A contextual codesign approach to promote acceptance of new supervisory technology among healthcare professionals

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Abstract

Introduction: In Dutch psychogeriatric nursing homes, tension exists between regulatory requirements and available staffing. While requirements are increasing, the workforce is remaining constant or even decreasing. To alleviate this tension, ICT means are introduced to support healthcare professionals during work. However, successful introduction of this necessary new supporting technology is often found to be troublesome. One of the reasons for this difficulty is the missing or fragmented attention for acceptance of the new technology, usually overlooking a holistic approach required in an organizational context. A positive effect on acceptance of new technology by healthcare professionals working in organizations may be achieved by deploying an approach that combines design activities from user-centered design (UCD) and participatory design (PD), and embeds this new design environment from the very first design activity in the organization.

Objectives: The primary goal of this study is to investigate the effect of such a contextual codesign approach on the acceptance of new technology among healthcare professionals. A secondary goal is the actual development of a prototype of new supervisory technology, deploying the approach.

Methods: A contextual codesign approach combining UCD and PD in an organizational context was developed. This approach was then deployed within a nursing home to introduce supervisory technology. Three groups of subjects participated in the study; (a) directly involved, taking part in the central codesign session, (b) indirectly involved, working in the same nursing home on a different part of the same ward and, (c) not involved, working in a different nursing home. Qualitative results were gathered using a modified version of the UTAUT model. These results were further analyzed with ATLAS.ti to compare acceptance among the three groups.

Results: Results show that the participation of healthcare professionals in a codesign approach does promote acceptance of new supervisory technology. While only minor influences from the CCD approach on constructs of the modified UTAUT model were observed, results show that careful adherence to the CCD approach leads to such a well elaborated prototype with matching recognizable scenario, that all participants expect advantages of using this system in the future. As such, the basis for acceptance of the future system is laid.

Conclusion: The introduction of new technology in healthcare can benefit from the deployment of the CCD approach because of clear positive effects on acceptance. A number of issues with the CCD approach is identified and needs to be addressed in future research.

Table of contents

1. Introduction

The population in nearly all countries is ageing fast (United Nations, Department of Economic and Social Affairs, Population Division, 2013). Inherent to this development is the need for more healthcare; at the same time both as enabler for and supporter during higher ages. Because of this, healthcare expenses will rise (van Dijk, 2012). But instead of financially backing this development, Dutch authorities are making cutbacks in expenditure for healthcare and are increasing both the number and enforcement of regulations. The increased need for care has thus to be delivered by a smaller workforce, under a stricter set of regulations, and for less money. Because of these developments, the current paradigm in care of direct interaction between a healthcare professional (hp) and a patient is difficult to sustain. A shift towards an interaction model that is more supported by ICT is a possible direction for a solution (Bennis & Lenior, 2014b; Heart & Kalderon, 2013; Yang, Kankanhalli, & Chandran, 2015).

A typical context to illustrate this tension between increasing regulatory requirements and available staffing is the following. Certain patients or patient groups, like those receiving intramural psycho-geriatric care, are required by Dutch law to be supervised by an hp at all times during care. Observations and previous research show that this supervision requirement is nearly impossible to maintain at all times in practice (Bennis & Lenior, 2014a). Available hp's are very busy during their working hours with delivering (urgent) care or assisting co-workers. This workload has a direct impact on the physical supervision of the communal living room where most patients stay during the day. Because it is necessary to treat supervisory tasks with lower priority, the communal living room is not completely supervised at all times. This tension between legislation and workload outlines a typical situation in which ICT can possibly support the tasks of an hp.

Introduction of this needed new supporting technology in healthcare is unfortunately often cumbersome (Leu, O'Connor, Marshall, Price, & Klein, 2012), the positive effects are overrated (Black et al., 2011) or not without unintended consequences that undermining patient safety and occasionally harm patients (Harrison, Koppel, & Bar-Lev, 2007). Next to a troublesome introduction, countless currently running ICT systems are never used to their full potential. Because of missing human action a great number of features simply remains unexplored, rejected, or forgotten (Orlikowski, 2000). This limited use can range from the circumvention of certain (perceived) system inefficiencies – e.g. develop "workarounds" (Hurley et al., 2007), to not using the system at all. We believe these systems to have been developed with too little attention for the combination of organizational context, the individual users, and the tasks users have to perform. This creates an interaction mismatch, among others preventing rapid acceptance.

To prevent this overlook of acceptance, the design process of professional ICT systems will need to be based on a more holistic view, taking the coherence of context, users, and tasks more into account. We will therefor explore an approach which will combine parts of existing methods to facilitate a better focus on the cohesion between the system, the users, the users' tasks, and the organizational context, supporting acceptance in such a way.

One of the existing methods to align these facets of the design process is Participatory Design (PD), offering tooling to involve the end-user in such a process. Facilitating that basis, the method User-Centered Design (UCD) offers the process initiator ways to create a good fit of the design process on the participants and their tasks, and the environment. In this new approach, both PD and UCD will facilitate the core of the approach in which the end-users will develop the solution for themselves. Such an end-user involving session is known as a codesign session, in which collective creativity in favor of the design process is

contributed by participants not specifically trained in design (Sanders & Stappers, 2008). Combining PD, UCD, and codesign will result in a carefully designed participatory environment in which the end-user is strongly engaged. This participatory environment is embedded in the organization from the very first design activity, securing utilization of results, compliance with legislation, and continuous improvement of the solution through consecutive iterations.

Through such an approach, a more design-involved end-user will have more stakes in the new technology. Also, because of the strong and direct embedding in the organization, the various concerned organizational stakeholders are continuously involved during all steps in the approach. We believe this close involvement of both users and stakeholders will support smoother acceptance of the solution.

Our research question is therefor as follows: "To what extent does the participation in a codesign approach promote acceptance of new supervisory technology amongst healthcare professionals?". To answer this question, first the construction of the Contextual Codesign approach will be explicated. Then, to explore the reach of this extent, a prototype for supervisory technology will be developed using the contextual codesign approach and acceptance will be assessed among users with different levels of involvement in the design process.

2. Theoretical framework

The research question posits a certain relation between *acceptance* and the deployed *design approach*. In the theoretical framework we will therefor explore these two main components of the research question. After this exploration, the setup of the codesign approach will be elucidated.

2.1. Acceptance

Already in 1991, Mark Weiser described the process of the seamless integration of computers into the world (Weiser, 1991). Current information technology is indeed manifested in all conceivable desirable and required forms and shapes and can exist both ubiquitous (everywhere and anywhere) or as a variant of desktop computing (laptops, tablets, etc.). This information technology is inhomogeneous, invisible, comprehensive, smart, and mostly unmonitored; directly interfering with people's everyday life – aware or unaware (Langheinrich, 2012), both in their professional context as well as private settings. This disappearance of (technical) barriers creates the situation that the expending technology power can only be harnessed through the ability to create applications of technology that people are willing to use (Davis, Bagozzi, & Warshaw, 1989). Wang (2005) confirms this relation by stating that a combination of technological advancements and user acceptance determines the success of any information system. This is also true within organizations; one can introduce all forms of technology in organizations, but technology can only improve productivity when it is accepted and used by employees (Venkatesh, Morris, Davis, & Davis, 2003). In health settings the need for acceptance of new technology is also confirmed. Ziefle and Rocker (2010) found through a study of acceptance motives, that acceptance issues and users' needs and wants should be considered in order to successfully design this new medical technology. (Holden, Brown, Scanlon, & Karsh, 2012) explains through a cross-sectional survey of registered nurses that success with technology can benefit from assessing end-user acceptance and making clear the promoting factors.

Summarizing: acceptance is an important attitude towards a new technology and is influenced by various factors (Renaud & Van Biljon, 2008). The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) (figure 1) includes these factors (*ease of use, perceived usefulness,* and *attitude towards use*), and considers these factors from a more general level (through the constructs *Performance Expectancy*, *Effort Expectancy*, and *Social Influence*). Further, UTAUT contains, when compared to other acceptance models, many strong predictors of acceptance (according to Venkatesh et al. (2003), the UTAUT model explains approximately 70% of the variance in behavioral intention). The UTAUT model was therefor selected to systematically investigate these factors that influence acceptance of new technology by hp's. The intermediate construct *Behavioral Intention* (BI) in the UTAUT model, which is build up out of three core constructs (*Performance Expectancy* (PE), *Effort Expectancy* (EE), and *Social Influence* (SI)), is in this study interpreted as "acceptance" (Akbar, 2013).

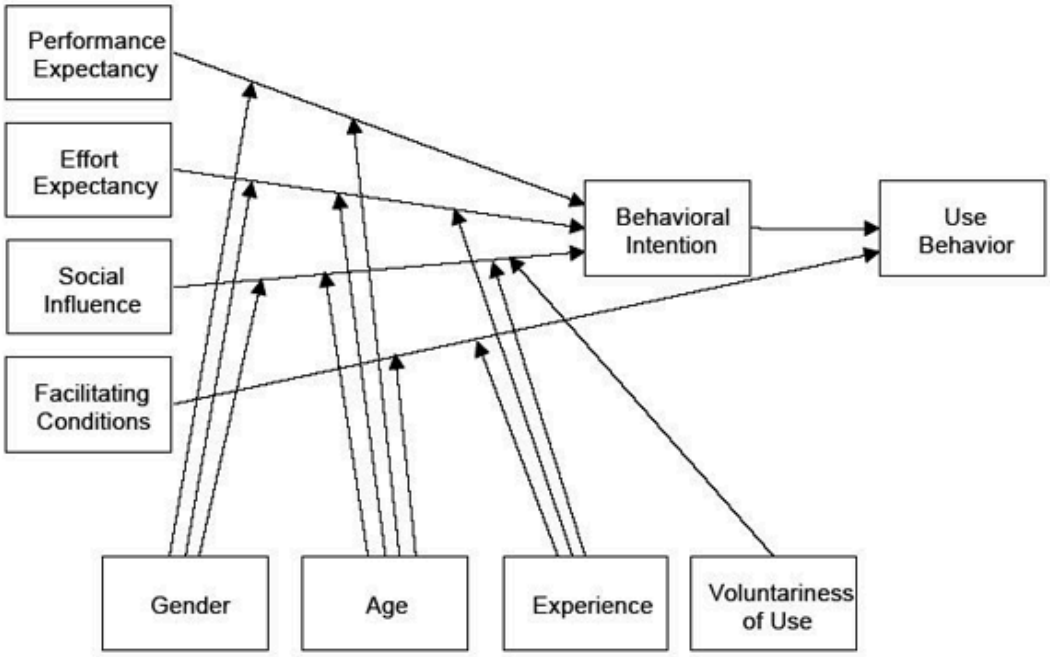

Figure 1: original UTAUT model

2.2. Design approaches

A design approach should guide an entire design process, e.g. from the first idea to the final implementation of the solution, within a certain context. One of the generally agreed upon principles regarding such an approach in Human-Computer Interaction (HCI) is designing with the user in mind; users should be involved in the design process to ensure the development of usable systems (Bekker & Long, 2000). Two of the major HCI design approaches that fit on that principle are User Centered Design (UCD) and Participatory Design (PD), though their practicalities are somewhat different.

Incorporating the user's perspective into the software development process is the main concern for UCD. UCD adheres to a number of key principles in order to achieve a usable system, being: active involvement of users and clear understanding of user and task requirements, allocation of function between user and system, iteration of design solution, and multi-disciplinary design teams (Maguire, 2001).

Instead of learning about users and applying this knowledge in the design of systems, PD explores conditions for extensive user participation in the design and the introduction of ICT systems at work. It is realized that the skills and the experiences of professionals need to be present in the design and organizational implementation of ICT systems and the work they support. This to achieve a better fit between technology and ways to perform work (Grudin, 1993) (Kensing & Blomberg, 1998b). PD assumes that both the users and the designers have different background and belong to different communities of practice. Further, the practice of the user is the starting point for the design (Bødker & Iversen, 2002).

An other approach with a typical focus on the end-user is codesign, a form of co-creation compatible with the mindset of most users (McCarthy & Wright, 2004; Vredenburg, Mao, Smith, & Carey, 2002), both drawing its roots from and complementing UCD and PD. Codesign can also be seen as an instance of co-creation, e.g. collective creativity in favor of the design process by participants not specifically trained in design (Sanders & Stappers, 2008). Codesign differs from PD in the fact that it does not assume any participant to be more important than another one. It differs from UCD by understanding that codesign is an evolutionary variant of UCD. UCD strongly steers designers to develop usable design solutions for end-users while codesign is more like a set of creative techniques to inspire the design process (Rizzo, 2010).

All three approaches attribute to a successful and thus acceptable technological solution. A combination of strong points from each of these approaches, placed in an organizational context, should improve design processes in ICT and yield a stronger acceptable result.

2.3. Contextual codesign approach

In the next section, the design of the Contextual Codesign approach (CCD approach) will be elucidated. Pivotal in the CCD approach is codesign.

2.3.1. Basis of the approach

Gagnon (2012) carried out an extensive systematic review of factors influencing acceptance of new technology among healthcare professionals. Gagnon found that (1) design and technical concerns, (2) lack of familiarity with ICT, and (3) lack of time to learn to use a new ICT are the most important limiting factors for acceptance. Perception of the benefits of the innovation followed by ease of use were found to be the most common facilitating factors for acceptance.

We believe that the deployment of codesign as basis of the approach offers ways to cope with the identified inhibiting factors. According to Steen, Manschot and De Koning (2011), benefits of codesign for the technology users include higher satisfaction and a better fit between the technology (service) and the users' needs (inhibiting factor 1). They also promote educating users as an improving longer-term effect (inhibiting factor 3). Further, small additions to codesign can lower the new systems' learning curve (Dodero, Gennari, Melonio, & Torello, 2014). Codesign supports a better articulation of the users' needs and wants, on the basis of which, technology can be made more suitable for the user (inhibiting factor 2) (DiSalvo, Lodato, Fries, Schechter, & Barnwell, 2011). We further believe that the close involvement of end-users during the entire process will have a positive effects on the limiting factors.

Next to these advantages, an contextual embedded codesign approach was selected because we adhere to the view of Stappers and Sanders (2008) that design is no longer simply the development of products for users. Design must support future experiences of users, communities and cultures. This also applies within organizations. The scale of this complexity cannot be addressed using a single HCI design approach alone.

The revised CoDesign framework by Sanders and Stappers (Sanders & Stappers, 2014) (figure 2) was used as a starting point for the new approach because of its recognizability in the design process and its strong practical applicability.

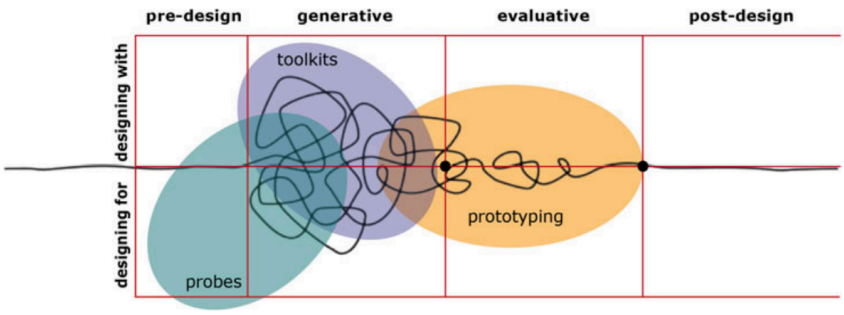

figure 2, revised CoDesign framework by Sanders and Stappers (2014, p. 11)

Horizontally, the framework shows two distinct mindsets: designing for (with the user as subject) and designing with (the user as partner). Vertically a number of research phases are recognized: pre-design, generative, evaluative, and post-design. Onto this grid, three approaches to making (probes, toolkits, and prototyping) are positioned. The curly line depicts the timeline of the design process, being very explorative at first to almost completely established in the last research phase. The timeline also shows the effects of the approaches on the design process. Probes stir up the design process, toolkits support exploration and elaboration, and through prototyping the design process is gradually becoming more and more focused.

This Codesign framework was further extended with methods and instruments from both UCD and PD to embed the codesign core. This combined environment from UCD and PD provides input for the central codesign sessions, ensures proper evaluation and follow-up and, through the inclusion of iterations, focuses on the importance of the continues cooperation with end-users.

As such, a holistic design approach was developed which incorporates a combination of identified design approaches and considers all activities in an organizational context. Because the approach is developed with a strong notion of codesign, and the approach will

be strongly embedded within an organizational context, it will be named "*Contextual CoDesign Approach*" (CCD approach), see figure 3.

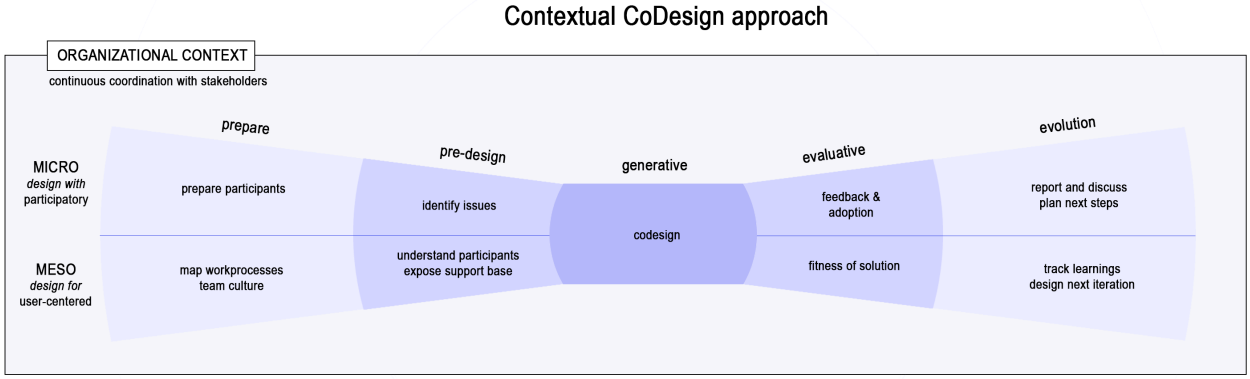

figure 3: CCD approach

In the approach, elements from the design approaches UCD and PD are placed horizontally. PD is designated as the *micro* level, in direct relation with the user. UCD is designated as the *meso* level, where design for the user takes place. The various phases of the design process are placed vertically (*prepare, pre-design, generative, evaluative,* and *evolution*). At the intersections, relevant activities are placed.

Codesign has many benefits for users of the future system (the bottom up approach, strong end-user involvement etc.), but focusing our view and efforts on those future users alone would be too limited and not realistic. The role of the organization and the possibilities and effects of changes within that organization should also be addressed. In the CCD approach, the *organizational context* is recognized and understood as context wherein the approach operates. In the current state of the model, it is addressed in a rudimentary form – through continuous coordination with organizational stakeholders only.

In the next paragraphs, the approach will be further explained.

2.3.2. Phasing and leveling

The revised CoDesign framework (Sanders & Stappers, 2014) offers a solid starting point but a more distinct phasing was applied. We adhere to the definition and most of the purpose and results of the *pre-design phase* as put forward by Sanders and Stappers. We however believe that the preparation of the participants should happen in contextual interviews, through informed observation, and work shadowing, instead of starting with probes (figure 2). Probes are very personal because of the open question nature, yet also very distant because of the elaboration – often on paper. Without prior contact, they can come across as being too intimate, while an introduction through, for example, work shadowing is more personal and thus more fitting, especially in a health context. We therefor introduced the phase *prepare*. We also believe that probes should be combined with (contextual) interviews. By placing probes and interviews in a single phase (*pre-design*), their interaction is clearer.

The *generative*, and *evaluative* phases from the CoDesign framework are adopted in the CCD approach, slightly extended with instruments from UCD and PD; a codesign session, an acceptance assessment, and prototyping.

The *post-design* phase was removed and replaced by an *evolutionary phase* to prescribe and secure follow-up activities (IDEO, 2013). This because Sanders and Stappers combine

the purposes and goals of the *pre-design* and the *post-design* phases, leaving the *post-design* phase somewhat without character. We believe that the last phase in the approach should be more prescriptive in the use and reuse of the achieved results.

Design participants in the CCD approach should be activated on one level, guided on an other level and their activities should be embedded in the organization on an other level. Therefor, the resulting model was split up into two levels of analysis (Liljenström & Svedin, 2005): the *micro level* (individual, in our case: individual end-users) describing the design with the user (PD), and the *meso level* (group or population, in our case: project basis) describing the design for the user (UCD). The *micro* and *meso* level follow the approach within the classification made by (Sanders & Stappers, 2014); *design with* and *design for*. Finally, these levels form the participatory environment which is enclosed by the organizational context.

Micro level

On the micro level, we focus on design with the intended end-user. This level has a very participatory design (PD)-like character (Sanders & Stappers, 2014). We use contextual interviews, codesign sessions and interviews; all typical PD like techniques (Kensing & Blomberg, 1998a) to iteratively construct the emerging design. Following is a description of the goals and activities of the micro level in the approach from phase 1 (prepare) to phase 5 (evolution).

Participants are prepared for coming activities (**1: prepare participants**) and issues regarding the goal of the project are identified through contextual interviews (**2: identify issues**). Researchers spend several days and shift in the organization, getting to know the staff, the procedures and the attitudes of the staff towards those procedures. The staff should know and recognize the researchers. The researchers should strive for acceptance and trust within the organizational department.

After the codesign session (**3: codesign & prototype**), acceptance of the solution will be individually determined using interviews based on constructs of the quantitative UTAUT model (this quantitative modification is explained in full in one of the following chapters) (**4: feedback and acceptance**). Based on the results of the acceptance assessment, the level of acceptance between different groups of participants that had a different treatments within the research can be discussed. During the evolution phase, participants and other staff will be invited to a presentation and a meeting regarding the results of the research (**5: report and discuss**).

Meso level

The *meso* level mostly takes on an User Centered Design focus. We deploy typical UCD techniques such as user observation, and usability testing (Maguire, 2001) as well as design approaches such as cultural probes (Gaver, Dunne, & Pacenti, 1999), to reach the various design goals as defined in the contextual codesign model. Following is a description of the goals and activities of the meso level in the approach from phase 1 (prepare) to phase 5 (evolution):

During user observation, work processes and the team culture are explored by the researcher (**1: map work processes and team culture**). This first reconnaissance is used to construct probes, an innovative user centered design approach based on self-documenting (**2: understand participants and expose support base**). The results of the probe help the researcher to design the codesign session.

After the codesign session (**3: codesign & prototype**), a technical prototype will be constructed to test the fitness of the solution through a usability test (**4: fitness of solution**). Acceptance of this solution will be measured on the *micro* level during phase 4. The learnings from this iteration will be documented during phase 5 (**5: track learnings and design next iteration**). These learnings will then also be used to design the next iteration.

Organization context

The participatory environment described above (consisting of the micro and the meso level) is embedded in the organizational context. This because acceptance within organizations is decided at two levels, both the organizational and the individual level (Frambach & Schillewaert, 2002), and because we want to address influences from organizational limits on the solution. The construct "stakeholders" includes all organizational entities like management, personnel, or other concerned parties.

Important issues in the organizational context are legislation and culture. Both have their influence on the design phase and the possibilities with the result of the design process. In continuous coordination, both legislation and culture are investigated, and aligned with the scope of the codesign session. Afterwards, compliance is checked and organizational fit evaluated. Issues are resolved or marked as outstanding and documented for the next iteration. Unresolvable issues can trigger an early start of the next iteration, maintaining the experience gained.

2.3.3. Design activities

Following the elaboration of the goals and activities in the levels of the CCD approach, and considering the applicability in the intended practice setting, relevant methods and techniques were placed in the resulting cells to support those goals and fit the setting (figure 4).

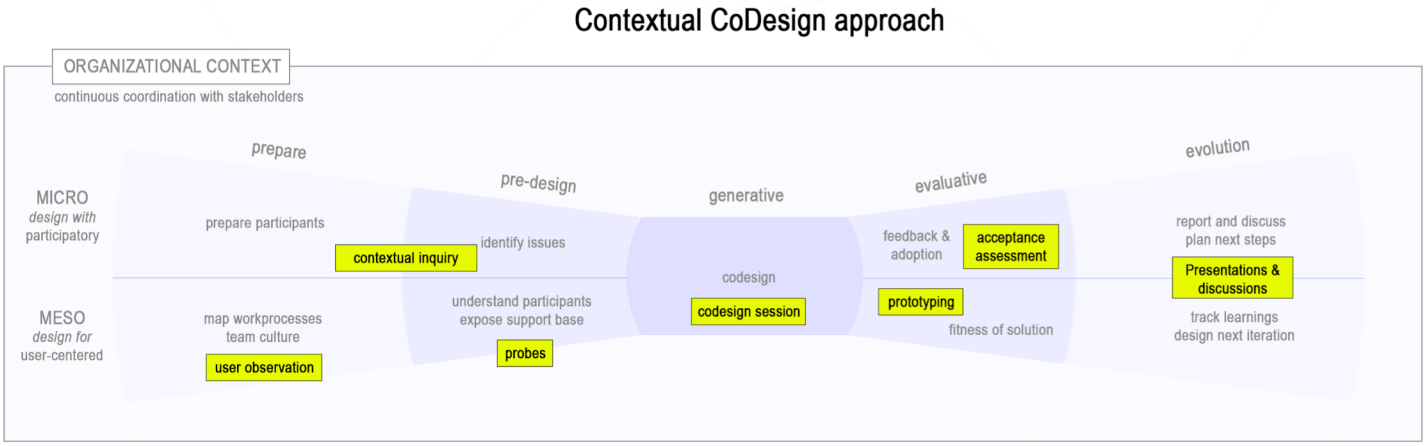

figure 4, CCD approach with methods and techniques

Selected methods and techniques for the CCD approach are *user observation, contextual inquiry, probes, codesign session, acceptance assessment, prototyping,* and *presentations & discussions*. Following, these methods and techniques will be exemplified.

User observation

To familiarize with the culture and to gain more insight in existing work processes and the adherence to them, the end-users will be observed. A researcher will view these users as they work in a field study and will take notes on the activity that takes place. Observation will be direct, also to deepen certain issues. Further, the observation also functions as an introduction of the study at hand; all participants will be involved during the user observation. Multiple work shadowing rounds will be setup, eventually resulting to a solid insight into the goings in the workplace.

Contextual inquiry

Contextual inquiry will be setup through work shadowing, interviewing, and marginally participating with the work. An advantage of deploying such an actively involved inquiry is that the trust of the participants will be gained and distortions due to the presence of the researcher are overcome. Further, contextual inquiry combines very well with user observation so both techniques can be executed in parallel. The interviews are done when the participants are performing work; in familiar context. The researcher interferes as little as possible to not affect the raw data collected. The results of the contextual inquiry, combined with the insights of the user observation, create an adequate starting point for the development of probes.

Probes

Probes can reveal the personal perspectives of a user to enrich design and support empathy (Mattelmäki, 2006). These probes aid the researcher in understanding the participants and to expose the support base for changes. It also gives direction to the codesign session. To perform a probe study, probe packages will be developed and supplied to end-users. These probes are setup with various challenging and ambiguous assignments to discover more of the motives and drivers of the end-users. The probes are further designed to have the participants think about technology and the applicability of that technology.

Codesign sessions

During the codesign session, which is a generative design method, the tacit and embedded experiences and knowledge of the participants will be addressed. All typical codesign elements must be present during the session to fully challenge the participants, leading towards the best results. According to Hagen (2011), those typical elements are:

1) **Visual, creative, expressive.** The emphasis on visual material, also to make things and freely associate.
2) **Physical and tangible.** Explore, visualize and remember.
3) **Based on storytelling.** Putting things into context, a central way of sharing, communicating and visioning.
4) **Playful.** Helping participants open up.
5) **Reflective, personal, and subjective.** Participate from own position with a professional attitude supplemented through the probes.

A typical way to design a codesign session using the methods is: a codesign session will be initiated with a storytelling part (3). Working towards the (2) physical and tangible, a

number of objects will be on the table. These objects must encourage fun (4), association (1) and exploration (2). A number of object should refer to the insights from previous activities, to trigger reflective parts (5). Explicit choices should be elicitated and expressed, to give form to the prototype but also to invoke discussion.

Prototyping

A first version of the technology, fitting the requirements stemming from the cocreation session, will be developed using prototyping. Because both hardware and software are not determined yet, and there is space for design, the prototype will be a combined effort from available and affordable hardware, and custom software.

Acceptance assessment

To facilitate evaluation of the design within the approach itself, a qualitative supplement to UTAUT was developed; the "UTAUT interview". Work has been done in this direction (van Biljon & Renaud, 2008), (Pappas & Volk, 2007) but obviously the resulting qualitative interview are tailored to specific situations, in specific languages with specific culture. To better support the CCD approach, a new variant was developed.

To make use of the UTAUT constructs in a qualitative way in order to say something about acceptance, the UTAUT model itself required some changes to better fit the CCD approach. The fourth core construct *Facilitation Conditions* was removed because it only has a direct influence on *use behavior*, not on *acceptance* (which, in its turn, also influences use behaviour).

The UTAUT model states that the effect of the three constructs on *acceptance* is moderated by four other variables: *Gender, Age, Experience,* and *Voluntariness of Use*, usually in a certain combination that strengthen or weaken the effect of a core construct on *acceptance*. These moderators play an important role in the explanatory power of the model (Sun & Zhang, 2006).

Because of the small group sizes in this study (n is at most 5 per group), the moderators *Age* and *Gender* were discarded. Splitting the groups in *Age* or *Gender* subgroups would make the samples too small.

The moderator *Experience* explains the experience a user has with the system at hand. Since this system is only is a prototyping stage, the experience of all users with the system is none. We can however assume, that the *Experience* moderator will have a stronger effect among subjects that have already discussed the design during the cocreation session, thus are present in the one of the involved groups in the design process.

A similar effect can be expected on the moderator *Voluntariness of Use*. One might be more inclined to voluntarily accept a solution that one actually helped creating. The effect of the moderator *Voluntariness of Use* is expected to be stronger for subjects that took part in the Intervention group.

However, because the CCD model has a qualitative nature and the UTAUT interview will focus on the core constructs of the UTAUT model only, the moderating effect of *experience* and *voluntarisness of use* on other relations (for example the influence of *Social Influence* on *acceptance*) can not be determined. Therefor, these moderators are also discarded.

This modified UTAUT model was used to develop the UTAUT interviews. The interviews were based on the highest loading UTAUT items (Spil, 2005; Venkatesh et al., 2003). Each item was translated, adjusted to be presented as a statement and supplemented with in-depth questions. Based on the answer of the participant, a sentiment score (positive, neutral, negative) will be assigned during the analysis. The interview itself will be semi-structured with structure determined by the various constructs and their items.

Because these evaluative interviews are designed on the basis of UTAUT constructs, it becomes possible to assess the acceptance of the new technology using the results of the interviews.

Refer to appendix 1 for an elaboration of the qualitative UTAUT questions.

Presentations & discussions

The results of each iteration of the CCD approach must be secured to enable the planning of next steps, to track learnings and to serve as an information backlog. In the form of presentations, participants and other stakeholders from the organization can be informed quickly about the current state of the project. Through discussions, face to face or in the form of, for example, focus groups, results are tightened and prepared for the next iteration. A final presentation including transfer of all related material to enable the organization to continue the project in the future is only one of many suitable ways to complete the project.

3. Process of the CCD approach

The main goal of the study is to explore the effect of a contextual codesign approach on hp's willingness to accept the new technology. This research will be exploratory and be used to explain the nature and context of certain phenomena, therefor a qualitative research approach was selected.

This study will be setup as a series of case study according to Yin (2013). The research question is explanatory, contemporary events are examined, and in experimental settings it will be possible to focus on one or two specific variables. The hp's but also a number of organizational stakeholders will be the main units of analysis in this case study.

To investigate the effect of a Contextual Codesign approach on the willingness to accept new supervisory technology by hp's, an appropriated test has to be performed. The CCD approach will be deployed to develop a prototype to support the supervision of communal living rooms in a nursing home.

This chapter describes the design, setup, execution, and evolution of results of the test, based on the CCD approach, covering everything but the acceptance assessment component. After the presentation of the results of this test iteration in the next chapter, a chapter with the process, execution and results of the acceptance assessment will follow. This dichotomy is applied because (a) the extensive setup and results are now split-up in a practical part (realization up to the prototype) and a more theoretical (acceptance) part, (b) relating the acceptance part to the realization part will answer the research question, and (c) the readability of this thesis benefits strongly from such a division.

In this chapter regarding the test, first the context will be discussed, followed by the level of involvement, the participants, soundness of design and execution, and the procedures of the CCD approach.

3.1. Context

The research will be carried out in three closed wards of nursing homes with psychogeriatric patients. Each ward consist of 3 nurses, 2 "helper" assistant nurses , and 2 hostesses. The nurses are in charge and the only ones who are allowed to handle and administer medication. The hostesses support the team during breakfast, lunch and dinner. The assistant nurses provide support to the nurses by e.g. changing incontinence material or "lifting" the patients in and out of their beds. Each wards further consists of 10 rooms which all accommodate one patient suffering from a psychogeriatric disorder to a certain degree, and a communal living room.

Two wards of the three wards are completely comparable, housed on the same building floor, not physically divided and completely equipped as independent units. Both wards have their own communal living room, located at the far ends of each ward. The third ward is located in a different building in the same town, operated by the same healthcare facility.

3.2. Level of involvement

To explore the effect of the codesign session, we will work with three groups of hp's, one from each ward, during the test. Each of the three groups has a different level regarding the participation in design activities (table 1).

Group	Participating in phase				
	Prepare	*Pre-design*	*Generative*	*Evaluative*	*Evolution*
Directly involved	yes	yes	yes	yes	yes
Indirectly involved	partly	partly		yes	yes
Not involved				yes	yes

Table 1: Level of involvement

One of the two groups on the adjacent wards is *directly involved*, the other group is *indirectly involved*. The *directly involved* group will be involved in the design process and develop a technological solution to maintain supervision over the patients that are located together in the communal living room, at times that the nurse supervisors are not physically present. The *indirectly group* will only be involved during the contextual interviews, and will be close by when the other activities take place. The third group, from the single ward, will not be involved at all, at distance and will thus be unaware of the developments. After the design activities have delivered a prototype, this prototype will then be discussed with participants of all groups during the acceptance assessment. Based on the answers to the questions, a qualitative comparison of the intention to accept the created technology can be deduced.

It is intended that group *indirectly involved* will be informed through informal talks with colleagues from group *directly involved*. To take this effect into account in the results, a question regarding this informal talks will be included during the acceptance assessment. Also, the contextual interviews will for a part also take place with group *indirect*. The participants from group *indirectly involved* will therefor be somewhat "in the loop" regarding the development of the prototype - they know that their colleagues developed this prototype. It is therefor expected that acceptance among participants from group *indirectly involved* will almost match the level of acceptance from group *directly involved*. Finally, group *not involved* will be totally unaware of the procedure followed. It is expected that acceptance among these participants will be lower than the acceptance of the participants of both group *directly involved* and group *indirectly involved.*

The types of research deployed are derived from the CCD approach. This includes contextual interviews, user observation, probes, interview using video types, and presentations.

3.3. Participants

A total of 13 hp's, both female (11) and male (2), have participated in the study. The average age is 39, the standard deviation is 13, the oldest participant is 58 and the youngest is 20. All are employed by the same employer, at two different nursing homes. Participants were selected from three different wards. Based on these wards, the three groups were composed. The *directly involved* group contains 5 hp's (avg=37, sd=12, min=20, max=55), the *indirectly involved* group 4 hp's (avg=38, sd=14, min=23, max=58), and the *not involved* group also contains 4 hp's (avg=43, sd=13, min=22, max=57).

3.4. Soundness of design and execution

The trustworthiness and the consistency of this study and its results are determined through the qualitative research standards: credibility, transferability, dependability, and confirmability (Williams, 2011). The study (containing the approach, the test and its results) will be held as a whole against these standards to verify its validity and reliability. Following is a design to account for these research standards.

To make the study believable in general and approvable by the participants, credibility is required. We achieved this credibility through (a) prolonged engagement, (b) persistent observation, and (c) member checking.

(a) During the first two phases of the CCD approach, ample time will be reserved for contextual interviews. Through work shadowing, interviewing, and slightly participating with the work, trust of the participants will be gained and distortions due to the presence of the researcher are overcome. A broad and varying range of events are to be experienced, making the results more credible.

(b) Parallel to the contextual interviews, user observation will be performed. This enables the researcher to deepen certain issues, mostly regarding the observation of the communal living room. Using the probes as addition, opinions and events regarding observation will also be investigated further in depth.

(c) The results of the probe will be individually checked with the participants who completed the probes. This will take place in the form of interviews and during these interviews, the results of the probe will be discussed and adjusted where necessary. The resulting prototype are included in the acceptance assessment, showing the design participants the outcome of the codesign session. No feedback regarding the processing were received.

Next to credibility, the transfer of the findings in this context should be made possible. Transferability is facilitated by thick descriptions to support comparison of target contexts to this research' context. We seek to comply to this criterion by providing extended descriptions of both participants and context throughout this study.

After investigating credibility and transferability, dependability – the stability of the inquiry process over time – was looked at carefully. To ensure this dependability, multiple steps in an audit trail are to be discussed with peers. More consistency of the conceptualization, the collection of the data, the interpretation of the results, and the final reporting thereof are achieved through this reviews – the techniques of the credibility and transferability will also be discussed thoroughly.

The fourth standard, confirmability – the quality of the results -, will be established using intercoder reliability on the coding of the acceptance assessment transcripts.

3.5. Procedures of the CCD approach

To answer the research question, and to develop the prototype, the CCD approach was completely run through.

3.5.1. Contextual interview and user observation

During the first two phases (*prepare* and *pre-design*), the organizational context was monitored through continu coordination with various internal stakeholders. These stakeholders were all internal to the nursing homes. Multiple discussions with the location manager of both nursing homes were carried out to select, investigate, and review current

legislation and possibilities and directions for the study, organizational culture, and other stakeholders during the study. The location manager was also consulted to make sure that the design activities were aligned with Dutch legislation and organizational possibilities (available time from participants, available spaces, the form of the deliverables and so on). Apart from all organizational interests, general national care legislation was found to be applicable at all times. At a decision level below, both team managers worked and communicated along the same lines, thinking along and being available. Results were frequently presented to the two of them, keeping them informed. One of the team managers was also a participant during the study.

On the micro level, contextual interviews were performed during job shadowing two entire shifts; one daytime shift and one nighttime shift. During the work shadowing, many questions were asked and remarks were made that deepened the knowledge of the context and the participants by the researcher. Also during this job shadowing, the user observation activity from the meso level was performed in a non-participant observer role. The handling of the patients and their directly involved family members, the alarm system per room and the communal living room, daily programme, facilities, roosters, medication, and the like were observed. During these interviews and observations, procedures and the adherence to them were identified.

Through small remarks about supervision and other technological aids, and through several probing questions, the participants were challenged to form an opinion about supportive ICT. Interest to participate in the codesign session was created. Because the researcher was visible for a number of larger periods at the ward, recognition, greeting and informal chatting became more common. A certain feeling of connectedness and trust was formed.

Eventually an understanding and an interpretation of the work of hp's was compiled. During the second observation round, a small number of new observations were found, the results of the first round were also discussed and sharpened.

3.5.2. Probes

Following the interviews and the observations, and based on the results of those activities, probe packages were designed. The probe packages are shown in figure 5 and consisted of the following components:

- cover sheet with whitespace for a written participant name
- a letter introducing the probe, thanking the participant, and explaining the confidentiality of the gathered material and the follow-up (the codesign session)
- **map**: a large map of the entire closed ward with a small note attached asking the participant to address 4 issues regarding supervision that range from enjoyable to alarming. The location on the map was not important, the idea of a map was used to more easily recover past events.
- **technology skill assessment**: two sheets with 6 technologies on them. Participants are asked for each technology to score their own skills and the applicability of the technology on the job on a 3 point Likert scale ("very skilled", "skilled", "not skilled").
- **remote supervision**: a sheet with a picture of the communal living room. Participants are asked to indicate how supervision can be maintained over distance (telecare).

Three options are given (security camera, microphone, and hp), a large whitespace is available for “better ideas”.

- A pen, a pencil and a gum
- Each probe is enclosed in a colorful plastic folder.

Figure 5: Probe packages

In consultation with the team manager, the probe package were delivered to the participants via the team manager. The participants were given 7 days to fill out the probes, after which all probes were collected. All five employees participating in the design activities completed the probes.

3.5.3. Probe interviews

To maximize the effect of the probe data, and to show the participants the value of their submissions, each participant of the design activity group was interviewed for half an hour regarding the results of the probe. Based on the elaboration of the probe, depth questions were asked. The opinion of the participants on probes was also explored.

3.5.4. Codesign session

The codesign session took place at the nursing home in a well lit, quiet office with a large conference table with comfortable yet active seats providing a pro-active mood. All six design participants were present (researcher plus 5 hp’s). After a short introduction to set everyone at ease, and to initiate discussion, the session was started.

The anonymized results of the probes were shared with everyone. Next to those results, a number of brought-along items by the researcher were specifically selected to support and fuel the codesign session (figure 6).

- Three photo frames of different sizes to illustrate possible tablet sizes.
- Glasses with LED’s facing forward to illustrate intelligent glasses
- A sunshade illustrating possibilities for portable displays
- A watch illustrating smart watch functionality
- Lots of pens and paper to support paper prototyping / idea sketching

Figure 6: codesign items

The codesign session was initiated with a storytelling part, using the (anonymized) results of the probes as a starting point. Working towards the physical and tangible, the brough-along items were placed on the table. The participants were thus not working with technical devices but more with items with outspoken shapes, forms, and/or material. Also, these items did encourage fun, association and exploration. A number of items refered to the insights from the probes, to trigger the reflective part from the probes. Explicit choices were expressed, to give form to the prototype but also to invoke discussion. The participants were from a care setting and were expected to act and react in a primary way, mostly intuitive. Because of this, the codesign session was not formally framed. Discussion and subsequent consensus lead towards a good starting ground to initiate work on the video prototype. In this specific case: where and how should ICT support telecare. How could the communal living room be supervised, without a nurse physically present?

After one and a half hour, extensive specifications for the prototype were discussed and drafted.

Multiple video cameras captured and recorded the session for later processing. The results of the session, a list of requirements, were used to start the work on the digital prototype. This prototype should carefully represent the ideas as put forward during the codesign session.

3.5.5. Organizational context

After the codesign sessions, stakeholders in the organizational context were informed about the course of the codesign session, the engagement of the participants and the results. Further steps in the process were explained and dates are secured for achievements and future appointments. Possible commitment of staff was discussed.

3.5.6. Prototype

The prototype was developed by the researcher based on the requirements that stemmed from the codesign session. Design heuristics (Nielsen, 1994) and a skilled background were

used to develop a first version of the technology. In appendix 6, an impression of the prototype is presented.

3.5.7. Presentations and discussions

Finally, discussions are conducted and reports are drafted to finalize one iteration of the approach.

4. Results of the CCD approach

The previous chapter discussed the process and the procedures of the CCD approach. In this chapter, the results of the CCD approach, minus the acceptance assessments, are presented.

4.1. Contextual interviews and user observation

User observation was performed to familiarize with the culture and to gain more insight in existing work processes and the adherence to them. Parallel to the user observation, contextual inquiry was deployed. Through this, the trust of the participants was to be gained and distortions due to the presence of the researcher were to be overcome. The results of the contextual inquiry, combined with the insights of the user observation, were expected to create an adequate starting point for the development of probes and support the development of a realistic scenario.

During the contextual interviews and the user observation period, a accurate log was tracked. The final contents of this log were condensed and used to serve as a starting point for the probes and the test scenario. The probes' starting point proved itself valuable because of the good reception of the probes by the participants (as stated in the probe interview). Further, the drawn up scenario that has been run through with all participants during the acceptance assessment phase was very recognizable for all participants, even those not present in involved groups. This scenario can be found in appendix 5.

The fitting scenario and the proper way of developing the probes, showed a good connection of the researcher with the users.

4.2. Outcomes of the probe design activity

The probes were deployed to give direction to the codesign session and to aid the researcher in understanding the participants.

After the probe packages were collected, the data was analyzed. The issues that were indicated on the "map" component of the probe package (refer to appendix 2) were placed into groups. This to verify the goal of this component of the probe; do the participants endorse the goal of the codesign session – considering technological means to support supervision. As can be seen in table 2, most indicated issues are indeed regarding supervision.

Issue #	Incidents group description	# incidents
1	No supervision in required areas	9
2	Situation of the ward is not patient/staff-friendly	6
3	(Fear for) intrusion / patients "sneaking" out	3
4	Understaffing	3
5	Bad camera/alarm locations	2
6	Insights in past events	2

Table 2: Incidents grouped

Most incidents reported are regarding the supervision in the required area's. The situation of the ward (issue 2) is interesting. Participants indicate that the ward creates a lot of excessive walking distance. They also address the loneliness in the hallways and the current inability to monitor the entire ward. The third issue (access and leave) also addresses the monitoring issue. Both understaffing (issue 4) and bad camera locations (issue 5) can be part of the cause here.

The second component of the probe package, the technology skill assessment, provided insight into technical competence of the participants (table 3). This component was included to gain insight in both participants' assessment of applicability of certain technological aids as well as an indication of participants' own skills using the technology.

	participant									
	1		2		3		4		5	
	own skill	use at work	own skill	use at work	own skill	use at work	own skill	use at work	own skill	use at work
smart watch	+	-	+	-	-	++	-	-	-	-
telephone / beeper	++	++	++		-	++	+	++	++	++
smart glasses	-	-	no answer	no answer	-	+	-	-	-	-
ipad / tablet	++	+	-	-	++	++	++	-	++	++
desktop computer	++	+	++	-	++	-	++	++	++	++
smartphone	++	++	++	-	++	++	+	+	++	++

Table 3: Results of the technology skill assessment

Results show that most participants are comfortable with common technology (tablets, desktops, smartphones). Participant 2 stands out because of the low score on tablet skills. She appears to be the only participant how has not used tablets before. During the interview afterwards she clearly stated not to be scared of the technology and was expecting to pick up the necessary skills quickly. During the codesign session, we can safely assume a moderate common level of technology comprehension.

The last component of the probe challenged participants to come up with alternative solutions to support supervision. Some participants mentioned the deployment of extra personel to supervise the communcal livingroom, while others did not come up with solutions or mentioned camera's or microphones. Clearly, no ready to use solution was available.

Because this component made participants think about possible solutions, an effect on the codesign session might exist because of the substantial number of raised possibilities for supervision there.

4.3. Probe interviews

The probe results were discussed with the participants during a half hour interview. During these interviews, the participants also evaluated the use of probes. The following opinions on probes were expressed:

- Probes encourage more deep thought.
- The "map" component asked participant to list 4 incident. This was motivational, the incident came up quickly
- More fun than questionnaires
- Challenging, also because of the pictures
- The probe interview was deemed important

One participant expressed doubt because the time spent could have been spent on care. We believe the probe was clearly introduced but a better introduction might be necessary.

4.4. Codesign session

The results of the contextual interviews, the user observation, the coordination with the stakeholders and the probe packages were used to setup the codesign session:

Occasion:

- Legal requirements to have supervision in the communal living room 24 hours a day (**from:** coordination with stakeholders)

Aims:

- Supporting supervisory tasks with ICT means (**from:** coordination with stakeholders, contextual interviews, user observation, probes)

To solve:

- Supervision in required areas (**from:** probe issues #1, #2 and #3)
- Situation in the ward not being patient and hp friendly (**from:** probe issue #2 and #3)
- Understaffing and current difficult supervision (**from:** probe issues #4 and #5)

Tools:

- A use scenario of a typical day at the ward (**from:** user observation)
- Collective insight in possibilities and impossibilities for ICT support during work (**from:** contextual interviews)
- Moderate collective technical insight (**from:** probe technology skill assessment)

The codesign session lasted one and a half hours. A report of the session is included in appendix 3. During the codesign session, instead of solely thinking about supervisory solutions, a combination of both supervisory tasks and reporting tasks was proposed. All participants of the session agreed to this.

Further, the participants were focused and strived for the overall best solution. It is notable that none of the participants showed a strong opinionated attitude, there was space for discussion but always with respect to one another. The supervisory issue was clearly understood and many possible solutions and issues were discussed. The use of the inspiration items added to the discussion. One of the participants even fitted the photoframes in the pockets of her working outfit.

After the codesign session, specifications were drafted and included in a requirements analysis document (appendix 4). The output of the codesign session are the requirements for VITO (the name of the portable device, meaning *Verplaatsbare Informatie en Toezicht Ondersteuning* – Portable Information and Supervision Support). These are:

1. Device has a diagonal of 8.0”
2. Is capable of displaying video and playing audio from AV sensors (camera’s and microphones)
3. Receives messages from a central server and initiates actions (alert user through event specific sounds, play specific message)
4. Offers message-followup (displaying the video from the event etc.)
5. Has medical pager capabilities (audio, video calls, sending photos to hp’s)
6. Supports reporting tasks (through audio, speech to text, photos etc.). Typing on the screen is uncomfortable and should be limited

7. Supports the playback of previous reports, on location (e.g. in the room of the patient), a “patient report”, read or read out

4.5. Prototyping

The codesign participants agreed strongly on a solution that is delivered by an 8” tablet. The Samsung Galaxy Tab 3 was selected because it was one of the available tablets with such a screen diagonal. After some searching, trying out and evaluating several digital prototyping services, Marvel (“Free mobile & web prototyping for everyone.”, http://marvelapp.com) was selected as prototyping tooling. Using Photoshop CC 2014, the screens of the prototype were developed (Appendix 6: prototyping screens). The design was based on several heuristics, combined with the requirements from the codesign phase. Using Marvel, the screens were tied together and the completed prototyping app was exported in HTML and, using Bit Web Server for Android, run locally on the Galaxy Tab 3. This to avoid network problems at locations and the be able to have good and realistic test runs. The tablet was used during all interview sessions.

5. Acceptance and the influence of the CCD approach

At this point, the CCD approach was run-through up to prototyping. To answer the research question, the extent of promotion on acceptance of the CCD approach, the acceptance assessment as built-in in the CCD approach was executed. Based on the result of that assessment, the extent of promotion was examined and the research question was answered.

5.1. Acceptance assessment

The UTAUT interviews were, together with the prototype, part of the interviews that were performed with all participants from all groups (*directly involved*, *indirectly involved*, and *not involved*). Interviews were conducted in the same office as used during the codesign session. Over a time period of three weeks, all participants were interviewed for about an hour. A protocol was used during all interviews to guide the course of the interview. The elements of the protocol were:

- Frontpage with name, age and date
- An standard introduction text to this part of the study
- An informed consent form, to be signed if not filled out yet
- A scenario describing a day from an hp in the ward. This scenario was run down to demonstrate the various aspects of the prototype (Appendix 5)
- List of statements about acceptance factors.

Participants stated their expectations regarding the statements, explaining their agreement or disagreement. The researcher deepened the answers where needed, mostly because of ambiguity. Audio recordings were made and those recordings were professionally transcribed. These transcriptions were checked against the recording.

5.2. Coding scheme

The qualitative data from the transcripts was analyzed using template analysis in ATLAS.ti. Each statement that the interviewed hp puts forward, was either linked to one of the constructs of the UTAUT model or to one of the other codes, and was scored on a 3 point sentiment score (positive, neutral, negative). The possible constructs for scoring were Effort Expectancy (EE), Performance Expectancy (PE), and Social Influence (SI). The additional other codes were *additions to prototype, heard about study, organizational issues, remarks about study* and *voluntariness of use*. To allow aggregating in the results, each statement with underlying fragments was also scored in ATLAS.ti (for example the score EE_Q2 represents statement 2 of the Effort Expectancy construct).

5.3. Reliability of analysis

Initial coding was conducted by two different researchers for two interviews to allow for comparison of interrater reliability. SPSS 19 was used to calculate Cohen's kappa representing the interrater reliability. Initial agreement for the two interviews was 0.706, substantial according to (Landis & Koch, 1977). It was however decided that two new categories for scoring were needed: *perceived enjoyment* (using a system is perceived to be enjoyable) and *aesthetics* (the system looks). Both interviews were recoded with the improved codebook (Appendix 7). The remaining 11 interviews were subsequently coded with the improved codebook by the researcher. A total of thirteen interviews were coded.

Based on all scores, the effect of the deployment of the CCD approach on acceptance can be explored.

5.4. Overview of results

Each participant responded to 13 statements in total regarding constructs from the modified UTAUT model. For the constructs Effort Expentancy (EE), Performance Expectancy (PE), and Social Influence (SI) four statements were presented. For the construct Acceptance (ACC) one statement was presented.

To have a first impression of the differences per group and per construct, the number of sentiment scores to each individual statement (positive, neutral, or negative) were summed per group and, together with the other statements, displayed in a heatmap (figure 6, one for each group). So for example, in figure 6-1, the column with the first results shows the sentiment scores for the first statement under Effort Expectancy (EE_Q1). The numbers represent the number of expectations that are expressed by the participants in the directly involved group for the horizontally placed sentiment (positive, neutral, or negative).

directly	PE_Q1	PE_Q2	PE_Q3	PE_Q4	EE_Q1	EE_Q2	EE_Q3	EE_Q4	SI_Q1	SI_Q2	SI_Q3	SI_Q4	ACC_Q1
POSITIVE (+)	6	5	5	2	8	5	5	7	7	7	9	8	6
NEUTRAL	1	3	2	1	1	2	0	2	0	2	0	0	0
NEGATIVE (-)	6	2	0	3	0	0	0	0	1	0	0	0	0

figure 6-1 heatmap directly involved group

indirectly	PE_Q1	PE_Q2	PE_Q3	PE_Q4	EE_Q1	EE_Q2	EE_Q3	EE_Q4	SI_Q1	SI_Q2	SI_Q3	SI_Q4	ACC_Q1
POSITIVE (+)	6	4	5	0	7	6	3	6	5	4	6	6	6
NEUTRAL	1	3	1	2	0	3	1	0	0	3	0	0	0
NEGATIVE (-)	3	1	0	2	0	0	3	0	0	0	0	0	0

figure 6-2 heatmap indirectly involved group

not involved	PE_Q1	PE_Q2	PE_Q3	PE_Q4	EE_Q1	EE_Q2	EE_Q3	EE_Q4	SI_Q1	SI_Q2	SI_Q3	SI_Q4	ACC_Q1
POSITIVE (+)	11	5	2	3	5	5	6	4	5	5	4	4	4
NEUTRAL	1	5	3	1	0	0	0	0	4	2	0	0	2
NEGATIVE (-)	2	1	0	3	0	0	0	0	0	0	0	0	0

figure 6-3 heatmap non-involved group

Overall we can see that all heatmaps show a large number of positive expectations over the constructs that determine acceptance. All groups seem to accept the prototype, be it with

some reservations. Elements that further stand out are the lack of neutral or negative expectations for the non-involved group under EE, the missing positive expectations for PE_Q4 for the indirectly involved group, and the high number of negative expectations under PE_Q1 for the directly involved group.

Looking further at the results and specifically the groundedness (occurrence) of codes, the added codes from the interrater reliability, *aesthetics* and *perceived enjoyment,* only have a count of 2 and 6. Results show that quotations from this codes are also very closely related to *Effort Expectancy*. Because of the low occurrence and the overlap with effort expectance, the results will be merged with *Effort Expectancy*. For sake of clarity, the quotations under *remarks about study (quotations: 25)* and *additions to prototype (quotations: 35)* will be further analyzed after looking at the effect of the CCD approach.

5.5. Review of results

Through the modified UTAUT model, expected acceptance is determined. To determine whether or not the CCD approach shows an effect on acceptance, each UTAUT construct, and its underlying statements, will be examined for CCD approach influences. Since all participants from all three groups responded to the same statements for each construct, the expressed expectations regarding the statements can be compared inbetween the groups and the effect of the CCD approach determined.

In the following section, each concerned UTAUT construct will therefore be examined. For each construct, every underlying statement will be consecutively explored using three steps.

The first step (*"overview"*) is a global examination for that statement using a table that shows the number of expectations expressed per participant grouped on the sentiment scale (positive, neutral, or negative expectation). In the second step (*"in depth"*), the responses from the participants to that particular statement are substantively discussed and compared. The last step (*"conclusion"*) pools all results for the statement and provides a conclusion. This last step also scrutinizes all results for an indication of the influence of the CCD approach using the differences in the results between the three groups.

After all statements belonging to a construct are discussed, a conclusion for that construct is given, discussing the influence of the CCD approach on the construct. After all constructs are completed, an overall conclusion will be given.

5.6. Performance Expectancy

Performance Expectancy is “The degree to which an individual believes that using the system will help him or her to attain gains in job performance”. On the following pages, first the four statements deployed to discuss this construct with participants (*usefulness of the system*, *the system as enabler of work tasks*, *work productivity with the system*, and *positive work rewards of the system*) will be elaborated. Afterwards, the effect of the CCD approach on acceptance through Performance Expectancy will be discussed.

5.6.1. Usefulness of the system

Overview

After a run-through of the scenario, demonstrating the features of the prototype named "Vito", participants were asked to respond to the statement "I would find Vito useful in my job".

Table 4 shows the number of expectations expressed per participant for usefulness of the system, grouped by sentiment (PE+, PE=, and PE-).

	PE_Q1	*I would find the system useful in my job*												
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
PE+	1	1	1	1	2	1	1	4		3	2	4	2	23
PE=				1					1	1				3
PE-				6				2	1	1			1	11

Table 4: Expectations regarding usefulness of the system

Participants from all groups express mostly positive expectations about the usefulness of the system. The not-involved group however, expresses more expectations (11 out of 23) than both the other groups (6 each). In the following paragraph, this salience will be investigated.

In depth

Positive expectations expressed for usefulness of the system:

> 4: "Je hebt gewoon veel meer overzicht als je zeg maar, ja wat je laat zien op andere kamers, dat je daar geen toezicht hebt. Dat je daar dan wel eventueel even kan kijken."
>
> 7: "Ik denk dat het vele momenten van op en neer wandelen scheelt, waardoor je de tijd weer productiever en beter weg kan zetten bij de klant. Ja, er is gewoon inderdaad continu toezicht"
>
> 10: "[De functionaliteiten], die zijn ook makkelijk, want bij onze rapportages kun je momenteel wel foto's toevoegen, maar die moet je eerst inscannen, dus dan moet je eerst naar het scherm lopen, inscannen, uit je mail halen en dan toevoegen in je rapportages. Dat is heel –"
>
> 11: "komt omdat het vaak best wel grote afstanden zijn die je moet overbruggen en daar gaat heel veel tijd inzitten. Dat je met een kort moment eigenlijk goed overzicht hebt van hoe het met een cliënt is."
>
> 12: "Ja, dat denk ik wel. Je kunt zo veel dingen al op de plek zelf, hè. Dus daar win je al zo veel tijd mee, dus, ja"
>
> 13: "Ja je hebt hem altijd bij je, je kunt – Je hoeft niet, vandaag ook, dan heb ik een rapportage moet ik weer naar de computer, moet ik hem aanzetten, hij doet het niet, moet ik weer wachten, familie staat ook te wachten"

As illustrated above, participants agree on the expected positive points: a better overview and continues supervision of the entire ward, and less walking because of both supervisory support and the fact that Vito is always carried on the person – creating possibilities for quick data entry and review. The not-involved group has a larger number of expectations because they expressed more positive affirmation ("yes", "indeed"), and individually named more examples of use.

Negative expectations are expressed, especially by participant 8 of the directly involved group:

> 8: "Hoe gevoelig is hij voor vallen uit je zak?"
>
> 8: "Ik weet het niet, maar het is best een zwaar ding wat je in je zak moet hebben hoor."
>
> 8: "Nee, want hij geeft al aan dat er iets is. Maar wat is er dan? Wanneer gaat die dan filmen?"

5: “Maar voor de rapportage heeft het dan geen meerwaarde, want ik moet dan toch nog daar de ontlasting invoeren en nog de mail doen en de telefoon.”

9: “Ik zie het dan praktisch gezien en dan denk ik als ik in dat bed sta, dan moet ik- dat kan ik niet bij me dragen, dan moet ik dat neerleggen. Hè daar zijn-“

Participants mostly express worries about carrying the device itself and impact of that during work. Also, both dropping the device and expectations of hinderence of the device during care are named. An other issue is regarding missing functionality and thus still necessary current systems – the added value of the new device is than offset directly. Finally, unclear system behaviour is mentioned. These issues arise in all groups.

Conclusion

There are some difference in numbers of expectations but taken overall, no noticable differences between the three groups regarding expectations for the usefulness of the system come forward. An effect of the CCD approach on one of the groups is not observed.

5.6.2. The system as enabler of work tasks

Overview

Following the previous statement, participants were now asked to express their expectations regarding the statement "Using Vito enables me the accomplish my tasks more quickly".

Table 5 shows the number of expectations expressed per participant for the system as enabler of work tasks, grouped by sentiment (PE+, PE=, and PE-).

	PE_Q2	*Using the system enables me to accomplish tasks more quickly*												
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
PE+		1	2	1	1	1	1	3		1	1	2	1	15
PE=	2	1					1		2	2	1	2		11
PE-				2					1	1				4

Table 5: Expectations regarding the system as enabler of work tasks

Expectations are balanced between postive and neutral across all groups, with only a small number of negative expectations.

In depth

The following examplary positive expectations were expressed for the system as enabler of work tasks.

2: Ja zeker als ik even op een rustig plekje inderdaad kan gaan zitten.

3: En mijn collega echt sneller kunnen vinden als ik ze nodig heb

5: Want als je al ziet hoe snel je met de rapportage gewoon klik op die bewoner, hé ik wil een rapportage, ik wil dit, ook naar een arts toe.

12: Ja, omdat je het gelijk kunt doen en niet op briefjes zet en dan bij de computer dat openvouwt. Dus niet kwijtraakt en vergeet.

Parcipants from all groups express expectations regarding positive support for work tasks such as: flexibility in selecting a place to work – even to only add one or two things, more effective contact with co-workers, and directly available information. There is no difference noticable in emphasis or number of expected advantages between the three groups.

The neutral expectations include, for all groups, the expected learning curve, doubs about the actual amount of time saved, and the capabilities of the finished product e.g. will it be able to support all administrative tasks.

Some negative expectations are:

6: "Ja, dat is weer, ja er zijn, net wat jij ook vroeg van het niet, sommige dingen kun je, moet je echt in het Carres afronden of regelen. En dat kan niet op zo'n tablet."

8: "Ja, maar ik denk ook kijk met mailen en met bellen en dat soort dingen, dan is dat echt niet handig als dat weer niet hier op kan. Dan moet je het andere straks hierop doen, het volgende moet je weer toch naar die computer. Die zou dan wegmoeten."

9: "Ja dan is het besparend. Hè maar kijk als er nog bij moet- ja dan schiet het zijn doel voorbij natuurlijk."

These negative expectations are close to the neutral expectations but are stronger expressed and are mostly concerning missing or ineffective functionality. The negative expectations are equally strong among all groups.

Conclusion

No noticable differences between the three groups regarding the system as enabler of work tasks come forward. An effect of the CCD approach on one of the groups is not observed.

5.6.3. Work productivity with the system

Overview

Following the previous statement, participants were now asked to express their expectations regarding the statement "I expect that through using VITO my work productivity is increased".

Table 6 shows the number of expectations expressed per participant for work productivity with the system, grouped by sentiment (PE+, PE=, and PE-).

	PE_Q3	*Using the system increases my productivity*											
	DIRECTLY					INDIRECTLY				NOT INVOLVED			TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
PE+	2	1	1		1	1	1	2	1	1			1	12
PE=		1		1				1			2	1		6
PE-														0

Table 6: Expectations regarding work productivy with the system

Participants from the directly and the indirectly involved groups express mostly positive expectations regarding the expected work productivity because of the system. The participants from the not involved group seem a little more hesistant to expect a certain degree of increase.

In depth

The expressed expectations for the *directly* and *indirectly involved groups* are comparable, the *not involved* group does have two participants who are not entirely convinced about the increase in productivity.

> 10: "Ja, dat zal verschillen. Als hij, stel dat er een dag is op de huiskamer dat er heel veel met stoelen geschoven wordt en je krijgt iedere keer valse meldingen, ja, dan niet"
>
> 10: "En dan schakel je bij en, ja, en je productiviteit zie je dus wel enigszins verbeterd maar anderzijds zeg je: het risico is dat ik dan teveel bezig ben soms met meldingen afhandelen die misschien anders gewoon gepasseerd waren?"
>
> 11: "De productiviteit dus, daar zeg je nog steeds een beetje zo van nou [..] Je kunt sommige dingen wel sneller afhandelen"

These participants express worries about false negatives and the increase in productivity – issues that have a significant effect on work productivity with the new system.

Conclusion

Both the *directly* and *indirectly involved* group show a stronger effect regarding perceived increase in productivy. The *not involved* group is somewhat more hesistant. An effect of the CCD approach is visible on the direcly and indirectly involved groups.

5.6.4. Positive work rewards of the system

Overview

The last statement belonging to the construct Performance Expectancy is "If I use Vito, I will increase my changes of getting a raise". All participants were asked to express their expectations regarding this statement.

Table 7 shows the number of expectations expressed per participant for positive work rewards of the system, grouped by sentiment (PE+, PE=, and PE-).

	PE_Q4	*If I use the system, I will increase my chances of getting a raise*												
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
PE+			2								1	2		5
PE=					1	1			1				1	4
PE-	1	1		1			1	1		2	1			8

Table 7: Expectations regarding positive work rewards of the system

Only three of the participants have a positive expectation that using the system might indeed lead to a raise. Most participants do not share that positive expectation. The participants from the *indirectly involved* group do not express any positive expectation regarding positive work rewards of the system.

In depth

Most participants do expect a certain positive effect from the use of the system, but most do not expect that effect to be a raise. Most expectations were regarding compliments.

1: "Ja maar Jolanda geeft wel eens wat complimenten aan mij. Dat is, dus dat pept iedereen denk ik wel op."

9: Ja een compliment misschien, maar that's it.

10: Ja, [complimentjes], die zal daar wel, dat doen ze wel.

11: "Als medewerkers in het begin met zo'n ding gaan werken en dat op een goeie manier doen, dat dat op een andere manier beloond moet worden door een stukje, ja feedback of enthousiasme, dat soort zaken, dat denk ik wel"

There were no notable large differences between the intents of the positive, neutral, or negative expectations. The expectations all addressed that compliments as a reward for using the system were expected, also based on past introductions of new systems. None of the participants expected a raise for using the system, some expectations were more negatively formulated, others took a more neutral or positive approach, hence the differences in sentiment scores.

Conclusion

No noticable differences between the three groups regarding the positive work rewards of the system come forward. An effect of the CCD approach on one of the groups is not observed.

5.6.5. Performance Expectancy Conclusion

Over the whole, mostly positive expectation are expressed for all statements, except for positive work rewards of the system. Participants from all groups state that positive work rewards are expected, but not in the form of a raise, but more in the form of compliments. Combining the results of the other statements, participants expressed mostly positive expectations that the system will support their performance at work, direcly influencing acceptance. A positive effect of the CCD approach on the directly and indirectly involved groups regarding perceived increase in productivy is noticed. The CCD approach is further considered responsible for the mostly positive expectations, facilitating acceptance, on all statements regarding Performance Expectancy.

5.7. Effort Expectancy

Effort Expectancy is “The degree of ease associated with the use of the system”. On the following pages, first the four statements deployed to discuss this construct with participants (*understandability of interaction with the system, becoming skillful in using the system, usability of the system,* and *operability of the system*) will be elaborated. Afterwards, the effect of the CCD approach on acceptance through Effort Expectancy will be discussed.

5.7.1. Understandability of interaction with the system

Overview

For the first statement belonging to Effort Expectancy, participants were asked to respond to the statement "My interaction with Vito would be clear and understandable".

Table 8 shows the number of expectations expressed per participant for the understandability of interaction with the system, grouped by sentiment (EE+, EE=, and EE-).

	EE_Q1	*My interaction with the system would be clear and understandable*												
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
EE+	2	2	1	2	1	3	2	1	1	1	2	1	1	20
EE=					1									1
EE-														

Table 8: Expectations regarding the interaction with the system

Participants from all groups express positive expectations about the understandability of interaction with the system.

In depth

The following examplary positive expectations were expressed regarding this statement.

1: "Nou voor mij ziet het er heel simpel uit. Voor mij zou dat heel makkelijk zijn"

4: "Nou zoals ik het nu zie vind ik het wel duidelijk"

8: "Ja, dat het een snel gebruik is ook voor mensen die daar wat moeite mee hebben"

10: "Ik vind het juist overzichtelijk."

Participants from all groups agree on the expected positive points: easy to understand, the interface is clear and uncluttered, and accessable for non-technical hp's. The only neutral expectation was regarding the dialect of the participant and the (non) possibily of speech-recognition.

Conclusion

No noticable differences between the three groups regarding the understandability of interaction with the system come forward. An effect of the CCD approach on one of the groups is not observed.

5.7.2. Becoming skillful in using the system

Overview

Following the previous statement, participants were now asked to express their expectations regarding the statement "It would be easy for me to become skillful at using Vito".

Table 9 shows the number of expectations expressed per participant for becoming skillful in using the system, grouped by sentiment (EE+, EE=, and EE-).

	EE_Q2	*It would be easy for me to become skillful at using the system*											
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
EE+	1	1	1	1	1	1	2	2	1	2	1	1	1	16
EE=		2				1		1	1					5
EE-														

Table 9: Expectations regarding becoming skillful at using the system

Participants from all groups express mostly positive expectations. Some neutral expectations are expressed, especially by the indirectly involved group. In the following paragraph, this salience will be investigated.

In depth

Participants from both the *directly* and the *not involved* groups are equally positive about the expected level of ease to become skillful at using the system. The *indirectly involved* group is only slightly less convinced about the level of ease and show a few reservations:

> 3: Nou ik neem aan dat we even een cursusje krijgen.
>
> 5: Nee ik wil zeggen, zo is het op zich gewoon duidelijk. Ik denk dat het wel ingewikkeld wordt als je die dingetjes er allemaal bij doet
>
> 6: Maar ja ik denk als je een keer vieze handen hebt of natte handen, […] dan moet je met handschoentjes.

Participants express worries about the lack of training, a system that is too bloated, and the use of the system with dirty hands. Important issues but in these cases, the expectations were more expressed casually, as a side note. Therefor no indication of expected problems with becoming skillful with the presented system is noticed for any of the three groups.

Conclusion

No noticable differences between the three groups regarding the expected level of ease to become skillful at using the system. An effect of the CCD approach on one of the groups is not observed.

5.7.3. Usability of the system

Overview

Following the previous statement, participants were now asked to express their expectations regarding the statement "I would find Vito easy to use".

Table 10 shows the number of expectations expressed per participant for usability of the system, grouped by sentiment (EE+, EE=, and EE-).

	EE_Q3	*I would find the system easy to use*												
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
EE+	1	1	1	1	1	1		1	1	1	2	1	1	13
EE=							1							1
EE-							1		2					3

Table 10: Expectations regarding usability of the system

Participants from both the *directly* and the *not involved* groups are equally positive about the level of ease to use the system. The *indirectly involved* group is somewhat less convinced.

In depth

The expressed expectations for the *directly* and *not involved groups* are comparable, the *indirectly involved* group does have two participants who are not entirely convinced about the expected usability of the system.

4: Ja ik vind hem nu toch nog wat groot. Ik bedoel ik hem mijn zakken ook vol met piepers en met bhv piepers of sleutelbossen.

4: Ik ben niet erg ontevreden over het continue bij me dragen van dit apparaat

6: Maar soms ook onhandig met, als je verzorger bent of je staat aan bed en je hebt die tablet. O ja die moet even, dat kan ook nog

6: Andere zakken, dat zou ook nog wel lastig kunnen zijn denk ik. Hele tijd meesjouwen en ja

6: Door je hurken en dat kan dat ding denk ik regelmatig, dan vliegt hij er zo uit en dan ligt hij op de grond.

The issues are all regarding the form factor of the device. Participants name the size of the device, and the expected clumsiness of carrying or placing the device. These issues have an effect for those participants on expected usability of the system.

Conclusion

Both the *directly* and *non involved* group show a stronger effect regarding perceived usability of the system. The *indirecly involved* group is not entirely convinced. An effect of the CCD approach is visible on the direcly and non involved groups.

5.7.4. Operability of the system

Overview

The last statement belonging to the construct Effort Expectancy is "Learning to operate Vito is easy for me". All participants were asked to express their expectations regarding this statement.

Table 11 shows the number of expectations expressed per participant for operability of the system, grouped by sentiment (EE+, EE=, and EE-).

	EE_Q4	*Learning to operate the system is easy for me*											
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
EE+	1	2	1	2	1	2	1	2	1	1	1	1	1	
EE=		1	1											
EE-														

Table 11: Expectations regarding positive work rewards of the system

Participants from all groups are almost equally positive about the amount of expected effort to learn to operate the system.

In depth

The following examplary positive expectations were expressed regarding this statement.

1: "Ja ik verwacht dat ik gemakkelijk kan leren om Vito te bedienen. Dan gaat het echt over de omgang met het apparaat zelf, dus met je handen, met je vingers, de knoppen die erop zitten."

4: "Ja, nou dat denk ik wel. Ik denk wel dat ik dat snel doorkrijg ja."

8: "Kijk, die paar knoppen en als het dan allemaal overzichtelijk is en je weet inderdaad met dat vierkantje moet ik daar heen en met dat rondje is het daar. Dan lijkt mij, als ze het dan nog niet weten met zijn allen, dan weet ik het ook niet. Toch?"

13: "Ja, ja dat weet je zo."

Participants from all groups agree on the one expected positive point: easy to learn how to operate. The neutral expectations were regarding the weight of the device and the possibility to use the device while wearing gloves.

Conclusion

No noticable differences between the three groups regarding the operability of the system come forward. An effect of the CCD approach on one of the groups is not observed.

5.7.5. Effort Expectancy conclusion

With the exception of the ease of use of Vito (statement 3), no noticeable difference between the three groups is observed. The deviation in statement 3 for the *indirectly involved* group is caused by a single participant who does not like the form factor of the prototyping device. Since this is only a small minor issue, and subject to further elaboration for the final device, this deviation in statement 3 is regarded as minor. We therefor see no effect of the CCD approach on Effort Expectancy for individual groups. However, because of the high number of positive expectations on all statements, a positive effect on Effort Expectancy as a whole by the CCD approach is notable. This positive effect on Effort Expectancy directly positively influences acceptance.

5.8. Social Influence

Social Influence is: “The degree to which an individual perceives that important others believe he or she should use the new system”. On the following pages, first the four statements deployed to discuss this construct with participants (*effect on system use from influential others, effect on system use from important others, helpfulness of senior management,* and *organizational system support*) will be elaborated. Afterwards, the effect of the CCD approach on acceptance through Social Influence will be discussed.

5.8.1. Effect on system use from influential others

Overview

For the first statement belonging to Social Influence, participants were asked to respond to the statement "People who influence my behavior thing that I should use Vito".

Table 12 shows the number of expectations expressed per participant for the effect on system use from influencial others, grouped by sentiment (SI+, SI=, and SI-).

	SI_Q1	*People who influence my behavior think that I should use the system.*												
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
SI+	1	1	2	1	2	1	2	1	1	1	1	1	2	17
SI=											2	2		4
SI-			1											1

Table 12: Expectations regarding effect on system use from influencial others

Participants from all groups express mostly positive expectations about the effect on system use from influencial others. A number of neutral expectations are expressed and one negative expectation is expressed.

In depth

There are no large differences between the three groups regarding the perceived influence of other people. Most participants name the team manager as one of the most important people to influence their behavior at work. They expect the team manager to influence or even dictate the use of the new system.

> 2: Dus dat Jolanda vindt dat ik Vito moet gaan gebruiken? Ik denk als ze er eenmaal veel geld in gestopt hebben en veel energie ingestopt hebben, dan denk ik dat ze niet blij zullen zijn als ik nog achter de computer zal kruipen zeg maar.
>
> 3: Dat verwacht ik wel dat hun dat gaan zeggen ja.
>
> 9: Ik vind, ja. Ik denk het en als zij willen dat wij dat doen, dan zullen wij dat moeten doen. Zo simpel is het eigenlijk.

Participant 7 expresses a negative expectation:

> 7: De één zal echt zien van hee, dit is mooi, dit is fijn, dit is handig en de ander zal zeggen: ja, en de privacy van de bewoner dan? Ik denk dat we daar best nog wel een slag te slaan hebben

Participant 7 is the team manager in question. She raises this important issue regarding privacy – but we consider it more as a decision that should be taken later in the process, thus the possible effect on this statement is not taken into account.

Participant 10 and participant 11 from the *not involved* group have more reservations:

> 10: Ja, dat zal verschillen denk ik, per mening.
>
> 10: Qua familie en privacy issues, dat verschilt per familie, denk ik
>
> 11: Want als mensen- Als ik op een bepaalde manier moet werken waar ik zelf niet achter sta, dan zal het voor mijzelf wel moeilijk zijn, maar dan zal ik er wel een manier in moeten vinden. Maar uiteindelijk zal mijn werkgever en de cliënt, ja die zullen toch het laatste woord daarin hebben denk ik.
>
> 11: Dus ik werk op vier locaties, dus ik ben er wel van overtuigd dat medewerkers zich wel gemotiveerd moeten voelen en hierin meegenomen moeten worden.

These participant discuss the issue of different groups that can influence ones behavior. They do not deny that they experience an effect from influential people in their surroundings that think that they should use the system.

Conclusion

No noticable differences between the three groups regarding the effect on system use by influencial others come forward. An effect of the CCD approach on one of the groups is not observed.

5.8.2. Effect on system use from important others

Overview

Following the previous statement, participants were now asked to express their expectations regarding the statement "People who influence my behavior thing that I should use Vito".

Table 13 shows the number of expectations expressed per participant for the effect on system use from important others, grouped by sentiment (SI+, SI=, and SI-).

	SI_Q2	*People who are important to me think that I should use the system.*											
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
SI+	1	1	2	2	1	1	1	1	1	1	1	1	2	16
SI=	1	1				1	1		1	1	1			7
SI-														

Table 13: Expectations regarding effect on system use from important others

All participants express positive expectations regarding the effect on their system use from the opinion of important others. Participants state that when important others are positive about the technology, they are very inclined to personally match that positive attitude. The most named important others are co-workers and family. A number of neutral expectations are expressed.

In depth

Participants from each group express a number of neutral expectations:

Directly involved:

1: Nee ik denk dat mensen alleen maar hun eigen mening erover geven, hoe zij vinden dat het is.

2: Ja ik denk dat ze wel zouden zeggen dat ik het moet proberen sowieso, maar ik denk niet dat ze zich er echt mee bemoeien of zo.

Indirectly involved:

3: Nee, er zal wel over gepraat worden. Er zal wel gezegd worden, een zal wel zeggen ik vind het niks en de ander zegt ik vind het leuk.

4: Ik vind vooral mijn eigen mening belangrijk

6: Het voelt als een verplichting maar je moet ook mee.

Not involved:

9: Dus ja dat vinden mensen wel leuk, maar verder zullen ze er weinig van vinden

10: Sommigen wel en sommigen niet. Want sommigen zijn heel erg afstotend tegen techniek.

Participants expect that important others will discuss the system, but will not force their opinion onto the participant. Fear for technology by the important others and the importance of ones own opinion are also mentioned. Over the whole, these expectations are in line regarding weight and are evenly spread among the three groups.

Conclusion

No noticable differences between the three groups regarding the effect on system use by important others come forward. An effect of the CCD approach on one of the groups is not observed.

5.8.3. Helpfulness of senior management

Overview

Following the previous statement, participants were now asked to express their expectations regarding the statement "The senior management of this business has been helpful in the use of Vito".

Table 14 shows the number of expectations expressed per participant for the helpfulness of senior management, grouped by sentiment (SI+, SI=, and SI-).

	SI_Q3	*The senior management of this business has been helpful in the use of the system.*												
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
SI+	4	1	1	1	1	2	2	1	1	1	1	1	1	18
SI=														
SI-														

Table 14: Expectations regarding the helpfulness of senior management

All participant are solely positive, no neutral or negative expectations are expressed.

In depth

The following examplary positive expectations were expressed regarding this statement.

5: "Ja, […] het management is behulpzaam in het gebruik van Vito."

8: "Nou, dat als er iets is waar je weet ik veel wat voor moeite mee hebt of last van heb, dat ik daar aan kan kloppen en dat zij mij daar verder mee kunnen helpen"

13: "Bijvoorbeeld Jolanda? Ja. Die helpt overal mee mee als je vragen hebt."

Participants from all groups have no doubt that the senior management will support their every wish regarding support for using the new system.

Conclusion

No noticable differences between the three groups regarding the helpfulness of senior management come forward. An effect of the CCD approach on one of the groups is not observed.

5.8.4. Organizational system support

Overview

Following the previous statement, participants were now asked to express their expectations regarding the statement "In general, the organization has supported the use of Vito".

Table 15 shows the number of expectations expressed per participant for the organizational system support, grouped by sentiment (SI+, SI=, and SI-).

	SI_Q4	*In general, the organization has supported the use of the system.*											
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
SI+	4	1	1	1	1	2	2	1	1	1	1	1	1	18
SI=														
SI-														

Table 15: Expectations regarding the organizational system support

All participant are solely positive, no neutral or negative expectations are expressed.

In depth

The following examplary positive expectations were expressed regarding this statement.

6: "Dat denk ik ook wel natuurlijk, die steunen weer hun daarin."

9: "Ja, ja, juist. Dus daarin zijn ze wel vooruitstrevend, ja dat vind ik wel."

13: "Ja ik denk het ook wel want het is allemaal meer met minder."

Participants from all groups view their organization as progressive and supportive regarding the use of the new technology. Some participants identify the organizational need for innovation and see that the organization is acting accordingly.

Conclusion

No noticable differences between the three groups regarding the organizational system support come forward. An effect of the CCD approach on one of the groups is not observed.

5.8.5. Social Influence conclusion

Considering all items, there is no noticeable difference in expectation between the three groups.

Results show that the Social Influence construct is strongly positively influenced by a clear way of managing the introduction of new technology. The overall similar expressed expectations to the fourth statement under Performance Expectancy (If I use the system, I will increase my chances of getting a raise) supports the explanation here; the way of introducing new technology or new procedures is clear and understood by the staff. The rewards are also clear.

The conclusions of the last two statements (support from management and support from organization) support the clear management style within the organization. Both the management as well as the organization as a whole are considered to be helpful and supportive during, and after, the introduction of new technology.

In conclusion we determine that the CCD approach does not have a noticeable effect on Social Influence for individual groups. But, because of the high quality prototype stemming from the CCD approach, an influence on all four statements from the CCD approach is notable. Because the prototype defines the possible end product so clearly, participants expect influential others, important others, management, and the organization to be positive about the system. This effect results in many positive expectations that are expressed under the various statements belonging to Social Influence. This positive effect on Social Influence has in its turn a direct positive influence on acceptance.

5.9. Acceptance

Overview

The construct Acceptance is discussed with the participants using only one statement: "Imagine Vito being available for use and you are the one to decide whether or not to use this system in the organization. Would you start using Vito?"

Table 16 shows the number of expectations expressed per participant for acceptance of Vito, grouped by sentiment (ACC+, ACC=, and ACC-).

	ACC_Q1	*I intend / predict / plan to use the system in the next months*												
	DIRECTLY					INDIRECTLY				NOT INVOLVED				TOTAL
	pp1	pp2	pp7	pp8	pp13	pp3	pp4	pp5	pp6	pp9	pp10	pp11	pp12	
ACC+	2	1	1	1	1	2	2	1	1		2	1	1	16
ACC=										2				2
ACC-														

Table 16: Expectations regarding acceptance of Vito

All but one participant are positive, two neutral expectations and no negative expectations are expressed.

In depth

Both the *directly* and *indirectly involved* groups show strong positive expectations regarding the acceptance of the system. The *not involved* group is somewhat less convinced. To illustrate, these are the submitted expectations:

Directly involved:

1: Zou ik het gaan gebruiken? Ik zou hem wel gaan gebruiken

1: Van mij gewoon sterk

2: Ja ik zou dit gaan gebruiken, ik ben er tevreden over

7: Zou je dit gaan gebruiken? Ja, dat heb ik al wel tien keer gezegd denk ik. Zeg ik het voor de elfde keer.

8: Ja, zekerheid, ja ik denk het wel.

Indirectly involved:

3: Die computer, van mij mag die de deur uit. Gewoon qua tijd en dit is echt tijdbesparend

4: ik vind wel een fijn gevoel om Vito te gaan gebruiken omdat het toch zo zou gaan

4: ik vind het belangrijk dat de familie het fijn vindt, dan vind ik het ook fijn

5: ja ik zou dit gaan gebruiken

6: Ik denk het wel ja. Ja dat ga ik wel, vind ik wel, ja.

Not involved:

9: Nou ik vind het wel de moeite waard om het uit te proberen

9: [rapporteren] ik denk dat daar een stukje werk uit ons handen, waardoor ik meer tijd daarover heb. Dus dat zou wel fijn zijn. Maar of het toezicht […]Ja, ik weet het niet.

10: ja ik zou dit gaan gebruiken

10: Ja, gewoon puur alleen voor de camera's en de detectie, want dan kun je ze beter in de gaten houden en als er iets is, ben je er sneller bij.

11: Ja zoals ik hem, wat ik nu zie zou ik hem zeker gebruiken.

12: Verder vind ik het, ja, en je kunt overal toezicht houden als je wilt, als je niet ter plekke bent en je rapportages, de arts. Ja, het is perfect.

We see an overall very strongly expressed expectations from all groups for the system. Participants are satisfied, feel that the system can save time, believe that the system will offer benefits for all concerned parties, and are generally agreeing to start using the system.

Conclusion

No noticable differences between the three groups regarding accceptance of Vito come forward, all are equally positive. An effect of the CCD approach on one of the groups is not observed. An effect of the CCD approach on all groups is clear however. Very positive expectations are expressed amongst all groups. Participants have no doubts and are ready to start using Vito, even if they were the managing director and their decision would affect the entire company.

5.10. Remarks about the study / Additions to the prototype

Most comments for all groups tagged as *remarks about the study*, name the development process of the technology, and in particular the strong end-user role, as refreshing and very desirable. Some quotations to illustrate:

> 1: Nou het is wel mooi dat erover nagedacht wordt om het allemaal makkelijker te maken en een beetje voor de veiligheid van de mensen. Dus ja, het is zo leuk.
>
> 4: Nou ik vind het wel een heel goed onderzoek. Vind het wel echt petje af. Heel goed. Ja.
>
> 7: Het was ook heel op een andere manier bezig zijn met dingen dan de standaard. Ja, ik vond het echt, ook de opdracht die we de eerste keer kregen. Mee denken van wat je in huis krijgt. […] Super. Nou, en de ronde tafel gesprekken was ook gewoon heel leuk.
>
> 8: Ik vind dat er wel goed wordt gekeken wat de mogelijkheden zijn en openstaan voor commentaar en weet ik het.

Effects of these opinions about the CCD approach on acceptance are difficult, if not impossible, to indicate. They do, however, indicate that end-users from all groups are positive about a development process that is designed using the CCD approach.

Under *Additions to the prototype*, end-users address a number of additions:

- Extension of the technology to also include: phone functionality, reporting functionality, medical pager and emergency response pager;
- Carrying cases and solutions to temporarily attach the device somewhere to be able to give care without the device obstructing movement;
- Different form factor (larger, smaller, other hardware)
- A version for extramural care, for example in homecare;
- More extensive readback functionality;
- The device should turn itself automatically off, to avoid use by patients.

5.11. The influence of the CCD approach

The effect of the CCD approach on acceptance through the construct Performance Expectancy is minor. For three of the four statements belonging to Performance Expectancy, no noticable differences between the three groups are observed. The CCD apporach has an effect on acceptance through Performace Expectancy when expectations are expressed about work productivity with the system. The directly and indirectly groups expect their work productity to be higher when using the system.

The influence of the CCD approach on acceptance through the construct Effort Expectancy is also limited. For three of the four statements, no noticeble differrences are observed. An effect of the CCD approach is visible for the directly and non involved groups regarding expected usability of the system.

For none of the statements belonging to the construct Social Influence differences in expectations are observed.

All groups also express highly comparable positive expectations regarding the construct Acceptance itself. No differences in expectations are observed.

These results were however not as expected. The three groups were created because an effect on acceptance from the CCD approach was expected to occur stronger in the involved groups (directly and indirectly) than in the not involved group. Results show that the difference in expectations between the groups over all constructs is very small and

conclusions regarding the effect of the CCD approach on acceptance are very hard to draw because of that.

However, results do show that the prototype is playing a pivotal role here. For almost all statements, very positive expectations are expressed. The positive expectations that are expressed for the construct Acceptance are even considered as being strong. Because the acceptance assessment was done after a demonstration of the prototype using a realistic scenario from the workplace of the participants, this prototype obviously cleary put forward the functionalities and support of the possible future system. This perspicuity of the prototype was in all propability responsible for the positive expectations among all groups for all constructs.

The prototype is based on a carefull process (part of the CCD approach) with a number of real end-users. This process and the inclusion of real end-users yields real acceptation, also among indirectly and not involved participants. The results show that when a development process is guided by the CCD approach, the end-users have positive expectations of the system and are thus more inclined to accept the results. These positive expectations are mostly based on the clear prototype.

The introduction of new technology in healthcare can benefit from the deployment of the CCD approach because of clear positive effects on acceptance.

6. Conclusions and discussion

The research question guiding this thesis was: “To what extent does the participation in a codesign approach promote acceptance of new supervisory technology amongst healthcare professionals?”.

To answer this question, the Contextual Codesign (CCD) approach (figure 9) was designed. This approach should overcome observed underexposure for acceptance in existing design approaches and models in a healthcare working environment. In practice, the approach was deployed to create a positive effect on acceptance of new supervisory technology by healthcare professionals working in a certain organization.

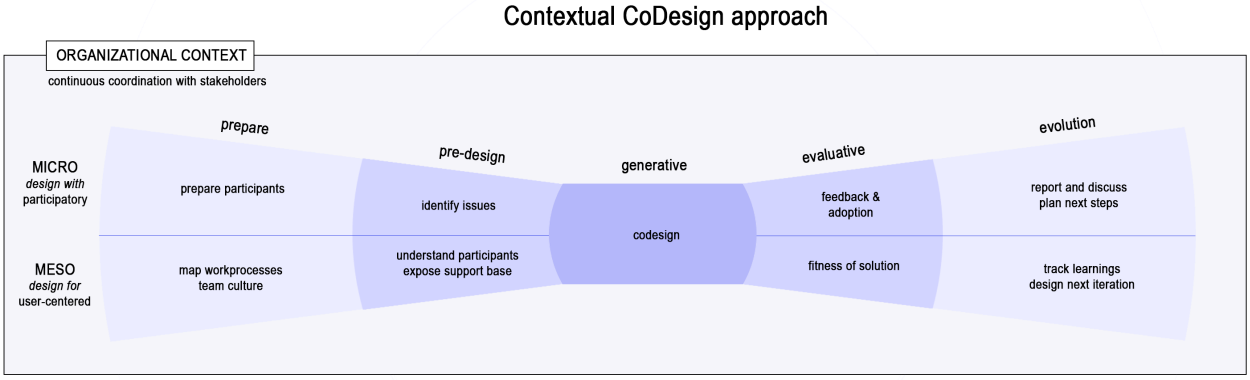

Figure 9: CCD approach

To counter the most common limiting factors for acceptance among hp’s, a combination of existing approaches and models (UCD and PD) was made. This design environment was thereafter placed in the organizational context.

Deploying the approach in practice resulted in a prototype to evaluate the fitness of the solution. Also in phase 4 of the CCD approach (*evaluative*), acceptance assessments were performed using interviews based on a qualitative variant of the UTAUT model. After completion of these activities, the *evolution* phase takes place supporting discussion and reporting.

Using the results from this iteration of the CCD approach in practice, the research question can be answered. Results show that the participation of healthcare professionals in a codesign approach does promote acceptance of new supervisory technology. While only minor influences from the CCD approach on constructs of the modified UTAUT model are observed, results show that careful adherence to the CCD approach leads to such a well elaborated prototype with matching recognizable scenario, that all participants expect advantages of using this system in the future. As such, the basis for acceptance of the future system is laid.

A number of issues regarding the CCD approach were encountered which are subsequently discussed.

(a) The evaluative phase started too soon. During the codesign sessions, the requirements for the technology were drafted. These requirements were compiled into a working prototype by the researcher using heuristics and a skilled background. This does not guarantee a good match of the technology on the user. The development process from requirements to the actual prototype that was used during the interviews should be more supported and influenced by the users. An extra iteration after the development of the first version of the prototype should yield a better alignment of the technology with the end-user.

(b) A number of questions that were put forward during the acceptance assessment were too difficult for the hp's and lead to initial misinterpretation of the question. Since the interviewer was fully initiated in the research, all question were clarified and then answered as intended by all hp's. The translation of the qualitative UTUAT into quantitative questions should be done with more consideration of the context and capabilities of the end-users. A testing phase where the questions are first proposed to a representative group of end-users and thereafter adjusted should be considered.

(c) The organizational context is addressed in the approach, but not thoroughly. In this iteration, continues coordination within this organizational context was believed to be sufficient. A depth study should look into mechanism in organizations that are in relation with elements of the CCD approach. A stronger interweaving of those mechanisms might strengthen the results of the deployment of the CCD approach.

(d) While it is expected that multiple iterations of the CCD approach with the embedded component for acceptance assessment will lead to an even better fit between technology and end-user, such a project has not yet been conducted.

This iteration of the CCD approach was carried out within a nursing home. Because of the positive effect of the CCD approach on acceptance, and because only a small number of end-users is required and thus costs and effort are relatively low, the approach is applicable in more settings besides nursing homes. Prototyping is already commonplace – within the CCD approach this prototyping also takes place but the scope of the prototype is larger, e.g. also aimed at acceptance. We find this broadening of the scope of prototyping a logical next step in development processes.

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Appendix 1: Qualitative UTAUT

<table>
<tr><td colspan="2">Performance expectancy (PE)
The degree to which an individual believes that using the system will help him or her to attain gains in job performance.</td></tr>
<tr><th>UTAUT model</th><th>UTAUT interview</th></tr>
<tr><td>PU = Perceived Usefulness (Davis, 1989)
RA = Relative Advantage (Rogers, 1983)
OE = Outcome expectations (Compeau & Higgins, 1995)

PE1. I would find the system useful in my job (PU)
PE2. Using the system enables me to accomplish tasks more quickly (RA).
PE3. Using the system increases my productivity (RA).
PE4. If I use the system, I will increase my chances of getting a raise (OE)</td><td>De mate waarin een individu meent dat het gebruik van het systeem hem of haar zal helpen om verbeteringen in prestaties op het werk te bereiken.

PE1: Ik verwacht dat Vito nuttig zal zijn in mijn werk.
- Waarom? Nuttiger of minder nuttig dan andere apparaten?
- Zou het zonder Vito ook kunnen? Is dat niet nog nuttiger?

PE2: Ik verwacht dat ik met Vito mijn taken sneller kan afronden.
- Waarom? Hoeveel sneller bij welke taken?
- Komen er niet juist extra taken bij? Hoe staan die in verhouding tot de winst?

PE3: Ik verwacht dat Vito mijn productiviteit verhoogt
- Wat vind jij productiviteit? Hoe ondersteunt Vito daar in? Welke keuzes kun je maken rondom productiviteit?

PE4: Ik verwacht dat Jolanda mij extra zal belonen als ik Vito gebruik.</td></tr>
</table>

Effort Expectancy (EE) *The degree of ease associated with the use of the system.*	
UTAUT model	UTAUT interview
PEU = Perceived ease of use (Davis, 1989) *EU = Ease of use (Moore & Benbassat, 1991)* EE1. My interaction with the system would be clear and understandable (PEU). EE2. It would be easy for me to become skillful at using the system (PEU). EE3. I would find the system easy to use (PEU). EE4. Learning to operate the system is easy for me (EU).	De mate van gemak bij het gebruik van het systeem EE1: Ik verwacht dat werken met Vito duidelijk en begrijpelijk is. - Waarom? Is de interactie duidelijk en begrijpelijk? Waardoor blijkt dat? - Zie je verbeteringen op dit vlak? EE2: Ik verwacht het gebruik van Vito mijzelf snel eigen te kunnen maken. - Waarom? Wat vind jij eigen maken? - Waar zitten de moeilijkste onderdelen en wat heb je juist het snelst door? EE3: Ik verwacht dat Vito gemakkelijk te gebruiken zal zijn. - Waarom? Zou een ander systeem niet nog makkelijker zijn? - Welke onderdelen zijn juist lastig om te gebruiken? EE4: Ik verwacht dat ik gemakkelijk kan leren om Vito te bedienen - Hoe wordt je daarin graag ondersteund? Welke ondersteuning is nodig? - Waarom is het leren bedienen makkelijk?

Social Influence (SI) *The degree to which an individual perceives that important others believe he or she should use the new system.*	
UTAUT model	UTAUT interview
SN = Subjective Norm (Ajzen, 1991) *SF = Social Factors (Thompson, Higgins, & Howell, 1991)* SI1. People who influence my behavior think that I should use the system (SN). SI2. People who are important to me think that I should use the system (SN). SI3. The senior management of this business has been helpful in the use of the system (SF). SI4. In general, the organization has supported the use of the system (SF).	De mate waarin een individu ervaart dat belangrijke anderen menen dat hij of zij het nieuwe systeem moet gaan gebruiken SI1: Ik verwacht dat mensen die iets te zeggen hebben over hoe ik mijn werk doe, vinden dat ik Vito moet gaan gebruiken. - Waarom? Welke mensen zijn dat? Kun je een aantal voorbeelden noemen? - Hoor je vaak van deze mensen? SI2: Ik verwacht dat mensen wiens mening ik belangrijk vind, vinden dat ik Vito moet gaan gebruiken. - Waarom? Welke mensen zijn dat? Kun je een aantal voorbeelden noemen? - Gebeurt dat vaker, die invloed van deze mensen? SI3: Ik verwacht dat het management behulpzaam is in het gebruik van Vito - Waarom? Welk management is dat dan? - Hoe zie je deze hulp het sterkst? SI4: Ik verwacht dat de organisatie over het algemeen achter het gebruik van Vito staat. - Hoe wordt je ondersteund? Waarom denk je? Zie je andere hulpmiddelen ook zo ondersteund worden?

Behavioral Intention (BI) *The degree to which a person has formulated conscious plans to perform or not perform some specified future behavior.*	
UTAUT model	UTAUT interview
B1. I intend to use the system in the next months. *B2. I predict I would use the system in the next months.* *B3. I plan to use the system in the next months.*	De mate waarin een individu bewuste plannen heeft geformuleerd om bepaald toekomstig gedrag wel of niet uit te voeren. Stel Vito was beschikbaar voor gebruik en jij mag beslissen. Zou je dit gaan gebruiken? Hoe sterk vind je dat? Meer een voornemen, een voorspelling of een plannetje?

Appendix 2: Probe results

Probe component: map

Each participant indicated four or more incidents on the map. An example of a filled out map can be seen in figure FOM1. Following are all incidents as indicated by the participants. The incidents are continuesly numbered to be able to refer back to the incidents during the analyses.

participant 1 | nurse

1) It is easy for outsiders to access the ward
2) The camera's are placed on spots where there is no activity.
3) Patients on the ground floor can open their windows themselves. This creates a risk for burglary.
4) There is no supervision in general areas at certain times

participant 2 | nurse

5) No supervision around the elevators, someone can "walk along" the visitors.
6) the situation of the ward. It is not possible for patients to walk around, a number of corridors come to an end.
7) When a patients from a room is missing, the entire ward can create quite a distance (room 3.08 -> room 3.21)
8) When a patients in a far off room is having a bad time, it is a long walk each time (each half an hour) to check or to feed the patient
9) Limited space for activities

participant 3 | team manager

10) apartment 307, patients falls within her room, nurse finds out only after some time because of rush around other rooms
11) during the afternoon there is only 1 hp available for the entire ward, because of budget. This hp has to be at all places at the same time.
12) patients how want to go to the ground floor but cannot because of the closed character of the ward and supervision
13) Going to the ground floor during the summer to enjoy the weather outside. Not possible because of supervision and available staff

participant 4 | nurse

14) 3.08: this room is always open because this patients resides at her own room. An other patient entered the room and detached the alarm. If the patient living in the room would want to activate the alarm, it would not be possible
15) When assisting patients during their afternoon nap in their own room, a lot can happen in the communal living room: disagreement amongst patients, restlessly banging on the windows
16) A corridor that is not accessed much does not feel like a safe place. When a patients falls in that corridor, it might take a long while before her or she is found

17) A special “cuddle”room which I used once myself. Nice for patients to find peace. Unfortunately no time / volunteers.

participant 5 | nurse

18) Patient fallen down. With camera supervision we could have figured out the cause and anticipate on this

19) Biting incident. When this would be viewable by camera we could have separated the patients sooner

20) force door of room. With camera supervision we could have seen what happened

21) adjustment of doorway towards elevator? New “mobile” patients can join other people on their way outside. How to prevent?

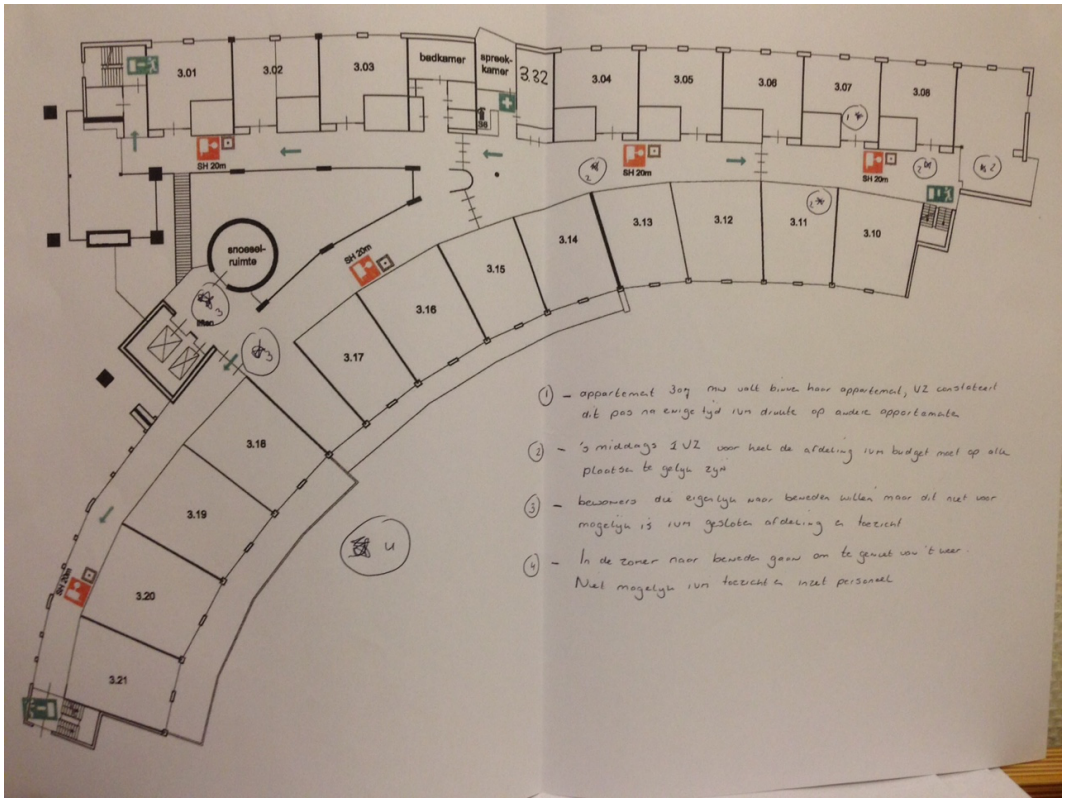


Figure FOM1: example of filled out probe component: map

Table PC1 shows the various incidents grouped:

Probe component: technology skill assessment

Table TSA1 shows the results of the assessment of technology skills. The Likert item “not skilled” is translated to a -, “skilled” to a +, and “very skilled” to ++.

	participant									
	1		2		3		4		5	
	own skill	use at work	own skill	use at work	own skill	use at work	own skill	use at work	own skill	use at work
smart watch	+	-	+	-	-	++	-	-	-	-
telephone / beeper	++	++	++	++	-	++	+	++	++	++
smart glasses	-	-	no answer	no answer	-	+	-	-	-	-
ipad / tablet	++	+	-	-	++	++	+	-	++	++
desktop computer	++	+	++	-	++	-	+	+	++	++
smartphone	++	++	++	-	++	++	+	+	++	++

Table TSA1: Results of technology skill assessment

The following remarks were written by the subjects:

participant 1: Technological aids are convenient but cannot always be deployed. This depends on the kind of care that needs to be given

participant 4: Next to ipad/tablet: “for in this house”. Next to smart watch: “too complicated, no jewelry allowed during the job”. Next to smart glasses: “Not skilled. I wear glasses myself. I did not know about this product yet, I googled it.”

[analysis]

Probe component: remote supervision

participant 1: no selection of options given. Remark: An app on your phone that is connected to e.g. a camera in a general area. Every employee can than supervise these areas during her work.

participant 2: security camera

participant 3: security camera. Remark: The creation of a “leefcircel”, a living circle in which patients can move around freely. This both in house as in the garden. The ward must be open. This would be a great challenge to follow up with research!

participant 4: hp

participant 5: hp. Remark: family caregiver, volunteer

Appendix 3: Codesign session report and analysis

cocreation session 19th of may

Central question: how to monitor patients in communal living rooms?

Issues arising during the cocreation session are indented with an -

Comments with yellow highlighting: Included in prototype requirements

Comments with turquoise highlighting: Open issues

FIRST VIDEO

For inspiration, researcher presented various items such as photoframes in various sizes with ipad pictures in them, glasses that represent google glasses, a watch representing the apple watch, paper, pens, and a mobile phone. This to introduce the technical possibilities and to set the framework. Researcher further gave a short introduction about the difficulties of developing a appropriate way to inform the HP when an event triggers.

- Installation of camera's in rooms with patients under terminal care. Care is very intensive when there is no camera (a visit every 10 minutes). Privacy issues are addressed. Mobile cameras for temporary use are discussed.
  AV sensors in all rooms, halls, and communal livingrooms
- Viewing device: mobile phone.
  Evolved to 8.0" tablet with viewing capabilities "VITO"
- A beep from the viewing device when an event is triggered.
  Events are monitored by "EINSTEIN", the central control and processing unit.
  EINSTEIN signals VITO in case of an event.
- One device to control everything, including the medical pager, all camera images (for supervision), reports. Everything mobile.
  VITO
- Dockingstations for ipad / tablets? Velcro on the walls of the rooms
- After some discussions, the best fitting size for tablets is determined at 8.25", when using software with good usability (e.g. readability of items, adjusting to preferences etc). This was also determined by carrying both the 8.25" photoframe and the 10" photoframe during part of a shift. Problems from previous use of iPads at an other job are discussed.
  VITO is a tablet with an 8.0" screen, ~8.25" diameter with bezels

- Possibility of replacement of the main desktop computer with all portable devices.
- Include reporting tasks in the portable device. This saves the effort of keeping a small note with all incidents during ones' shift. It could also save time during the staff transfers.
  VITO offers support for reporting tasks
- Ability to sent pictures to doctors / Skype contact
  VITO

- Interaction with the device is discussed, should fit everyone's capabilities and preferences.
  VITO interaction design
- How should the device alert the HP? …
  VITO: Various alert for various events
- The effect of being filmed when at the job is discussed. This is not desired. The participants decide that camera's should automatically turn off when a autorized hp or familymember is in the room. Only when there is no physical supervision.
  Managed by EINSTEIN
- One participant thinks that, when using the device during her work, she knows too much about situations that arise in other rooms - this puts a lot of pressure on her, especially when she will be busy with other patients. An other participants believes this to be the way around, extra insight functions as extra support.
- Future system must not log events, only realtime alerts are supplied. No big brother.
  EINSTEIN
- Patient privacy is addressed as being a challenge to be solved in the future. But expectations are that a prototype of the system might support acceptance among representatives.
- HP's / familymembers should be able to activate the system to have an other hp watch along and assess the situation. How? With a button?
  Alert button on central sensorunit in room
- Camera's in room should be accessable via the device during special occasions such as during terminal care, fall prevention, or restless. Hp's should also be able to activate these camera's for a short while to check upon the patient in the room. When physically entering a room, most clients wakeup. With the camera's, a quick, non-disturbing check could be done. Empowerment of the hp.
  Activated via EINSTEIN, video and audio via VITO
- During the nightshift, it would be desirable to be able to "flip" through all the camera images
  Activated via EINSTEIN, video and audio via VITO
- During the night it is sometimes difficult to actually see the patient in bed because of the dark. Camera's could be extra sensitive and show more. Prevents turning on the light in the room.
  Extra sensitive mode for AV sensors
- There is a camera in every room. Default is off. Only activates on request.
  AV sensor requirement
- A round to check on the patients can be performed through the device by activating the camera's one by one (swipe motion).
  Activated via EINSTEIN, video and audio via VITO
- Camera functions in a way like traditional sensors
  Future system requirement
- Following up a sensor event via check on device
  IxD VITO
- Would it be possible to replace movement sensors with the camera's?
  Future system requirement
- Relatives will be happy with the proposed camera solution
- Events can be defined on which the system will inform the hp's. I.e. a sound louder than the maximum defined volume will trigger the hp's device. Or a lot of movement / running patients. Technically, the camera will has to be active.
  EINSTEIN

- Babyphone function for audio transmission
  VITO (IxD) and EINSTEIN
- The costs of an employee instead of the system is being discussed. Because of the insecure future, participants believe that technology is inevitable. This session is indeed believed to address acceptance issues.
- Physical contact is considered to be more valuable than contact via technology - But, deployment of this new technology should allow for more physical contact with patients.
- During the shift, patient reports are committed to the device. During the followup shift, the another hp can go through the reports in the room of the patients, with the patient present. This adds to the patient handson time.
  VITO
- The amount of reporting has declined, but still takes a considerable amount of time during the job.
- Discussed are experiences at other location with comparable solutions. The software crashes a lot, destroying patient reports. Typing on the screen of the device is uncomfortable. The available keyboard is a hassle to connect to the device.
  VITO

SECOND VIDEO

- The keys in your pocket could damage the device
  Use instructions and accountability should be clear
- The possibilities of adding the “in house emergence response team” (BHV) pager to the device are discussed.
  Future VITO
- Is it possible to work comfortably on the 8.25” tablet?
  IxD VITO
- The addition of the Citrix environment on the tablet. Perhaps a better idea, would be the think about ways to work on the 8.25” tablet, instead of just porting existing solutions.
  IxD VITO
- The participants are axious to know how such a solution would work in the real world during workhours.
  Prototyping VITO
- Swiping through all patients to select one and than be able to add reports, photos etc.
  IxD VITO
- Reports can also be speech, photo’s (certain nightgown with buttons) or other material.
  IxD VITO
- Speech to text can be included on the system so reports dont have to be typed in anymore. IxD VITO Relatives will also read this report. But, relatives could also be informed about the new ways of reporting. This saves work for the hp and that means more attention for the patients.
- A patients “record” for the day will contain all added material.
  IxD VITO
- The hp has a choice to read or listen to report items.
  IxD VITO
- Everyone is enthousiastic about the new reporting summary in text or speech
- Organizational issues are discussed but not relevant.

- The idea of having 24h supervision and the possibility to review recorded material is discussed. This plan is cancelled because the low number of incidents and the giantic impact on the privacy in the hallways. Consultation with the family is considered.
- Some unidentifiable incidents have led to serious freedom limitations of a patient (wheelchair to prevent repetition of the incident etc). Through 24h supervision, the cause can be determined and possibily releave the patient of the freedom limitation. Participant do however believe that the effect of the added supervision technology outweights the insight into that small number of incidents (so small that participants can all lively remember the mentioned incidents).
- hp's themselves do not like the idea of 24h supervision because of the intrusion on their privacy at the job.
  and solved by EINSTEIN
- Supervision of the hallways… this is considered a slipperly slope. Do you want to supervise everything?
- Manager start a discussion about opening the ward and removing all limitations on the patients.
  Future support
- Camera's in remote locations.
  hallway AV sensors
- Future patients might be more aggresive than current patients

Good supervision is in the benefits of the patients:

- less limitations because hp have more supervision possibilities
- more contact with the hp because of more efficient reporting and more supervisory possibilities.

Most hp have a strong feeling that they should be there for the patients. A happy patient results in a more happy hp.

Appendix 4: Prototype requirements

Prototype of new supervisory technology “De Loop” BrabantZorg

Floorplan with locations of new AV sensors. Only part of the floor is elaborated.

= AV sensor composed of a camera and a microphone

prototype floorplay

Prototype of new supervisory technology “De Loop” BrabantZorg

Devices specifications and requirements

VITO: “Verplaatsbare Informatie en Toezicht Ondersteuning”

V1. Device is a 8.0” Samsung GALAXY Tab 3
V2. Is capable of displaying video and playing audio from AV sensors
V3. Receives messages from EINSTEIN and initiates actions (alert user through event specific sounds, play specific message)
V4. Offers message-followup (displaying the video from the event etc)
V5. Has medical pager capabilities (audio, video calls, sending photos to hp’s)
V6. Supports reporting tasks (through audio, speech to text, photos etc.). Typing on the screen is uncomfortable and should be limited
V7. Supports the playback of previous reports, on location (e.g. in the room of the patient), a “patient report”, read or read out

EINSTEIN: Central control and processing unit

E1. Server unit
E2. Rulebased processing of AV sensors data. Detects events and executes correspondong actions e.g. messaging VITO
E3. All AV sensors are inactive as default. EINSTEIN activates AV sensors when needed (no hp present in livingroom, checkup on patients)
E4. Does not log events traceable to hp’s
E5. Rules can be based on volume of sound or moving / running / falling patients

AV SENSOR: Combination of video and audio

AV1. Default off. Turns on only when activated by EINSTEIN
AV2. Extra sensitive mode for video in the dark
AV3. Possible replacement of the traditional sensors

prototype requirements

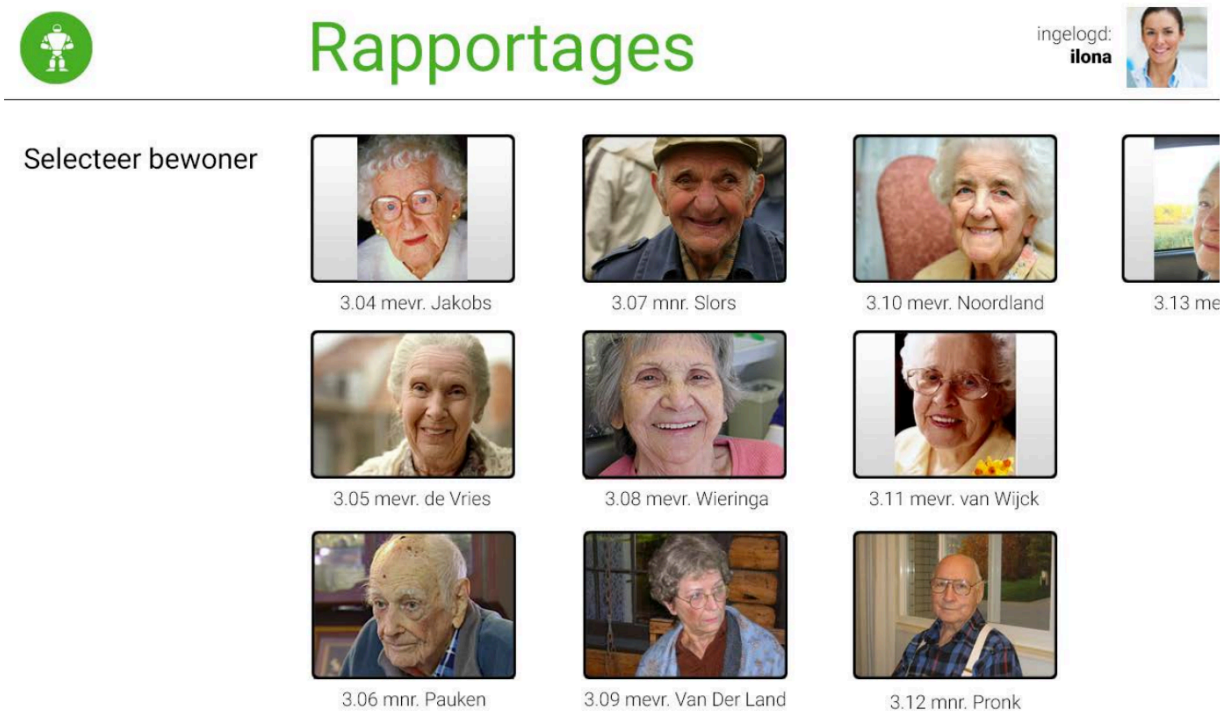
Appendix 5: Scenario

Jouw naam is Ilona en je functie is IG verpleegkundige. Je bent een werkzaam als medewerker op “de loop”, afdeling Aazicht. In het volgende scenario neem ik je mee op een middagdienst van 15.00u tot 23.00u. Naast al het gewone werk, heb je deze keer een hulpje bij je, Vito - een tablet die je ondersteunt bij het houden van toezicht en het doen van je rapportages en overdrachten.

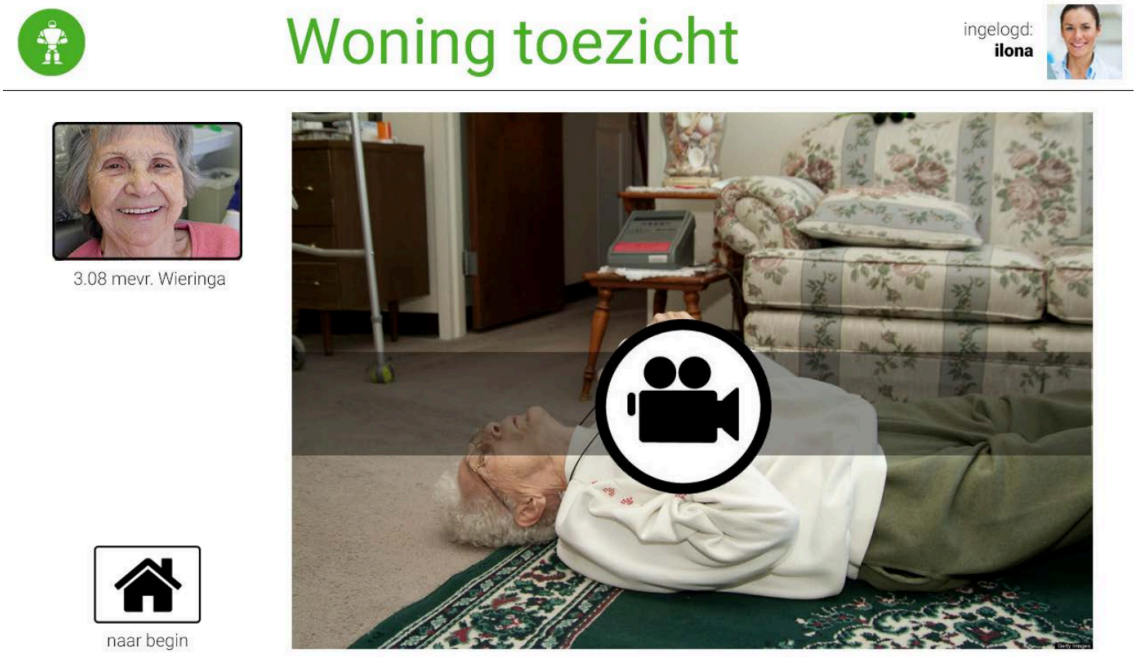
1. Je komt aan op het werk, pakt VITO uit de lader en stopt hem in de zak van je jasje. [V1]
2. Je loopt naar kamer 3.07 en gaat daar de rapportage van de bewoonster van kamer 3.07 , mevrouw Doornbos, doornemen [V7]
3. VITO slaat alarm [V3], oei er is onrust in de huiskamer. VITO schakelt automatisch over naar een video / audio verbinding om de situatie in de huiskamer te checken [V2][V4]. Gelukkig blijkt er niets aan de hand.
4. Je gaat naar kamer 3.04 om mevrouw Spijk uit bed te halen, op de pot te zetten en in haar rolstoel te plaatsen. Dit gaat allemaal prima, je rapporteert nog even dat ze vandaag bijzonder helder was [V6] Ook vind je dat ze een nieuw nachthemd nodig heeft, dat moet de ochtenddienst morgen even bespreken met haar man. Je voegt een foto van haar nachthemd toe aan de rapportage [V6]
5. VITO laat alarm uit 3.20 horen, de familie roept je hulp in [V3]. Terwijl je mevrouw Spijk naar de huiskamer rijdt, kijk je op VITO naar de situatie in 3.20 [V2][V4]. Daar is wel even hulp nodig want meneer Ter Beke is gevallen. Je gaat er snel naar toe, lost de situatie op en rapporteert de lelijke plek op meneer Ter Beke’s been via VITO aan de afdelingsarts [V5].
6. De bewoonster van 3.12, mevrouw Jakobs, ligt slecht. Je checkt even via VITO hoe het met haar gaat. Dit lukt niet, want er is een collega, Marlies, in de kamer aanwezig. Je neemt contact op met Marlies om even te vragen hoe het gaat met mevrouw Jakobs. [V5]
7. De tijd gaat snel, het is druk. Nu is het 22.30u en je wilt even een rondje kamers doen. Je pakt VITO en “swiped” snel langs alle kamers [V2].

Appendix 6: Prototyping screens

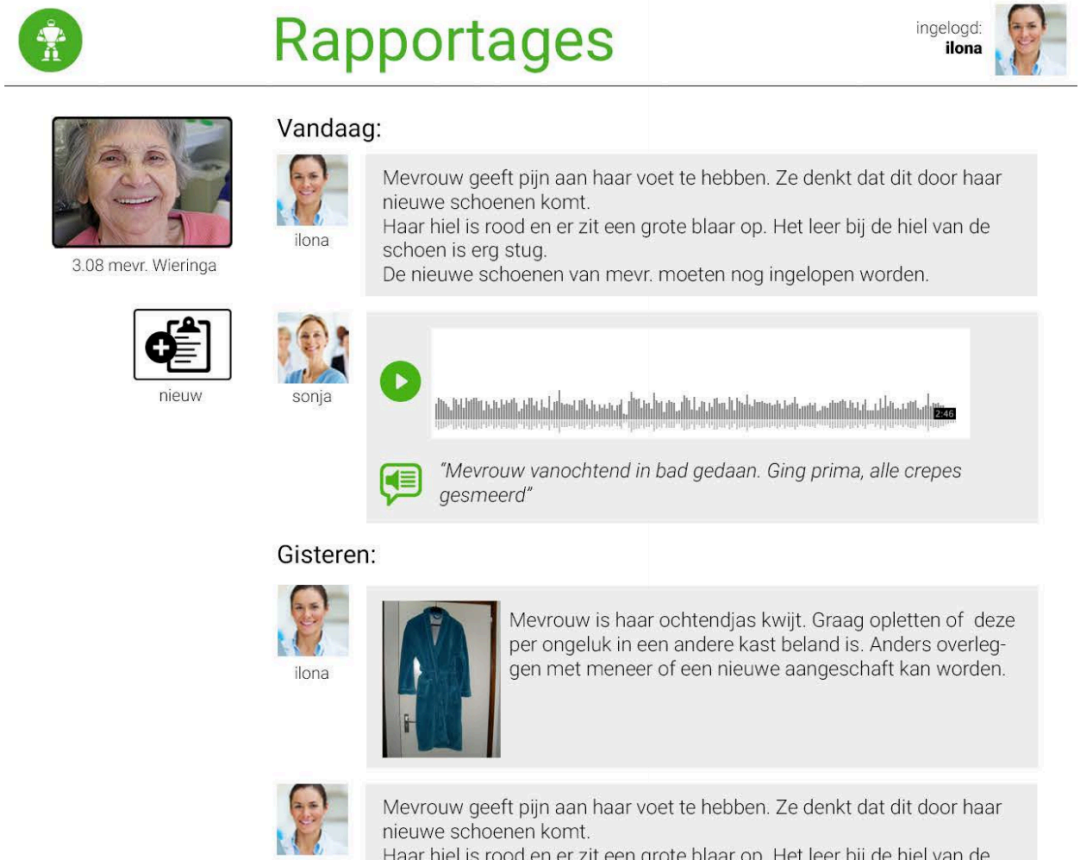
homescreen



Reports screen



room supervision



reports

Appendix 7: Atlas.ti codebook

Codes: Code Book

Number of Codes: 34, commented: 0

Name	Groundedness
ACC+	15
ACC=	2
ACC_Q1	12
Additions to prototype	35
aesthetics	2
EE+	75
EE-	11
EE=	10
EE_Q1	12
EE_Q2	12
EE_Q3	12
EE_Q4	12
FINAL_Q1	12
Heard about study =	2
Heard about study+	2
Heard about study-	8
organizational issues	3
PE+	55
PE-	27
PE=	24
PE_Q1	12
PE_Q2	12
PE_Q3	12
PE_Q4	12
Perceived enjoyment	6
Remarks about study	25
SI+	66
SI-	1
SI=	11
SI_Q1	12
SI_Q2	12
SI_Q3	12
SI_Q4	12
Voluntariness of Use	1