Where does the interaction break down? The stakeholder map of health IT systems development and use in Finland

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Abstract

Prior research shows that clinical users' experience of healthcare IT systems in Finland is poor. Research shows further that physicians are highly critical of the perceived lack of user participation in systems development, but developers of the same systems argue that they do work with users and are highly interested in their views. This study aimed at mapping the stakeholders involved in the user–developer interaction network, in order to identify the spots where the interaction breaks down. A method for depicting the healthcare landscape was adapted for depicting the healthcare IT systems development landscape. Experts selected through purposive sampling were interviewed to identify stakeholders and problems. Content analysis was used to categorise problems into development spots. A stakeholder map was drawn, consisting of 22 organization types, nine activities within them, and two groups of individuals. Seven development spots were identified, within and between the healthcare provider and the software provider but also related to other stakeholders. A significantly larger number of stakeholders are involved in healthcare IT system development than what was initially evident. They all influence the end-user experience in some way. It is not only the software product itself (whether with good or bad usability), but also several other factors that may affect user experience. Further research can now focus on what can be done and by whom to address the development spots.

Keywords: health information systems, Finland, medical informatics, software engineering, user experience, usability, user participation

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Introduction

The basic reasoning motivating this paper is straightforward. It is widely recognized that the user experience of the computer systems in health care in Finland is far from satisfactory, according to both anecdotal evidence in public media and scientific research among medical personnel in particular [1,2]. Further research shows that physicians are highly critical of the perceived lack of user participation in systems development, argue that "IT developers never ask for the users' opinions or experiences", but would themselves be willing to participate if they knew how [3]. On the other side of the coin, however, developers of the same systems strongly argue that they do work with users, are highly interested in their views and take them into account [4]. If both sides want to interact with each other, but the user experience is still not good at all, where does the interaction break down?

Definitions of key terms

Since this kind of a paper speaks to a number of audiences with quite different disciplinary backgrounds, it is important to clarify what are the specific meanings of the key concepts and terms used in this paper. *Information system (IS)* is to us "the processes on managing [...] information in an organizational setting", i.e., a socio-technical system including human and technological parts [5]. *Health information system (HIS)* is an IS used for managing health-related information. The core technological part within an HIS is called here *healthcare IT system (HITS),* which refers to a software product or an integration of software products as well as the necessary hardware on which the software runs. [4]

The term *end user* refers to all professionals working with HITS in healthcare organizations, including both healthcare professionals (e.g. nurses and doctors) and other professionals (e.g. secretaries). With regard to healthcare software products for self-service, patients are also seen as end users. *Developer* refers in this paper broadly to those who are involved in the design, specification, implementation and testing of software products. *User experience* is defined as follows*: "Every aspect of the user's interaction with a product, service, or company that make up the user's perceptions of the whole"* [7]. On the basis of user experience, users often assess whether the system is good or bad. In this paper, we focus on the factors that affect the development of healthcare software products.

When searching for where does the interaction break down, we apply the term *development spot* (previously called development point [6]) defined as follows: *"A contradiction (tension, mismatch, disharmony) may exist within or between the elements of an activity or between related activities within an activity network. The contradiction causes phenomena considered harmful or problematic when it occurs/shows within a work activity and may require change efforts. A development point is the location of the contradiction and the area where change efforts are needed within the networked work activity system."* [5]

It should be noted that the healthcare delivery system in Finland differs in some fundamental aspects greatly from healthcare systems in countries like USA, United Kingdom, Germany, Denmark, etc. The basic principle is that the local level of government, municipalities, are responsible for all healthcare provision to their residents, either independently or through associations of municipalities [3,8]. Municipalities are autonomous by constitution, their councils are elected by direct vote, and they have the right for taxation. Each municipality or association of municipalities thus has the right and duty to select and procure the HITS for its own use. Groups of municipalities have recently established joint-stock companies to manage their IT procurement and maintenance activities. In this paper the term *municipal IT company* is used for them.

Background on HITS development

All public and most private healthcare providers in Finland use electronic patient record systems [9]. In the mid-1980s, healthcare organizations moved towards the kind of patient information systems currently in place [10]. Since that development, new software

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products for a number of clinical and management purposes have been developed and integrated into these systems. In the past few years, however, users have brought attention to issues with the poor level of quality of healthcare software systems, attributing the current systems with numerous usability-related problems [11].

In 2010, a large study of Finnish physicians (N=3929) on the experiences of using healthcare IT systems showed that Finnish physicians were very critical of the systems that they use in their everyday work [1-3]. Interestingly, the issue of unsatisfactory usability regarding electronic healthcare information systems has been documented worldwide (e.g., [12-14]). In addition, it has been argued that user experience is not a significant business driver for healthcare information systems, especially when it comes to electronic health / medical record (EHR/EMR) innovation, and that the user interfaces of enterprise EMRs are lagging behind in the software industry [15]. In response to user complaints, the American Medical Informatics Association (AMIA) has lately presented recommendations that are to *"… provide a plan to increase understanding of the impact of usability on the effective use of health IT, and lead to safer and higher quality care with the adoption of useful and usable EHR systems"* [16].

Contrary to common assumptions, most physicians in the study of 2010 were willing to participate in development activities and criticized the developers of Finnish healthcare information systems of ignoring users' wishes and needs [3]. Developers disagreed, most of them being indeed willing to take end-users' needs and wishes into account [4]. In their opinion, these needs were highly considered when developing the systems. Why, then, do the resulting systems not satisfy users?

Software system development is a complicated process. The context of healthcare brings even more challenges to the table. According to Mykkänen [17], the specificity of healthcare information systems include, amongst other things, the following issues: 1) healthcare work is information-intensive, and to avoid information overload for end-users, the systems should only display relevant information; 2) work processes are complex and full of exceptions, require multi-professional cooperation and are only partly supported by software applications; 3) confidentiality of patient information in the information system has to be guaranteed; 4) the software used in healthcare requires real-time reliability, robustness and fault tolerance; and 5) the functionality, architecture and technology of healthcare software applications are heterogeneous and further complicated because of networking and integrations between existing applications [17].

In addition to the above mentioned items, there are also some other commonly known challenges of healthcare IT system development. The development is controlled by the laws and regulations at a national level, and in some cases at a European or even global level. These national and international regulations bring about challenges to development, as laws meant to protect patient privacy may act as a barrier to IT systems development and use. If a patient does not grant signed permission for other organizations to view patient data, physicians from organizations will not see the patient's medical and treatment history. Moreover, healthcare IT systems require 24/7 availability and reliability, making it a challenge to develop an entirely new healthcare software product while maintaining the old one at the same time, especially for small and medium-sized software development companies.

Furthermore, when using usability methods when developing HITS, there are also some considerations; e.g., some usability methods are difficult to use in actual patient care situations because of the confidentiality of patient records and privacy regulations [13]. Also the context of use of HITS is highly complex and physicians' and other healthcare professionals' workflows are difficult to understand without medical or healthcare education. Jones argues that the design needs of healthcare organization are probably too domain specific for most generalist user experience designers [15]. Challenges to user experience design may also stem from the facts that physicians use foreign terminology, medicine has a lot of specialties, and every specialist may have different needs for using EMRs [13].

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User participation in IT systems development

Researchers and practitioners have recognized the importance of user needs in IT systems development since the 1980s, when terms like *User Centred System Design, Human Centred Design, Participatory Design,* and *Cooperative Design* became popular [18,19]. In his ground breaking paper of 1991, Jonathan Grudin pointed out that the opportunities for user participation differ greatly in three different software development contexts: in-house/custom development, commercial product development, and competitively bid development [20]. Most of the Participatory Design research is dealing with the first type of situations, in which users and developers can collaborate directly with each other. However, in reality most situations are currently of the latter two types, which are actually two separate processes that require each other (Figure 1, [21]). Few studies have been published about Participatory Design of packaged (Commercially Off The Self, COTS) software products [22], particularly in the health care field [23].

User-developer interaction is made even more indirect because there are other organizations involved in addition to the software producer and software user identified in Figure 1 [23,24]. In the simplest common situation, there is a vendor or consultancy company that sells and/or implements software products to user organizations (Figure 2,[24]). In real life the network of organizations and activities involved can presumably be much more complex.
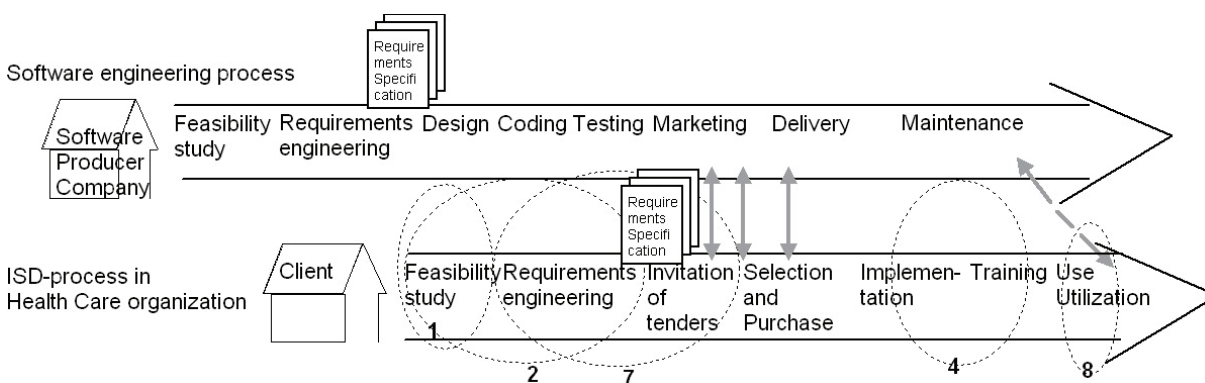

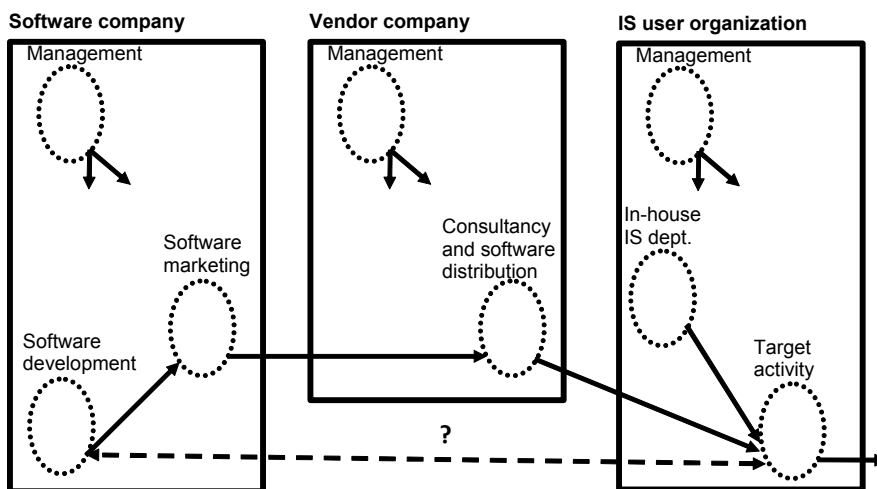**Figure 1.** Packaged software development and acquisition as two separate processes. [21]

Figure 2. An example of organizations and activities along the paths of interaction between software development and use (the development's "target activity") [24].

Furthermore, all the contexts identified by Grudin are about producing or introducing new IT systems, whereas for most of the time the systems are in the phase regarded as maintenance or use (Figure 1, right end) or customization [25], which is the focus of the two previous studies [3,4] and therefore this one, too.

Objectives

The research question of this study was identified in the beginning of the introduction: Where does the interaction break down? To address the question, the stakeholders involved in the healthcare IT systems user–developer interaction network need to be identified first. After that the spots in the network where the interaction breaks down need to be identified. These objectives are turned into the following research questions:

1. What stakeholders are identified in the healthcare IT systems development network in Finland – what are their roles in the interaction, what activities are they engaged in, and how are they related with each other?

2. In which areas within the interaction network can problems be identified that may cause breakdowns in the interaction?

The scope of the study is delimited to packaged software products (COTS), i.e., in-house developed or tailor made software systems are not considered. Secondly, the study is focused on the routine use phase of a system lifecycle, i.e., neither initial system development from scratch nor the procurement and initial system implementation (taking into use) of a system by a healthcare organization is in the focus. The main emphasis is thus on the "business as usual" and stepwise migration of systems in use. Initial system development on one hand and software system procurement on the other hand are considered only as far as they impact on the routine use and stepwise migration phase.

Methods

This study can be described as qualitative exploratory research, where the emphasis is on *"… 'sense making' or understanding a phenomenon, rather than predicting or explaining"* [26], taking an interpretive stance on the analysis of the results. In order to make the research process transparent, the following sections present the primary steps of the research process, the primary intermediate results and the final results.

Methodological approach

The theoretical framework for studying the first research question is adapted from the healthcare landscape depicting methodology [27]. While the original methodology is focused on health needs, healthcare services, healthcare activities and healthcare organisations as well as the related information flows, in this paper we use the same notation but applying it to IT needs, IT services, IT activities, etc. The same approach was used in a simple way in Figure 2 [24]; cf. Figure 4 and Figure 5. The idea is to first identify a community of ultimate beneficiaries (individuals depicted as a cluster of small circles), then identify a need-service relationship (arrows in opposite directions) between them and a service provision activity by another group of people, and then further networks of need-service relationships between activities (depicted by ovals), possibly taking place within different formal organisations (square boxes) and societal formations (rounded boxes).

In this case the ultimate beneficiaries are the end-users of HITS in Finland, and the methodological approach for research question 1 is to establish the pathwork from their needs for appropriate HITS to support their work all the way to the developers who can implement the desired functionality into the HITS in use. The changed or new functionality will then travel back to the end-user through the same or different pathwork of activities to finally provide the service to the initial need – whether a service that fits the need or not. Only those aspects of the original methodology are used that are needed for the purposes of this paper.

The theoretical framework for research question 2 is the concept of development spot, defined in the introduction, which has been developed in the Activity-Driven Information Systems Development (AD-ISD) approach [5,6]. Usually AD-ISD is used for analyzing work activities and networks of activities, to identify development spots where information systems interventions can provide help, but in this study information systems are probably not the most relevant ways of addressing the development spots. This study is delimited only to the topmost level of AD-ISD (activity networks and organisations), i.e., the internal aspects of the activities within the network are not studied. The landscape methodology and AD-ISD are compatible at this level.

Data collection and analysis

The data was gathered iteratively in two rounds of semi-structured [28] expert interviews, supported by a map and a thematic question list. The flow of research is presented in Figure 3.

A rough initial map of the main stakeholders in HITS development was drawn on the basis of literature and earlier experiences in research and software development (see Figure 4). In the first round of the interviews, the initial map was used as a tool to facilitate discussions, instead of using strict, pre-defined questions. Notes were written and changes were drawn to the map while interviewing. After the interviews, the map

was re-drawn accordingly and, in addition, themes were formulated into a more formal list of questions (Figure 3) to support the second interview round.

In the second round a new group of interviewees was selected and interviewees were asked about their background and current positions in the development of healthcare IT systems. Participants were also asked if the map updated on the basis of the first interview round contained all stakeholders and, if not, who were missing and why they were important. Furthermore, the interviewees were asked about how stakeholders collaborate and what kind of problems come up when collaborating. Each interview lasted between 40 and 60 minutes. The interviews were documented by writing notes while interviewing.

After the second round of interviews, the empirical materials were processed using a content analysis technique [29], in order to construct a holistic view of HITS development and to highlight the influences that each stakeholder has on user experience (Results, p. 199-201). Content analysis was carried out in an iterative manner. Based on the first walkthrough, initial categories were outlined. The classification of data was revised after repeated walkthroughs. Finally, seven categories of development spots were formulated and new stakeholders were added to the map. A graphic presentation (Figure 5) was constructed to show the stakeholders and their main activities, as well as problematic spots and communication challenges.

Figure 3. The research flow.

Materials

The interviewees were sought from different organizations related to HITS development. We aimed at involving experts who were representative of the main different viewpoints regarding HITS development. Purposive sampling was used to select expert interviewees [30]. This method is used when sampling is aimed at a deep insight into the subject and when the attempt is at a greater understanding of the phenomenon rather than empirical generalization. The researchers initially recognized that the following viewpoints are important in order to capture the multifaceted perception of HITS development:

a. Healthcare organization, IT department / Municipal IT Company
b. Healthcare organization, end-user
c. Healthcare software development company, development unit
d. National eHealth actors
e. Healthcare IT systems development research

Altogether, twelve Finnish eHealth experts were interviewed. Five interviews were conducted in the first round and seven in the second round. Table 1 presents a summary of the interviewed experts in relation to the five abovementioned viewpoints. Six of the interviewees had multiple viewpoints.

Initial map for interviews

There are several stakeholders and issues that need to be considered when developing software for healthcare organizations. We started this description by identifying the stakeholders based on the researchers' prior understanding. The participants vary somewhat according to the kind of development situations, but we identified the following stakeholders when thinking about product-oriented development: patient, healthcare organization (end-users, super users, system administrators, clinician representatives and management), municipal IT company, software provider (developers, sales, customer service and management), national and European Union (EU) authorities (Figure 4).

Each stakeholder contributes to healthcare software development in its own way, which in turn impacts on what the final products are like. It is therefore reasonable to say that the influences of the different stakeholders have consequences in relation to the end-users' experience of the software product. While different kinds of end-users have different kinds of needs regarding their information system user experience, in this paper we focused on clinical staff as end-users.

Table 1. Interviewees and their viewpoints.

Viewpoint of the interviewee	Interviewees											
	1	2	3	4	5	6	7	8	9	10	11	12
A Healthcare organization, IT department / Municipal IT Company								x		x	x	x
B Healthcare organization, end-user	x	x					x	x				
C Healthcare software development company, development unit	x		x	x	x	x	x	x			x	
D National eHealth actors									x		x	x
E Healthcare IT systems development research	x								x		x	

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The middle of the initial map (Figure 4) shows the software provider responsible for developing the software products and getting input from the other stakeholders represented in the figure. The left side of the map displays the main reason for all these development actions: patients needing care. From there, between patient and software provider there is, naturally, the care provider. In some cases, healthcare organizations have their own IT departments while in others the IT functions are partly outsourced to a municipal IT company that provides IT services and products for the healthcare organization. On the right side of the figure, the national and EU authorities are represented. The initial map in Figure 4 is a simplified version of the one used in the interviews and thus presents only the essentials.

Results

In this chapter we present the multi-stakeholder environment in which healthcare IT systems are being developed in Finland, based on the information gathered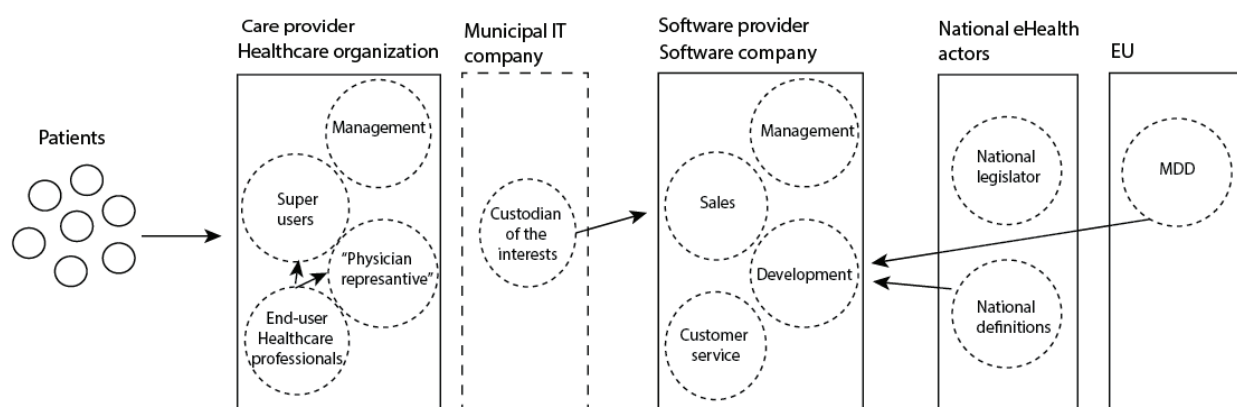 from the literature and from interviews. The chapter also reports the development areas and challenges that the interviewees face in developing software and in attempting to achieve good usability and user experience. The problematic areas are illustrated in Figure 6 and the identified problems are grouped into eight categories.

The stakeholders in HITS development

The following stakeholders were identified during the interviews: patients' relatives, patient organizations, trade unions and other professional associations, local government (municipalities), multiple software providers, standards producing organizations such as HL7 or HIMMS, user groups (organizational and national), social care providers, infrastructure providers/hardware distributors and research institutes. The initial map (Figure 4) was enriched with the findings, resulting in Figure 5. Collaboration, communication and information flows between the stakeholders are represented by arrows in the map.

Figure 4. The initial map of stakeholder organizations in healthcare IT systems development.

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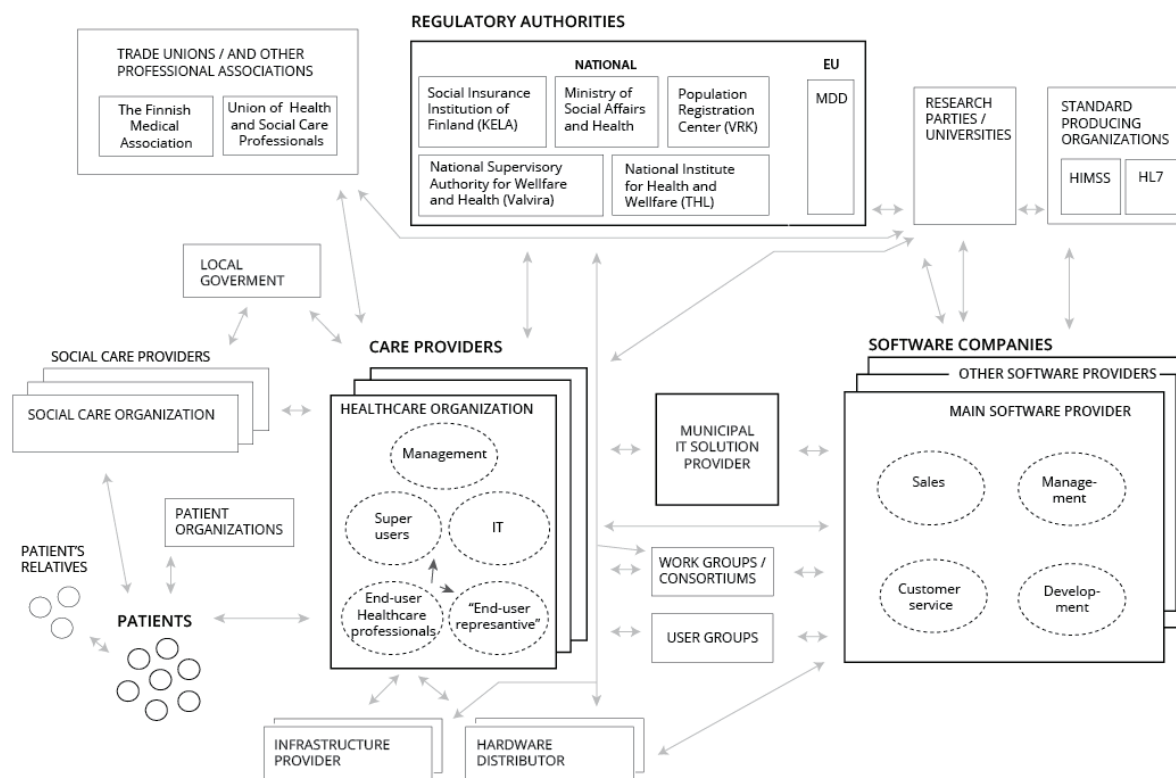KOLLEGIALT GRANSKAD
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Figure 5. The map of stakeholders in HITS development resulting from the study.

Next, the stakeholders are discussed in more detail. The role of each stakeholder and its possible influence on end users' experience of HITS is described as emerged from the interviews.

Patients' role in healthcare has grown recently, making them empowered actors capable of utilizing and producing their own health data. Patients are supposed to manage their own health-related data more actively by carrying out such tasks as recording their own measurements (e.g. blood pressure results), getting information (e.g. lab results, acute diseases' care plans and treatment feedback) from healthcare providers, and booking appointments. Patients expect to receive eHealth services in the same way that they receive e-services in other areas of life, and it is generally assumed that self-service will reduce costs. However, if HITS tools have poor usability for patients, the expected cost savings of self-service will not be realized. **Patients' relatives** and **patient organizations** are part of the

network, particularly by affecting the patient, who sets the requirements for the health services.

Healthcare organizations were reported to be conservative towards reforms. Even an interviewee from a healthcare organization pointed that out. In software development activities, healthcare organizations were seen to be responsible for identifying and communicating the goals of healthcare professionals' activities: what information is needed and what kind of processes must be supported with software. If those goals are not identified and communicated in a way that is understandable to the software provider, it is the end-users' experience that ultimately suffers. Sometimes healthcare organizations form unofficial or official **consortiums** to articulate common causes and goals for the development of the software. In addition, **social care organizations and providers** are linked to patients' healthcare in cases of integrated care, e.g. homecare. However, social care and healthcare have different

information systems, and their information flows are restricted by laws that aim at information privacy.

End-users (physicians, nurses and unit clerks) define through their everyday work whether the software is a suitable tool for the task or not. To have high-quality software, it is critical that the information system and daily work fit together. According to the interviewees, the roles of the **super users** and **end-user representatives** need to be defined more clearly. In practice, super users are quite often technical staff. **User groups** (in one organization and national groups) are also important parties who influence the end-user experience, for example by prioritizing and refining the needs and requirements for new software features. **Trade unions and other professional associations** such as Finnish Medical Association, The Union of Health and Social Care Professionals and Finnish Nurses Association were also seen as relevant stakeholders, since they can influence the end-users' working conditions.

Local government (municipality) was described as an actor that makes financial decisions that partly determine the acquisition of new software products and updated versions. The interviewees thus saw a surprisingly narrow role for municipalities. **Municipal IT companies** were perceived as consultants or intermediary bodies between software providers and healthcare organizations. They may, depending on the case, provide support to end-users, take care of the user access management, training and maintenance, or mainly take care of the acquisition processes. This stakeholder may have an enormous impact on end-users' experience of the software, depending on the IT company's level of participation in the development activities.

Software providers' main activities are product development and deployment, which also involves acceptance testing (together with their customer) and maintenance activities. The development process itself obviously has a great impact on the product and thereby on the end user experience. In Finland, healthcare organizations have many IT systems developed by **multiple software providers**, which means that the user experience may be related to one particular software product or to the interoperability between products.

Other stakeholders that influence the interoperability and availability of patient information are **hardware distributors** and **infrastructure providers**.

National regulatory authorities such as the Social Insurance Institution of Finland (KELA), the National Institute for Health and Welfare (THL), the Population Registration Center (VRK), the National Supervisory Authority for Welfare and Health (Valvira) and the Ministry of Social Affairs and Health are responsible for legislation, producing specifications and coordination, and also testing and validating some parts of the HITS. The specifications of HITS itself have a considerable impact on user experience.

Standards development organizations such as HL7 (Health Level 7) and HIMSS (Healthcare Information and Management Systems Society) influence software development by providing standards to follow.

Research institutes are seen as independent and objective actors. They bring research-based knowledge to support development and to monitor and evaluate current development activities and end results (e.g. software products).

Problematic areas in the landscape of HITS development

In this section, we present the problems and findings related to the development of HITS that the interviewees identified. Many problems are related to communication between different stakeholders or activities. Through content analysis, seven categories were formed to present the main spots were development activities are needed. Table 2 shows the categories together with the number of development needs or problems identified in relation to each category.

Figure 6 illustrates the positions of the development spots in the stakeholder map by a lightning symbol with the identification number of the spot in question.

The individual development needs or problems identified by the interviewees are next described according to the category or development spot in Table 2.

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Table 2. Categories of problem areas / development spots identified through content analysis.

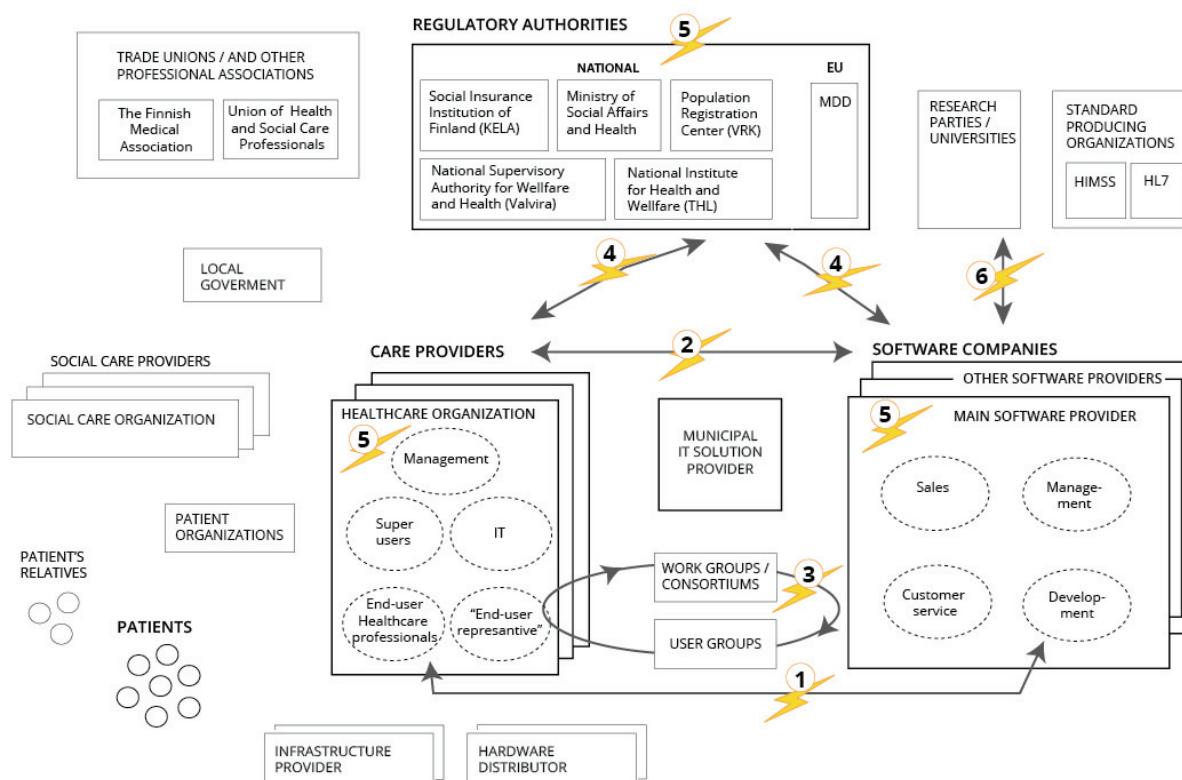| ID	Main problem area / development spot	N needs / problems
1	End-user - developer collaboration	4
2	Healthcare organization - software provider collaboration	7
3	Clinical knowledge in development activities	4
4	National authorities' role	5
5	Internal processes of the stakeholder organizations	2
6	Research-based, evidence-based design and assessment	2
7	General issues of HITS development	4

Figure 6. Development spots in the stakeholder map.

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Development spot 1: End-user – developer collaboration

Developers visiting end-users' work places. From the developers' point of view, collaboration between end-users and software developers was seen to work quite well, as long as the developers visit end-users and as long as the right end-users participate. The prerequisite for successful collaboration appears to be that when visiting end users the developers must interact with people who are able to participate and act as a voice for the end-user group.

Too many intermediating participants in the interaction between end-user and developer. Some interviewees reported that the descriptions of end-users' needs may change before they reach the software developer because there are too many stakeholders between the end-user and the developer. The information flow from end-user to developer may contain as many as five intermediary steps: end-user -> IT support person in own organization -> municipal IT company help desk -> software provider's customer support -> product manager -> software developer.

Development takes quite a long time. Therefore developers end up working with quite different products than the end-users, who are struggling with existing software problems. This dynamic may influence the collaboration between the developers of new products and the end-users of existing products who, as one participant described, are "in totally different worlds, as if in different time zones".

Communicating the needs for development (corrections, defects, new features). The interviewees also revealed enormous problems in communicating the wishes, needs and problems of the end-users to the software developers. Also, from the point of view of the end-users and the healthcare organization, getting feedback on the reported problems was said to be troublesome. End-users are uncertain if the suggested features would be added in a new version, if a reported problem would be corrected in the software and, if it was to be corrected, when the changes would be made. End-users often complain to local customer support or super users, but they are not sure if the complaints end up with the right people in the software company. In short, no one seems to know what will ultimately happen to end-users' wishes. Respondents wondered if users' wishes might be buried under a pile of "to-do" tasks or possibly just sent directly to the trash can. Interviewees reported that nowadays end-users are tired of complaining about their current software or making new proposals. In other words, the communication and feedback process should be more transparent.

Development spot 2: Healthcare organization – software provider collaboration

Scheduling challenges. In addition to a conflict of perspectives, time is another problem in collaborative development. Software providers and their customer – the healthcare organization – may have scheduling challenges, where collaborative development activities can be difficult to schedule in such a way that fits both stakeholders' development goals.

Considerable number of development needs. In healthcare organizations, the abundance of needs for development makes them difficult to prioritize.

Lack of simultaneous development of the work processes, care processes and IT system. It is a challenge to develop and change activities at the same time as an organization is developing a new IT system. However, when the processes change, the requirements for the IT support change – and when the IT system changes it brings about needs for changing the processes. Interviewees emphasized that the simultaneous development and re-organizing of organizational processes, care processes and IT systems is rare these days.

Right persons involved in collaboration. Interviewees were also critical of the fact that IT procurement usually only involves a single salesperson from the software provider to communicate and collaborate with the healthcare organization's IT staff. It would be beneficial if people capable of affecting software application development (e.g., people like software architects), were also involved.

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Differences in organizational working cultures. Communication problems and other problems may occur between the healthcare organization's IT staff and the software provider due to different working cultures.

Lack of shared understanding of requirements and development goals. The healthcare organization and the software provider don't have a shared understanding of the goals and concepts in the beginning of the development of new functionality and versions. However, shared understanding is a necessity for the project to succeed. Too many compromises have to be made when there are too many opinions and understandings about the goals. The concept of the software is abstract and hard to understand. Especially technical specifications, steeped in a technical language, seem to be difficult to understand in a shared way. Prototyping was identified as an excellent method for communication and development and for obtaining a shared understanding. Even so, it is not a simple task to achieve a shared understanding among end-users and developers.

Prioritizing development needs. It seems to be a problem to decide whose wish is the most important. In some cases this problem has been solved by polling by end-users, but in some cases the interviewees wondered if end-users should be more involved in deciding which wish is implemented. However, regulatory authorities set requirements that software developers must abide by (such as requirements based on laws and degrees).

Development spot 3: Clinical knowledge in development activities

Up-to-date clinical knowledge in software development. According to the interviewees, it is very important to involve people who possess clinical knowledge and end-users' expertise as a standard part of software development, especially in requirement specification, clinical testing, and prototyping. Moreover, interviewees emphasized that the clinical knowledge of these individuals should be "fresh". Clinical knowledge of the practice becomes outdated in a

few years if one is working only as an expert in a development company but not as a clinical practitioner in a healthcare facility.

Choosing the right persons to present end-users. Similarly, the choice of participants from the healthcare organization matters: some experts participate alongside their clinical work, while others may have left the clinical work due their responsibilities in the IT department. In other words, the level of knowhow varies significantly. Clinical expertise must be from the specific field that the application is intended for; different knowledge is needed, for instance, in primary care than what is needed in obstetrics and labor and delivery applications. Among the physician and nurse representatives working in software development as clinical experts, the level of clinical work experience in healthcare organizations varies significantly. Accordingly, the development team's knowledge of the real-world context and of everyday work practices in healthcare organizations varies as well.

End users too busy to participate in development. Clinical end-users are busy with their daily work tasks. If end-users have to participate in development in addition to their own work, rather than devoting dedicated work time toward development or receiving compensation for the extra work, their motivation for software development may go down.

Taking the varying needs of practitioners in different medical fields into consideration. Some considerations emerged of the role of end-users and user representatives in software development activities in general. Is the end-user representative participating in development able to represent the various kinds of end-users sufficiently? Is it even feasible to expect an end-user representative to be accountable for safeguarding all kinds of end-users' needs (including physicians and nurses from various different medical specialties) when representing clinicians in software development workshops? When trying to cover and please too many specialties, such compromises might be brought about that might not be satisfactory for any of the groups. Clinical practices develop continuously and it is hard to keep up with the latest updates on medical research in every

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specialty. Thus the end-user representative's role was seen not as acting for actual end-users but rather as an intermediary and intermediator between highly specialized clinical end-users and developers.

Development spot 4: National authorities' role

Collaborating with national authorities. Yet another challenge is the collaboration between national authorities and software providers. The interviewees also wondered if the national authorities understood current software development practices. Different operating cultures can cause problems between national authorities and healthcare organizations.

Inflexibility of national authorities. In the interviews, national authorities were criticized for being inflexible and slow in the national level definitions and specifications, and the interviewees expected more agile ways of working .

National requirements specification. The interviews revealed concerns on whether there are enough clinical experts participating in the national requirements specification process. End-users and national authorities should have more communication and common actions, especially when it comes to national-level specifications.

Amount of required data: users are required to record a lot of information. According to the interviewees, the specifications from national authorities are not in line with users' needs and requirements; the usability of clinical software systems was seen to suffer because of the level of detail of data that was required to be recorded in the systems. The interviewees from healthcare organizations (both IT and clinical staff) commented that national authorities require that more and more details related to patient care must be documented in electronic health records.

End users' knowledge of what the national archive requires from them. It was argued that the ordinary end-user is not familiar enough with issues related to the new national electronic archive of patient records (KANTA).

Development spot 5: Internal processes of the stake-holder organizations

Communication between different professionals inside organizations. If communication between different professionals in the software development organization (e.g. salesmen, management, developers and customer support personnel) is not ongoing at all times, it may complicate development activities. For example, a salesperson should not promise to the customer to deliver features that are impossible to implement. In healthcare organizations the communication between end-users and IT staff can be challenging, since the two groups often lack a common language. Even if many of the healthcare organizations' IT staff might have a background in a healthcare profession, the professional jargons differ.

Timing of participation. Sometimes the right people do not participate in the right phases in the software development process, or they do not participate early enough in the development process, which can increase development costs.

Development spot 6: Research-based, evidence-based design and assessment

Utilizing more research knowledge in development activities. Software development benefits from health informatics and usability research, both from the results of the research and the research activities themselves. Research-based concepts of software functionality (e.g. user interface structure and interaction design) help software providers in the development activities. When developers and researchers together develop models and methods to be used in the software development process, as is the case in action research, the two-way learning benefits both the research and the practice. Collaboration between research institutes and software companies could be more active.

Assessing the usability and utility of HITS should be more common. Healthcare organizations are interested in measuring the usability and productivity of healthcare IT systems, which makes the development of

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metrics and measuring methods a welcomed topic for future research.

Development spot 7: General issues of HITS development

Developing new features to old software is challenging. The interviewees said that it is much easier to develop a new product from scratch than to fix and further develop existing ones to accommodate the ever-changing requirements of the healthcare organization. The complexity of the technical, social and economic environments of HITS makes it difficult to build new features into existing software products. In addition, in some cases the technology can be outdated.

Supporting both the patient care process and the end-users' work processes with software. The software must support the work activities of the healthcare professionals as well as the client (patient) process to ensure efficient resource usage in the healthcare organization.

More holistic development is needed. There is a need to increase holistic development, overall processes and functionality design. At the moment, according to the interviewees, only a tiny fraction of functionalities are designed and implemented at the same time. Due to fragmented development, it is difficult to get all the pieces to work together.

Social and health care related requirements to software. Furthermore, healthcare and social care needs to work together, which may cause additional challenges to HITS development.

Discussion

The two previous studies [3,4] presented a clear need to research the obstacles that hindered good end-user experience of HITS in Finland despite good intentions. In this paper, we studied the HITS development process from a bird's eye perspective in order to understand which factors in the process might affect the user experiences.

The study was conducted by adopting a multi-professional viewpoint on HIS development and by interviewing experts. The small number of interviewees (12) can be considered a limitation of the study, but on the other hand, all of them were experts selected through a purposive sampling method. Furthermore, they represent five different viewpoints that cover the main stakeholder groups. It is thus unlikely that significant new stakeholders would be found by expanding the number of interviewees.

The resulting stakeholder map (Figure 5) consists of two groups of individuals (patients and their relatives) and 22 organizations or organization types, as well as nine activities within the core stakeholders (healthcare providers and software provider). The role of each stakeholder and the main relations between them, as seen by the experts, were described in section "The stakeholders in HITS development". Content analysis of the interviews produced 28 individual problems or needs for development, categorized into seven development spots within and between the healthcare provider and the software provider but also related to other stakeholders. The main problems were related to communication and collaboration between the different stakeholders. In the section "Problematic areas in the landscape of HITS development" these problematic areas in the landscape of HITS development are presented in detailed level.

There is, naturally, nothing sensational in the stakeholder map. On the contrary, it should by design correspond with commonly known (tacit) knowledge of people involved with HITS development in practice. What is new is that the network of many stakeholders was established systematically through scientific methods. We have not found any similar study from any other country. There are aspects in the map (e.g., the roles of municipalities, national Ministry of Social Affairs and Health, and the national Social Insurance Institution) that indicate that some aspects of a similar map from another country would include some significant differ-

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ences. It can be only speculated what would be the development spots in other kinds of stakeholder maps.

Conclusions

The main contribution of this paper was to model the current situation of healthcare IT system development in Finland – identify stakeholders and activities as well as interaction between them that affect end-user experience. In this study a holistic view of HITS development was achieved, resulting in a model expressing the shared view of HITS development from different stakeholders' perspectives.

The results of his study showed that a significantly larger number of stakeholders are involved in healthcare IT system development than what was initially evident. They all influence the end-user experience in some way. It is not only the software product itself (whether with good or bad usability), but also several other factors that may affect user experience. If the goal is good user experience, all of the factors need to work together seamlessly. It is obvious that the way a software product is developed has an impact on the product, and furthermore that the product itself has an impact on how the user will experience the product. The external development environment (economic factors, legislation, regulation and standards, ongoing development at the national and EU levels and the user domain) sets the requirements and conditions of development. Communication between or within stakeholder organizations has a great impact, too, as well as the knowledge and skills of the individuals who participate in development.

Understanding each stakeholder's role and contribution to the complex area of healthcare information system development could help to build software products with better end-user experience. Most of the identified development points concentrated on software providers and healthcare organizations and the communication between the two. However, national authorities and patients also influence development by setting requirements and restrictions to healthcare services and the IT systems used in producing these services.

This study was designed to be exploratory research, which is a reasonable approach when the phenomenon under study is not previously well researched. The aim was not to produce an inclusive explanation for bad user experiences. However, identifying the areas where problems in the development of HITS are likely to occur and understanding what kinds of problems typically come up is a very important step towards improving the products, practices, skills, conditions and other factors that impact on the end-user experience of healthcare IT systems. Further research can now focus on what can be done and by whom to address the development spots identified by this study.

Conflict of interest statement

The first author conducted the study as part of her doctoral research but is also an employee of a HITS development company. The company did not sponsor the study financially.

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