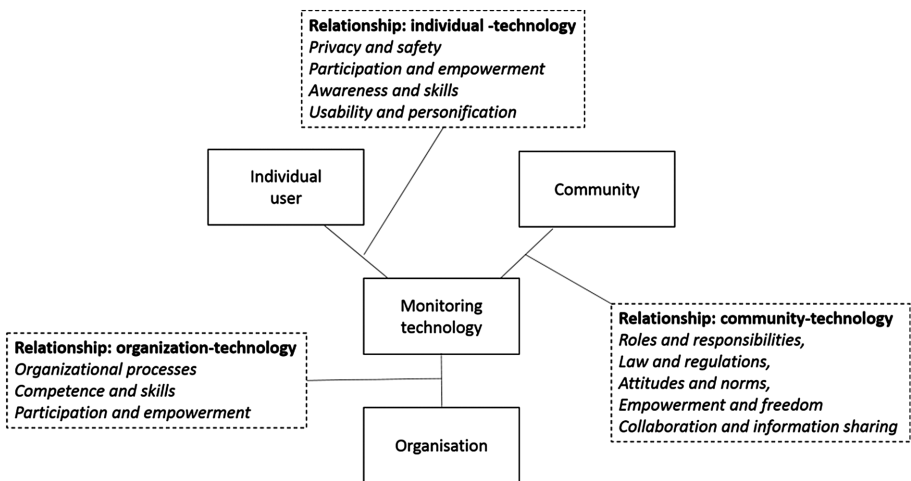

Fig. 2. Socio-technical challenges in implementation of MT in elderly care

5 A Framework for Classification of Socio-Technical Challenges

In Fig. 2, we present the framework for classification of S/T challenges arising during implementation of MT in elderly care. The framework is a refined version of our analytical model introduced in Fig. 1, Sect. 4. The technology node illustrates MT implemented in elderly care, the three outer nodes illustrate social aspects at community, organizational and individual level. The S/T challenges identified in this study

Table 3. Categories of socio-technical challenges

Relationship: community-technology
Roles and responsibilities: create clear responsibility structures and define new integrated care processes where different organizations and other parties are involved, define clear roles in these new care processes.
Laws and regulations: formulate new laws and regulations and adjust the existing ones so it is clear which rules should be applied when technology is an integrated part of elderly care.
Attitudes and norms: change users' and home care personnel's view of technology so they can see its potential to maintain or increase the quality in elderly care
Empowerment and freedom: ensure users' and homecare personnel's freedom to choose care services with technology or not. Involve users, citizens, homecare staff in decision regarding implementation of technology in elderly care
Collaboration and information-sharing: encourage, support cooperation and information sharing between private and public organizations and other parties regarding technical solutions that can improve quality of elderly care
Relationship: organisation-technology
Organizational processes: integrate technology as an integrated and natural part of care processes and organizational processes (in care organizations). In some cases new organizational processes need to be created for example for collecting requirements and purchase of new MT that corresponds to the users' need and are suitable for the specified purpose (municipalities, care organizations).
Competence and skills: improve general technical skills for home care personnel. Build competence how to compere, choose and purchase MT (municipality employees), how to identify user needs and collect requirements (developers, municipality employees, homecare staff), how to interpret and act to the information provided by MT (homecare staff)
Participation and empowerment: involve employees (e.g. homecare staff) in development, implementation and decisions regarding implementation of technology in their work.
Relationship: individual-technology
Privacy and safety: find a balance between elderly person's safety and privacy when MT is implemented as a part of the provided care services.
Participation and empowerment: involve users (elderly and their relatives) in development, implementation and decisions regarding implementation of technology in the care services.
Awareness and skills: explain and clarify the consequences of using MT as a part of care services e.g. regarding privacy, time spent with homecare personnel etc.
Usability and personification: build technology that is easy to use and adaptable to the users' diversified needs and preferences.

can be found in boxes connected to the relationships between the three outer nodes and the technology node.

The categories of S/T challenges illustrated in Fig. 2 are described in Table 3, below.

The framework and categories presented in this section were generated inductively from our empirical material and thus are not yet fully generalizable. However numerous of the S/T challenges identified in this study were also highlighted in literature (see Sect. 2, related research). For instance some of the factors identified by Vichitvanichphong et al. [8] and Peek et al. [9] as important for users' adaptation of technology, correspond to S/T challenges identified in this study in relation to the *individual –technology* category. Moreover, the S/T challenges identified during stage 1 and stage 2 in this study were similar even if the stages were conducted separately.

Nevertheless the framework and the categories need to be further verified and refined. The first step in our future research will be conducting systematic literature reviews focusing on S/T challenges in relation to the three levels identified in this study: community, organization and individual, aiming to refine and complement the categories identified and to assess the coherence with previous research.

6 Conclusion

Many of the existing projects aiming to provide a technology support to aging in place have a narrow technical focus ignoring the complex social and organizational context in which the technologies are implemented and used. In this paper we investigated the S/T challenges in implementation of MT in elderly care. *Based on qualitative inductive analysis of empirical data we suggest a framework for classification of the S/T challenges of MT in relation to the individual user, the organization and the community.* Our study shows that in order to be able to successfully implement monitoring technology one must to understand the social and organizational implications the technology implies for the different stakeholders, organizations and other areas of society. This paper contributes to a better understanding of S/T challenges in this context.

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