Linköping University

Making Keyboard Shortcuts Accessible:

Keyboard Shortcuts for Healthcare Professionals in an Electronic Healthcare System

Julia Grentzelius

Department for Computer and Information Science
Bachelors Thesis, 18 ECTS | Cognitive Science
Spring semester, 2023 | ISRN: LIU-IDA/KOGVET-G–23/012–SE

Supervisor: Björn Johansson, Professor, Linköping University
External Supervisor: Anders Höckergård, Senior UX designer, Cambio
Examinator: Peter Berggren, Adjunct Associate Professor, Linköping University
Course Examinator: Arne Jönsson, Professor, Linköping University

Copyright

Abstract

This thesis was initiated by Cambio Healthcare Systems and was aimed to investigate the usage of keyboard shortcuts (KBS) in the electronic health record system COSMIC. The aim was to determine which users would benefit from learning keyboard shortcuts and understand how users can learn them effectively. The study also aimed to identify suitable techniques for users in the sensitive healthcare environment, with a focus on efficiency. Through workshops and interviews with individuals with experience of the user, it was found that most users would benefit from learning more KBS, particularly primary nurses who would save significant time. A thematic analysis revealed four themes: *Benefits Everyone*, *Key Users*, *Documentation*, and *Visibility*. Lack of awareness and a need for visualization were identified as the main issues.

To address these findings, design requirements were established to meet user needs. Two design concepts, *a visualizing wiki* and *an all-knowing search*, were created as prototypes to represent potential design solutions. Evaluation with three participants showed positive results for the first concept, indicating it would be effective for teaching KBS to novice users. The second concept, while insufficient on its own, could complement the first concept and benefit users seeking quick results in COSMIC, such as medical secretaries and administrators. The study's strength lies in its preliminary stages, which provided valuable insights into user needs and identified underlying issues related to KBS in COSMIC.

Acknowledgments

Firstly, I'd like to thank the people at Cambio Healthcare Systems who helped me initiate this thesis and have paved way for me to make the most out of my work. A special thanks to Anders Höckergård for being an excellent supervisor, giving me valuable feedback, knowledge, support and encouragement throughout the whole process. Your help and support has been very valuable to me. Thanks to Isak Genberg making me feel welcomed, who always checked in on me and made sure I got all the resources I needed. Thanks to the employees at Cambio that participated in the various aspects of this study, this thesis would literally and figuratively not been possible without you. Also thanks to the WEB SDK team for making me feel at home in the office and for cheering me on.

Thanks to my university supervisor Björn Johansson for giving me excellent academical advise in moments of doubt. You answered questions I did not know I had and gave me the tools to produce this thesis.

Lastly, thanks to my friends and family. Thanks to my wonderful partner Ryan Hanson for emotionally supporting me and for happily proof-reading 16k+ words. Thanks to my girl friends for making this journey alongside with me and always bringing in humor in doubtful moments. Thank you!

Contents

List of Figures

1. Introduction

This thesis was initiated on behalf of Cambio Healthcare Systems (henceforth, Cambio) In Linköping. Cambio is the provider and developer of one of Sweden's biggest Electronic Health Record system called COSMIC (Cambio, n.d.). Sweden has since long been a leading country when it comes to healthcare digitization. Medical records have since the 1990s been documented through digital software. The trend towards digitization is considered an essential aspect of the future for healthcare; the Swedish Associations of Local Authorities and Regions have a goal of Sweden being a world leader in digital healthcare by 2025. Their aim is to *facilitate people to achieve good and equal health and well-being* and *develop and strengthen own resources for increased independence and participation in social life* (SKR, 2022). Increased digital advancement is not always met positively among healthcare workers. Technical skills vary widely, with some employees - such as medical writers - working exclusively with the various technical systems with high efficiency, while other employees have low technical skills and prefer to avoid all non-essential interaction with digital solutions. A thesis at Chalmers University of Technology stated that health care employees felt that they did not receive enough training to use the systems, and that they feel a concern about the employees not keeping up with the rapid technological developments (Ahlsell et al., 2018).

Chapter 3, Section 1 of the Swedish Patient Data Act states for the obligation of healthcare providers to keep medical records for each patient and at each point of care (Patientdatalagen, 2008). Eight of Sweden's 21 regions use the COSMIC product as their medical record system, with the number soon increasing to 17 of 21 regions (Cederberg, 2023). The product is owned by the company Cambio, which also produces other electronic health care products. As all health care interventions and interactions with healthcare must be documented, COSMIC's users range from various roles and contexts, such as caregivers in retirement homes to senior physicians at university hospitals (Cambio, n.d.). This presents the challenge of users have different levels of technical knowledge. Some users work exclusively in the system and are able to perform the necessary actions in the program in minimal time, so-called super users. Other users, so-called novice users, have limited technical knowledge and take longer to complete their tasks in the system.

COSMIC is a system that has a wide range of associated subsystems to assist and support all aspects

of healthcare (Cambio, n.d.). It is developed to support the users in their tasks and workflow that are required in their occupation and in contact with patients. It supports a wide range of care information support such as administration, medication management, documentation, etc. The functionality of the software is configured based on the processes of the setting and of the role of the system. To exemplify, there are services within healthcare such as intensive care, surgery, psychiatric, obstetrics, and labour and delivery that have specific processes that demands customized functionality. The different functionalities combined are many and result in an extensive product with modules that are constantly under development. All processes, regardless of how they may vary, lie within the same framework and under the same design guidelines. When the user logs in to the system, the system knows what functionalities to show based on role and ward that the user works in. An employee in maternity care will therefore never have access to the same modules as someone working in primary care. Users can individualize their own navigation based on frequently used services to their liking, such as a patient overview, new patient note, send referral or place order. The product aims to be easy to use, with this in mind, developers and UXers at COSMIC respect that the system is made for professionals, and the users are expected to get education or briefing in the system. If a designer has to choose between decrease in cognitive load or increase in efficiency, the efficiency and productivity of the product is often valued higher (Personlig kommunikation Höckergård, 2023).

Systems, such as COSMIC, that are primarily intended to fulfil a professional function and, at the same time, have a wide range of users need to assist users in their work in various ways. Such assistance may include, for example, training employees in the system, but also ensuring that the system itself has a design that is intuitive and helpful to the user. Those who are proficient in a system often have high productivity and have learned shortcuts to make work more efficient. Keyboard shortcuts (henceforth: KBS) is an effective way to accelerate work on a graphical user interface using the keyboard as an alternative to using mouse clicks in the interface. Keyboard shortcuts are a faster way to perform actions compared to clicking on an icon or navigating through a menu (Card et al., 1980). The difficulty with keyboard shortcuts is that a novice user is often unaware of their existence, and they are very time-consuming to learn. There is also not a willingness to take the time to learn and settle for the interaction procedures that they know are sufficient to carry out their work. More about the usability of keyboard shortcuts will be presented in section 2.3.

Modules in COSMIC does not only vary in surface level functionality but a number of the modules have their own KBS. In total, there is three types of KBS in COSMIC; there are global specific, framework specific and module specific. The global specific shortcuts contain some of the most commonly used KBS that a user would expect to have in any system, such as *Ctrl + S* for save, *Ctrl + C* for copy, and *F5* for refresh. In total, there is 25 global shortcuts alone. The KBS in the COSMIC framework are 15 lesser generally known shortcuts that are more focused on the overall window functions, such as *Alt + F4* for closing an active window, *Ctrl + U* to log out, and *Esc* to close an opened menu. Then

there is a large number of view-specific keyboard shortcuts that are for a very specific window in the product. A user might only be in a few of these views, but in total there is close to a 100 KBS in all views.

For the continued development of an increasingly digitized healthcare system, there is value in enabling users to become more efficient in their work in digital systems. At Cambio, there is an ambition to educate users with less technical knowledge in different ways to become more effective in their work. This is done partly by educating users on-site in advanced training courses to simplify their work, and partly by guiding users in the software in various ways. At present, the latter aspect is something that is under exploration and hence there is a need to investigate how such implementations could take shape.

1.1 Purpose and Research Questions

The aim of this thesis is to understand which users would have use of keyboard shortcuts and how users can learn to use keyboard shortcuts within the COSMIC. The study also aims to understand which techniques would suit COSMIC users considering the sensitive environment the employees are in, and that efficiency is at high priority. The thesis will further investigate how such implementation could look like in the software. The research questions are:

1. What COSMIC users would benefit the most from increasing their use of keyboard shortcuts?
2. How could such techniques be implemented into the user interface of COSMIC?

The thesis consists of a research for design method, meaning that the results of research are applied in design. The first research question will be investigated through a user focused workshop with individuals who have experience in COSMIC and/or have extensive knowledge about the users. Complementing semi-structured interviews were also made to gather more data. The second research question is to be answered through converging the findings from the first two research questions into 2-3 visual design concepts that will be validated through evaluation with a few former users.

1.2 Limitations

Firstly, this thesis will define keyboard shortcut as a combination of keyboard button presses that generate an action that normally would be achieved using interactive mouse clicks on the interface. Therefore any shortcuts that could be preformed by any other means than through a keyboard will be excluded. This entails touch screens or external tools that does not normally come with a computer

workplace. Secondly this thesis aims towards finding user interface implementations for learning keyboard shortcuts. The main focus will be on the product implementations and not external solutions such as training the employees through lectures, pamphlets or seminars etc.

2. Background

In this chapter, the theories and general concepts of the report will be explained. The concepts lay the foundation for why learning keyboard shortcuts is difficult and a brief explanation of the setting of the product. The chapter will go into which techniques for encouraging more frequent use of keyboard shortcuts.

2.1 Active User Paradox

In the 1980s, two researchers at IBM developed a concept of how we as humans use software and discovered; new users almost never read manuals about the software they use. Users *strike out in the unknown* and go about trying to perform their tasks. This would often result in errors, and the authors theorized that it has to do with an unwillingness to understand a system unless it is necessary for the task at hand (Carroll & Rosson, 1987).

Training materials are made with the assumption that users who want to learn something are willing to read. Carroll & Rosson (1987) showed that this statement is false for all levels of users and that very few users will take time to learn. Any task to encourage learning that does not directly derive to being useful in work tasks will be seen by the user as unnecessary. Whereas the preferable method for people is to just try different things out and see what happens. This, of course, comes at a risk. Without knowledge of the operations, the user will solely depend on assumptions, and could result in system damaging actions. Since made their discovery, many researchers have gotten the same result. The paradox is that that the user could go about their tasks more easily if they first took the time to understand the system and make use of documented instructions. Instead, people rarely do so in reality. The researchers believe that the result of this paradox is due to the nature of human behavior and that it is not a design problem that can be solved (Carroll & Rosson, 1987).

An active user can through -sometimes time consuming measures- learn the task necessary, but will face difficulties expanding their abilities and learning new tool. Therefore, the users will tend to keep the patterns of interaction as all new ways of learning are just too time consuming. This way of learning is lowering the chances for novice users to excel and improve their abilities. The user might

even be aware that there are more efficient ways to go about their task, but at the point the successful operations that they know outweigh the unknown (Carroll & Rosson, 1987). They might also have a sufficient knowledge of the system for them to never explore the rest of the interface. Overcoming active user paradox is an important aspect of becoming a better user.

2.2 Interface Staging

Not all users stay in the same lane of system proficiency. Krisler & Alterman (2008) discuss the term interface staging as three stages of application proficiency based on Dreyfus five stage model of skill acquisition. Both theories have the novice user being on the first level and the last stage is master or expert. The five-stage model visualizes how cognitive functions change over skill acquisition; whereas, Krisler & Alterman (2008) focus specifically on systems proficiency. Novice user sees the interface as a set of context-free features which could be defined regardless of experience. The novice relies on external interface cues to guide their work. Dreyfus calls this non-situational recollection which will develop into a situational recollection as the user have more experience in the system. Once a user internalizes interface information, the user can enhance performance by constructing plans.

For the user to develop their abilities and achieve an expert or master level, they need an understanding of the conceptual model that underlies the system or application. That includes understanding what the best operations are in different situations. The expert user does not need to stay tentative to their performance as they can act intuitively and instantaneously do their actions without any mental load (Dreyfus & Dreyfus, 1980).

2.3 Keyboard Shortcuts

Keyboard shortcuts, hot keys, keyboard accelerator, and macros are some of the terms that can be defined as a combination of keyboard button presses that generate an action that normally would be achieved using interactive mouse clicks on the interface. From here on, the action will be solely referenced as keyboard shortcuts (in short KBS). In this thesis, I will consider any button press on keyboard that could be replaced by a mouse action, as a KBS. This includes single button presses such as *Esc* and *F5*. There are a significant number of research papers that have concluded that the use of KBS is distinctly more time efficient than mouse interactions, yet very few people use them. Even the users with very high technical skills have fairly low usage.

Lane et. Al investigated individuals' favorite methods of operations amongst professionals working in Microsoft Word. The different methods included all possible click, toolbar icons, and KBS operations. Their research showed that even the simplest KBS such as copy, cut, and paste where only favored

by 13.94% of the test subjects (Lane et al., 2005). There was also no correlation between KBS and writing speed, experience in the software, or demographic data such as age. Following this, same study investigated the time difference for using KBS, toolbar icons or the menu method with is when the operation is found through menu. The results found, like expected, that KBS where substantially faster than the other methods. The amount of time decreased varied depending on if the user's hand were already on the keyboard or not. Still, not even highly experienced users employ KBS even with that knowledge. Instead, the icon toolbar was favored in most cases in the studied software(Lane et al., 2005).

As the active user paradox stated, the core issue as to why keyboard shortcuts are not as frequently used cannot be simplified to lack of knowledge. Although knowledge and learnability is a central issue, Peres et al. (2004) concluded in a survey that the preferred learning method is observing and being taught by KBS from colleagues. The study also concluded that people who use KBS usually have people around them that also use KBS with no correlation between age, familiarity, and use of KBS. For some users, not knowing the available shortcuts is part of the problem, but it cannot account fully for the low frequency. Tak et al. (2013) showed in experiments with the knowledge of KSB and under time pressure many test subject still failed to choose the methods that they knew where the fastest. Even though it has been proven difficult to teach KBS in general and even more so through means of graphical user interfaces, there is tested methods that have increased the use.

2.4 Methods for Learning Keyboard Shortcuts

After gathering information about how KBS is successfully taught in a system, there is a number of strategies and methods mentioned. In this section, I will focus on strategies presented to learning KBS in academic literature as well as the difficulties that led to them. Adopting a regular use of a keyboard shortcut could be divided four steps (Lewis et al., 2020). 1) *Motivation*: The user becomes motivated to learn a new shortcut for a command. 2) *Discovery*: The user discovers the relationship between a command and its shortcut. 3) *Rehearsal*: The user rehearses the shortcut action and begins practicing it. 4) *Memorization*: The user memorizes the shortcut mapping and fully adopts using the shortcut for the command. With continued usage, the shortcut action ultimately becomes muscle memory, and they attain automaticity (Shiffrin & Schneider, 1977). Based on these four steps, we can see that different strategies target different steps of leaning KBS.

2.4.1 Trying out the Options

Malacria, Bailly, et al. (2013) suggest a method called ExposeHK as a way of highlighting the shortcuts at hand in a given moment. This is done in two ways: by giving the users an ability to see which KBS are available at any given moment and by accessing an environment where it is safe to learn. Malacria,

Bailly, et al. (2013) writes how the difficulties with KBS can be subtracted into smaller design goals. The first of these design goals is to enable novice users to brows and rehearse KBS in a protected environment in order to learn. In this environment, all the KBS would be visibly displayed, and if the user wanted to practice the commands, the rest of the application would not be effected. Malacria, Bailly, et al. (2013) claims that this is a good way of making KBS shortcuts accessible for novice users that are new to KBS in the system and to encourage those users to improve in the system.

Overall, multiple papers claim that giving hot keys exposure and attention is a way of encouraging learning. One way of doing this is by writing out the KBS to each button or selector that has a corresponding KBS, in a toolbar tip. For example, a menu option to save would have the letters *ctrl+s* next to it in order to indicate. Grossman et al. (2007) calls this incidental learning, where the user is learning without getting to the instruction to learn in an effortless act. Giving exposure through a paired-associated stimuli can lead to KBS learning as a byproduct of completing a task (Grossman et al., 2007). Some do this by manipulating the cost of not using KBS by making it more time costly to use clicking actions then to use KBS, as a way of incentive KBS. Grossman et al. (2007) stated that even if it was effective to learn KBS, it raised negative feeling about the system. In the study by Malacria, Bailly, et al. (2013), such toolbar tip was less successful than letting the users browse in a protected environment.

Some articles claim that the novice user needs a way to be initially exposed to KBS, and the intermediate users needs a quick way of identifying KBS. These intermediate users are described as individuals who have partial knowledge of the shortcuts but are not always confident on experimenting unless they know a KBS for sure. Malacria, Bailly, et al. (2013). suggest a quick way of accessing KBS by exposing all available KBS in a menu by just pressing a single key such as *ctrl*. In their testing, this was an appreciated method by their participants, but even though the participants could learn more KBS, they need information about this new system to access the KBS. The examples above demonstrate multiple ways to broadcast which KBS exist. This can be done in different settings where all of the shortcuts are on display, or in an area where users can practice using KBS. Another way to accomplish this is by displaying the keys for a KBS whenever there is one available, in a menu for example.

2.4.2 Visualizing the Keyboard

Another method is KeyMap presented by Lewis et al. (2020) which builds on ExposeHK. KeyMap displays an on-screen keyboard, with command names, labelled on the keys when a modifier key is held down. The interface is designed based on Norman's principle of natural mapping, which matches the display of the shortcuts to the physical layout of the keyboard. Natural mappings is defined by Norman (2018) as *a design in which the system's controls represent or correspond to the desired outcome*. This principle is based on the idea that when controls map to the actions itself, then the

system is faster to learn and easier to remember (Norman, 2018). This design proposed in KeyMap makes shortcuts more memorable by leveraging spatial memory, and it enhances the user experience by providing memory cues with greater cue-target strength. Furthermore, this layout enables users to discover and practice keyboard shortcuts more easily (Lewis et al., 2020). The results demonstrate that KeyMap users were able to recall one more shortcut than ExposeHK immediately after training, and this advantage increased to 4.5 more shortcuts when they were tested again after 24 hours. Moreover, KeyMap users incidentally learned more shortcuts that they had never practiced before (Lewis et al., 2020).

An even more visual method of teaching KBS is IconHK. it is a design approach that incorporates visual cues into toolbar buttons to convey keyboard shortcuts without compromising the pictorial representation of the command (Giannisakis et al., 2017). For example, a button that has a KBS containing the word A, would have an A in its icon. This design approach addresses several design challenges including conveying the shortcut key combination, conveying the meaning of the command in the icon, maximizing shortcut exposure duration, minimizing the visual space used to convey shortcuts, and maintaining the overall aesthetic appeal of the application. IconHK offers a perspective on the design of toolbar button icons providing a way to enhance user experience and productivity (Giannisakis et al., 2017). The difficulty with this method is that it relies on the preconception that the system uses icons, which may or may not be relevant for some systems.

2.4.3 Nudging the User with Motivation

In another paper by Malacria, a HotKeySkillometer widget is presented as a way to encourage users to use more KBS (Malacria, Scarr, et al., 2013). The widget monitors the users interaction and suggests alternative ways or KBS when there is some available. In one field, the widget tells the user how much time they could have saved in seconds by using a KBS, yet in another area, the widget informs the user of which actions would save them time and in a third om the user is being rated from slowpoke to superstar. The widget appears in the bottom left corner every time a command can be used. The goal of the skillometer was to visualise the ability to improve and motivate the user to improve, their results showed an increase of KSB from 28% to 50% (Malacria, Scarr, et al., 2013). This is an example of nudging the user very explicitly in order to teach KBS. It is a more playful way of encouraging the user to use more KBS and plays on the users emotions.

2.4.4 Adjacent Ways of Teaching Keyboard shortcuts

Some articles tend to tackle the underlying issues of KBS as a way of making them easier to learn. One way of doing so is by association in something called mapped hotkeys or KBS (Odell et al., 2004). Mapped hotkeys represent a cognitive mapping between the key letter and the name of the command they represent. This mapping may require the user to reposition their hands to reach the

keys. For example, the *save* command can be issued using the *S* key, and the *bold* command with *B* key. Another way of doing it is by grouping KBS together. Unlike mapped KBS , grouped KBS don't have a cognitive mapping between the name of the command and the key letter. Instead, they're grouped together to allow for easy access without the need to reposition the hand. For instance, the number keys *1*, *2*, and *3* were assigned to a group of commands that are associated with each other respectively. The study found that mapped KSB was significantly easier to learn than the grouped ones (Odell et al., 2004). This way of creating KSB is not related to how they are presented in the system, but rather, a way of giving better opportunities to learning KBS in general. Studies also suggest completly different techniques that by expressing KBS by doing gestures with the mouse (eg: marking menus, see Odell et al. (2004), Appert & Zhai (2009)). This is more of a structural way of learning KBS that is only applicable when creating new KBS.

2.5 Background Synthesis

This section has explained what a KBS is and what difficulties exist for users to learn KBS. Active user paradox stated that new users want to learn through experimenting rather than learning through guidance, and active users tend to not want to improve or find better ways of interacting in the system. Interface staging is a concept that states that in order for a user to improve their abilities in a system they need to create a conceptual model of the system. Previously proposed methods of learning KBS puts focus on ways of visualising KBS in different ways such as broadcasting the options and nudging the user. The proposed methods also talk about giving the user proper feedback in order to learn KBS.

3. Methods

This chapter will describe the methods and proceedings of the thesis. Firstly, the foundations for research for design will be described, followed by a description of the overall processes of the methods. The chapter will contain methodological background for each chosen method, a general ethics section, and lastly, the procedures of the methods is described as divided by the three phases of this study. The three phases are *The Concept phase, The Processing phase* and *The Detailing phase*. These phases represent conducting research on the users and the subject keyboard shortcuts, followed by generating concepts for solutions, and evaluating those with clinical expirence in COSMIC.

3.1 Research for Design

This thesis is based on methods for research for design. This means that research sets the foundation for a design solution. Specifically, in this thesis, the type of design focus is interaction design. Interaction design, as defined by Preece et al. (2016), is design of interactive products that help people communicate and interact in their everyday and professional life. One way of doing research for interaction design is by gathering scientific and technological information and conducting studies to learn more about the situation that the design is made (Arvola, 2021). Subsequently, a design project can be divided into three phases. Arvola (2021) calls the initial phase the conceptual phase where the aim is to understand the project, do investigations, observations, and data collection which aims towards giving insight and setting intentions. The second phase is called the processing phase where the designer work towards an operational image of the design. here an the principles of the design is set to lay as the framework. The ideas generated in the conceptual phase is continued to develop on more detailed level. At this stage, the design might take physical form in terms of sketches or lo-fi prototypes (Preece et al., 2016). Once the overall design is done, the final touches are created in the last phase called the detailing phase. In this phase, the specific features of a design is fine-tuned into detailed specifications and realistic prototypes (Arvola, 2021).

3.2 Overall procedure

The method of this thesis is inspired by Arvola's three phase model, although this thesis puts more emphasis on the first conceptual phase of exploration and research. The concept phase includes both the first research question and theory gathering presented in the background. Both aspects were explored simultaneously. The first research question; *What COSMIC users would benefit the most from increasing their use of keyboard shortcuts?* is answered through conducting user research in forms of workshop and interviews. The combined results from the conceptual phase is refined in the processing phase. The second research question; *How could such techniques be implemented into the user interface of COSMIC?* overlaps both the processing phase and the detailing phase. In the processing phase, the requirements and goals are defined for the design, and prototype sketches are made for design concepts. In the detailing phase, feedback on the generated concepts is brought forward by usability testing with the end users. Normally, in a detailing phase, the results for usability testing sets the starting point for another iteration of prototyping to continue refining the design to a final product. This thesis will not further develop the product after the usability testing due to time constraints, but will present all the findings for future work to build on. Overall, the timeline is visualized in figure 3.1.

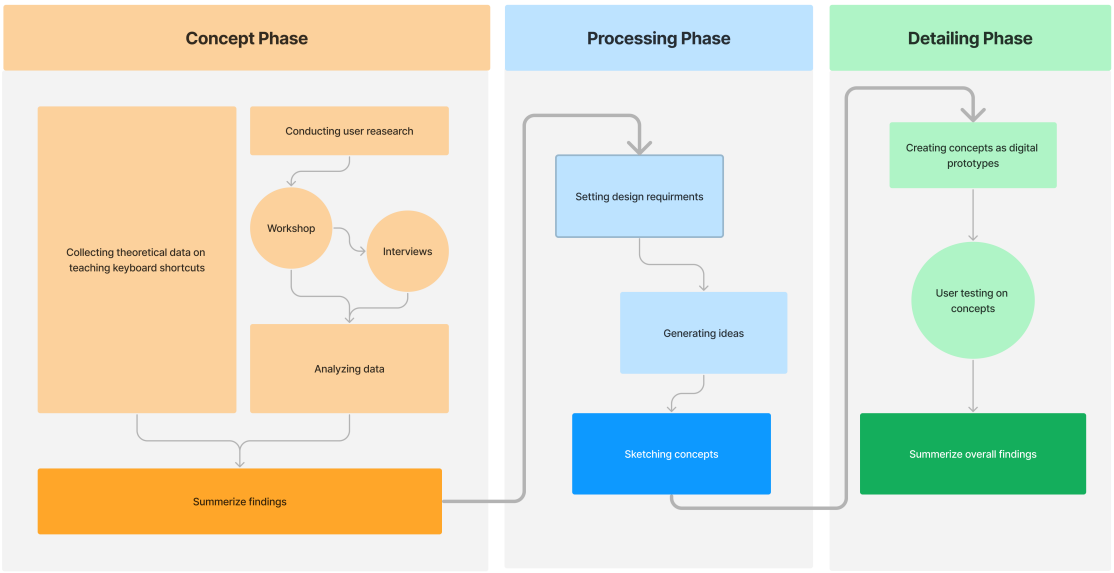

Figure 3.1: Overall workflow of the process

3.3 Participants

Participants took part in three aspects of this study; the workshop and the interviews in the concept phase, and the evaluation in the detailing phase. The participants were selected through a convenience sample, all participants were employees of Cambio. The request to participate as sent out through internal channels and through personal emails. Personnel who had good knowledge of the COSMIC end users or have recently been end-users was specifically requested to participate. The background of the participants had the following distribution:

Workshop participants

W1 Consultant, recently a COSMIC end-user as a physiotherapist.

W2 Senior UX designer, 4+ years working at Cambio.

W2 Support specialist, previously worked as a midwife.

Interview participants

I1 Systems engineer and project manager, worked in health care years ago, but not in COSMIC.

I2 Generalist Consultant, COSMIC end user as a nurse for 16+ years.

I3 Senior UX designer, 12+ years working at Cambio.

Evaluation participants

C1 Senior UX designer, 12+ years working at Cambio (same person as I3).

C2 Consultant, recently a COSMIC end user as a Physiotherapist (same person as W1).

C3 Former nurse and recently consultant at Cambio.

3.4 Conceptual Phase

In this first stage, it is paramount to understand the task and the circumstances given the project. As visualized by 3.1, a big part of this phase is to understand which COSMIC users would have benefit from learning KBS. To create a product or design of value, Arvola (2021) claims that the designer need to have insight of the users and what they do, feel. To investigate this, the idea was to get information from people with knowledge about the users and from the users themselves through a workshop. Due to not enough participants taking part in the workshop, complementary interviews were held to supplement the workshop with multiple perspectives. The data was then transcribed and analyzed through a thematic analysis. Both the interview and the workshop was held in Swedish, all materials presented in this section and in the results have been translated. This chapter will describe the methodological approaches and the procedures from this phase.

3.4.1 Workshop

Workshop is a research method common within design and information systems because it allows group discussions of artifacts (Thoring et al., 2020). It has been defined, by Ørngreen & Levinsen (2017), as a creative group problem solving. It also entails that different professional roles and perspectives of a given topic. For a successful workshop method, some guidelines should be followed. Setting a goal of the workshop ahead of time creates common ground for the participants and allows a better starting point (Thoring et al., 2020).

A request to join the workshop was sent out on the company's internal network as well as by separate personal emails sent out to known individuals with the right qualifications to provide feedback. Out of the participants that showed interest but could not attend the workshop, they were instead invited to interviews. The workshop took place in a conference room at Cambio, and the interviews were held individually over Teams. Both settings were recorded with video and audio. All participants in the study were asked to fill out a consent form before starting, allowing that notes, video, audio recordings, and materials produced could be used as data for the research (see A.1,A.2). They were also informed that their identities would be pseudonymized in the presentation of the results. Stating out both the workshop and the interviews the participants were given a background about the purpose of the study and presented with a definition of what keyboard shortcuts is. They were also asked to present themselves and briefly explain their role and background in the software.

In the process of recruiting participants the goal of the workshop and the interview was declared. Both specifying which participants would be suitable to take part and also defining what the goals were:

- Understand which user would benefit most from learning more keyboard shortcuts in the interface.
- Understand the user's work situation, their professional role and the environment they work in.
- Understand what they require in order to benefit from possible keyboard shortcuts implementations.
- Understand when it is less appropriate to use keyboard shortcuts.

One and a half hour was set out for the workshop. The interviews was set out to be 1 hour but all of them where only 30 minutes. To reach the goals the workshop was designed to start off with a broad scope of mapping users and, through discussion, diverge and focus in on a smaller set of users that possibly would have use of a more frequent use of keyboard shortcuts. The participants were first asked to, on sticky notes, write down as many types of users that exist in COSMIC based on their role such as medical secretary, orthopedist, etc. Once the participants had written as many roles as they could think of, they were asked to classify the users based out on how often they work in

COSMIC from rarely, sometimes, often, and always by placing them out on a white board. Once all the sticky notes where placed out, the participants were asked to point out and discuss any contradicting placements. After the group had reached consensus, the layout was documented and a new diagram was painted out on the white board. This time the group was asked to place out their sticky notes in a two dimensional axis. On the x-axis, *a scale consisting of no benefit to largely benefit using keyboard shortcuts was plotted out.* On the y-axis, *a scale consisting of does not have time to does have time to learn keyboard shortcuts was plotted out.* Once again, the group was asked to place out their own sticky notes and then discuss any contradictions. Once the group reached a layout they agreed with, the participants were asked select users with the most time to learn keyboard shortcuts and the users who would see the most benefit in learning more keyboard shortcuts. Out of the selected users, the participants were asked to discuss and write down a series of questions about each role.

- How often does the person work in the software?
- How good is the person at performing their tasks efficiently in the software?
- What attitude does the person have towards learning new things in the system?
- Does the person use any keyboard shortcuts and in what situation?
- What would be the outcome if this person learned more keyboard shortcuts?
- In which situations would users benefit from knowing more keyboard shortcuts?
- What difficulties or concerns does the person have about having methods for learning keyboard shortcuts in Cosmic?
- Other thought about this user?

To finish up the workshop, the participants were asked if they agreed with the results that had been produced, and they were given the opportunity to discuss any addition aspects that would be of use to the study.

3.4.2 Interviews

Originally, the data was to be collected only through a workshop, but because it turned out to be logistically challenging to find a time that was appropriate for all participants, complementary semi-structured individual interviews was held with the participants that could not take part in the workshop. Semi-structured interviews are especially good at obtaining descriptions of real life phenomena because it gives the opportunity of highlighting the topics the interviewee view as important while still being in the scope of what the moderator views as on topic (Brinkmann, 2023). The questions in a semi-structured interview should be open so that the participant can talk freely and the interviewer

should primarily take the part of an active listener. A positive aspect of combining methods is that if the result conforms to each other then they could be utilized to validate each other.

Similarly to the workshop, the interviews was focused on the same themes of understanding the COSMIC users but without the interactive aspects. A semi-structured interview guide was used as a framework for the interview, see A.3. If needed, the interview could deviate from the guide to highlight topics of interest for the interviewee. After the interviewees were given all the necessary information about KBS and filled out their consent form, they where asked to describe their background and their exposure in the software. Participants who had previous personal experience in the system were given a series of follow up questions about their own experience as well as their general knowledge of the users in the system. Whereas participants without their own experience in the software were directly asked more general questions about the users.

3.4.3 Transcription

Both the workshop and interviews where recorded and run through the built-in transcription tool in Teams. The transcriptions where manually corrected to the video recordings and adjusted to Linell's third level of transcription. The notion aims to reflect content only and therefore does not include detailed information regarding qualitative aspects of the actual the conversation such as pauses and overlapping speeches (Linell, 1994). The notes that where taken were reviewed and transcribed.

3.4.4 Analysis

The main data output from the workshop and the interviews are transcriptions. Along with transcriptions, there is visual data of sticky notes that will be presented in the results. The transcribed data from both the interviews and the workshop will be analyzed through thematic analysis. Thematic analysis is a widespread method of analyzing qualitative data such as interviews. It is a research method used to identify, analyze, and report patterns or themes within data. The method involves a systematic process of coding and categorizing data allowing researchers to identify recurring patterns and themes that emerge from the data. The first step of thematic analysis is to familiarize with the data set, which in this study consist of transcriptions from the interviews and the workshop. By familiarising means to read transcriptions and listen to audio, while making notes on analytic ideas. The next step in the analysis is coding, where the researcher works on a fine grain level to identify potentially interesting segments to the research question. The third step is then to generate initial themes across the data set, to describe a broader shared meaning. The forth is to develop and review themes. In this step the mission is to check in the themes make sense to the full data set, to the extracts, and that the themes highlight the most important patterns across the data set. In the last and fifth stage the research refine the themes, by fine tuning the analysis and give the themes names (Braun & Clarke, 2022).

Workshops and interview have very different data output. The main focus of workshops or focus group is mainly to create an environment of a moderated group discussions rather than just getting straight answers like in an interview. Therefore, the moderator needs to utilize discussion materials rather than simple questions. The data in the workshop can also consist of materials that is produced in order to start discussions. In one-on-one interviews, there is less room for discussion as usually the interviewee is the only one who possess any knowledge. The interviewer can always ask follow up questions, but it will not have the same dynamic as a workshop. On the other hand, interviews are still a good method of choice when collecting qualitative data about peoples experience in real life. Although the methods are different, a thematic analysis is a suitable analysis for extracting topics from conversation and was therefore deemed as a good method for analysis. Thematic analysis is particularly useful for exploring complex phenomena that cannot be easily quantified. It enables researchers to gain insight into participants' experiences, perspectives, and attitudes towards a particular topic. However, there are limitations to this method, such as the requirement for a high level of skill in interpreting qualitative data and the risk of researcher bias when interpreting the data.

3.5 Processing Phase

In this phase the knowledge from the first phase containing the first two research questions are to be applied by processing the information into concepts, sketches and prototypes. The phase is about setting a structures for how the design should be and work by setting a set of requirements. This entails creating content and features that realizes them and by creating a prototype that implements them (Arvola, 2021). The requirements can be set by user personas, brainstorming ideas, stakeholders, regulations, etc. In this project the requirements was set by the project goals, the data from the theoretical background and the data from the conceptual phase.

To define requirement for a design is to to define what the product or design must do in order to succeed. The requirements are sometimes broken down to different types of requirements (Goodwin,2009). *Data requirements* are the information that the users needs to consume in order to be successful. *Functional requirements* are verbs that describe what the user is supposed to be able to do. Lastly *product qualities requirements* are requirements that can be divided into product abilities that are objective attributes such as speed performance, and experience attributes that are subjective user experience goals that describe the feeling of the product. Good requirements need to be unambiguous and validatable (Arvola, 2021). Sometimes when defining requirements, other constraints are also identified. In the results of this thesis data-, functional- and experience attributes of product requirements is defined. Along with the requirements there will be a small portion to describe the motivations of the requirement. As there is no other real constraint to this project then the time constraint of the thesis, no constraints will be mentioned in the results. Conceptual sketches were then created based on the defined requirements. Sketches are a good way of exploring how different aspects of the design should

be composed (Arvola, 2021), it is also a good way to generate ideas. It doesn't have to look close to what the finalized product is, it can just be a good way of exploring what should or shouldn't be (Arvola, 2021). The sketches were created to match the requirements previously identified. In bigger design projects these concepts can be evaluated before going into the detailing phase, this thesis does not due to the time constraints.

3.6 Detailing Phase

After the processing phase, one should go into detail during the last and final phase, the detailing phase. In this phase a computer prototype of the concepts where made. This is also the stage where the combined leanings are brought together. Computer prototypes are realistic and detailed of the visual and interactive ques (Arvola, 2021). This makes it possible to test its looks and feels. In the prototyping, Arvola states that it is important to not build more than necessary to communicate, specify, and test the design. In the prototyping phase, my goal was to present the sketched concepts in a way that looked somewhat realistic to the feel of COSMIC as a product and exemplified how ways of teaching keyboard shortcuts could be implemented. To do this, the design concepts were created in the prototyping tool Figma. The concepts where placed in a lo-fi COSMIC framework to give the feel of being apart of the product. The design concepts were also designed with the same color schemes, fonts, and sizing used in COSMIC. The goal was to present the concepts in an applicable state, but without in-depth detail to allow the principles of the concepts to be evaluated as a whole, rather than just details of the design.

3.6.1 Testing the Concepts

Once the concepts have been made into digital form, the concepts were evaluated in interview sessions inspired by traditional usability testing. Usability testing have the goal of evaluating if the design reached the defined goals and design requirements (Arvola, 2021). To evaluate the concepts, three people with knowledge of COSMIC users and previous COSMIC users where invited to a meeting where they were presented with the concepts and were given the opportunity to give their thoughts. Normally, this type of testing is made quantitative to measure if the design is successful, but the testing made in this thesis work was made with a more qualitative approach with a smaller set of participants and no quantitative measurements. Instead, the participants where asked open questions about the concepts, such as what they thought about it and if they thought it would be successful of fulfilling the requirements. The testing occasion took about 30 minutes, and the participants were recruited from the workshop and previous interviews. An email was also sent out to newly employed consultants at Cambio to reach people with clinical experience, although, this only yielded one extra participant. During testing, the participants were informed about the purpose of the meeting, and they were asked to speak freely about the concepts. They were presented with one concept at a time,

and they were then asked to explain what they saw and what they thought about it. See appendix interviewing protocol. Lastly, the participants were asked if they thought that the concepts lived up to the requirements.

3.7 Ethics

This study followed the four main requirements for research as defined by Vetenskapsrådet (2017). All participants were informed of the aim of this study and the data collection upon their participation. They were informed their personal information would be anonymous and that they could withdraw their consent at any point. The consent form that the participants signed can be found in the appendix. For those who participated remotely, a digital form with the same information was filled out.

3.8 Method Synthesis

This chapter has described how the method of this thesis went into three different phases. Where in the first phase, I wished to answer what COSMIC users would benefit from increasing their use of KBS by doing interviews and a workshop where the results where analysed through a thematic analysis. The first phase also included part of the theoretical background where examples of techniques for encouraging more use of keyboard shortcuts. The second phase consisted of defining design requirements to start of the exploration of how implementations of teaching KBS could be implemented, as well as doing sketches. In the third phase, the exploration in the third research question is continued by creating prototypes of the design concepts. The concepts were then evaluated with people who have experience in COSMIC.

4. Concept Phase Results

This chapter will present the findings of the first phase of the study. Firstly, the findings from the workshop will be presented. Secondly, the results from the thematic analysis with be presented. Following the results, a short section summarizing the findings will be presented.

4.1 Workshop Results

In this section, the materials from the workshop will be presented. The materials are results of the tasks that the participants were given during the workshop. The materials are translated to English as the workshop was done in Swedish.

4.1.1 Time Spent in the Software

The diagram below presents how the participants rate of how often certain roles are in COSMIC. The participants chose to define rarely as at most once a day, occasionally as only on specific times during a given day for a specific reason, often is multiple times a day in various situations. The category always was defined as someone whose work only consist of working within the system. The different colors of the sticky notes represent the different participants. The figure below shows the placements after the group got the chance to discuss the placements and readjust them. Note that in figure 4.1 there are some roles that have multiple sticky notes represented, the different colours represent the different participants.

The participants were asked to agree on the placements, yet some minor differences remain on the roles where the participants could not agree. In figure 4.1, we see most roles that the group generated are placed in the often-column. In total, there are 19 unique roles represented, five of them being subgroups of nurses such as ward nurses and district nurses and two of them being subgroups of doctors, such as primary care doctor and doctor. In the rarely column, there are only two roles represented; assistant nurses and midwifes. In the occasionally-column, there are five unique roles represented, amongst them emergency room doctor, operating room nurse, and orthopedic clinician. The participants selected six user roles that they deemed always work in COSMIC. These roles consisted

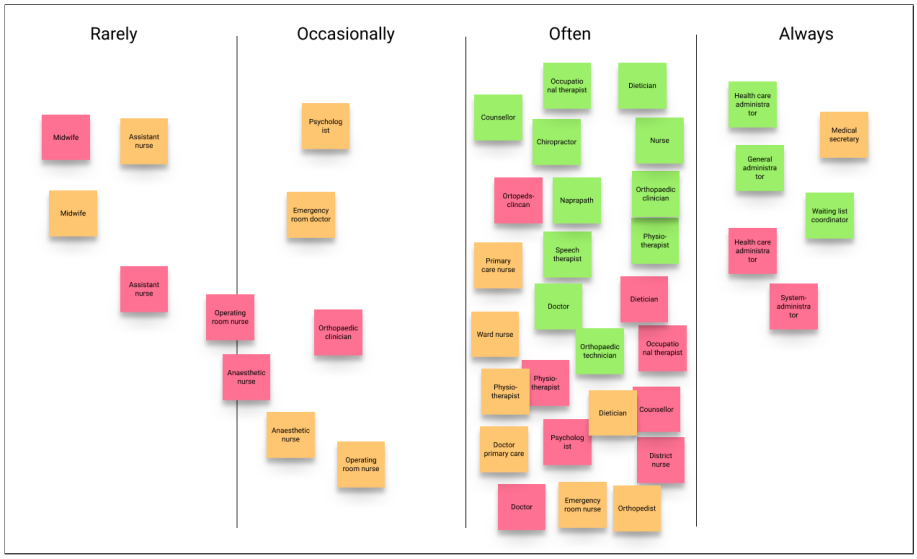

Figure 4.1: Users time in the software, from rarely to always as interpreted by the workshop participants.

of; health care administrator, medical secretary, general administrator, waiting list coordinator, and system administrator.

4.1.2 Time and Benefit of Learning Keyboard Shortcuts

The following figure demonstrates an axis of which users would have the most time opportunities to learn new keyboard shortcuts and who have the most to gain from learning KBS, according to the workshop participants knowledge. Figure 4.2 shows very few users in the left fields of the axis, indicating that most user roles were deemed to have benefit from learning KBS. The roles that the workshop participants thought had little to no benefit are assistant nurses, emergency room nurses, orthopedics, dietician, and counsellors. The right side of the axis is populated by most roles indicating that the vast majority of users would see benefits of learning KBS. As seen in figure 4.2, there is a clear divide between users who have time and users who don't. During the workshop the definition of having time was discussed by the participants as a difficult parameter to define because very few people have any time left over unless they have specific time set aside during the workday for administrative duties. The participants discussed that there is only a handful of roles that have such time, so inevitably, most roles will fall under the axis for not having any time. On the other hand, the participants discussed that many of those who do not have time could still learn KBS if there was time set aside by superiors in the workplace. With that in mind, the participants placed 16 roles in the field with largest benefit but no time. Amongst them, doctors and nurses in different positions and settings (e.g anaesthetic nurse, ward nurse, emergency room doctor, primary care doctor etc.). As well as counsellors, midwifes, and

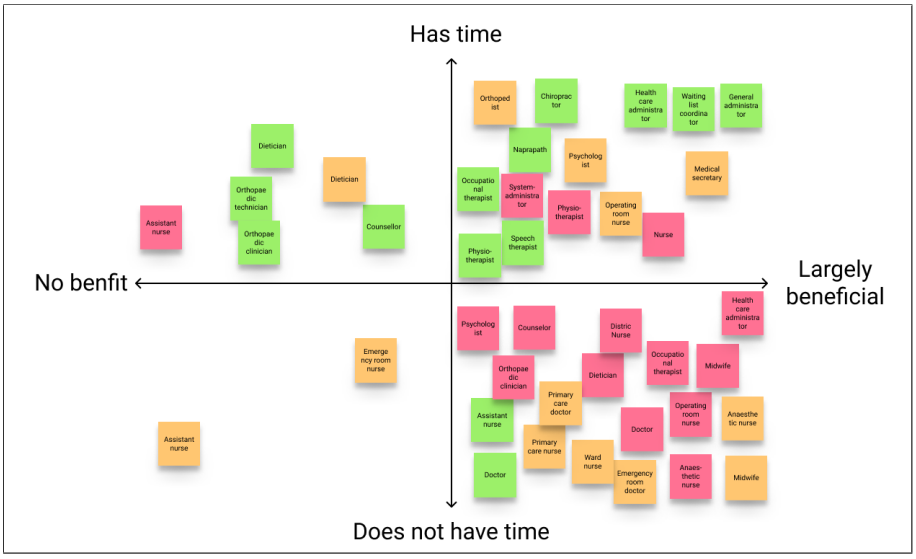

Figure 4.2: Users benefit and time ability to learn new KBS as interpreted by the workshop participants.

dieticians. In the field of time and benefit, 15 roles were identified such as physiologist, orthopedics, and physiotherapists. In the most upright corner, where roles have the best opportunities to learn KBS, the roles healthcare secretaries, general administrators, and system administrators were named.

4.2 Users

Based on the layout of the figure 4.2 and on the discussion that more users would have time if given the opportunity, the workshop participants were asked to pick out three user roles to focus in on as key users. They picked primary care doctors, primary care nurses, and a collection of administrators. The motive for picking primary care doctors and nurses was, as previously stated, that even though they have very little time, they would have the largest benefit if given the opportunity to learn more KBS as they spend a lot of time in COSMIC. When grouping together the administrators, the participant chose health care administrator, waiting list coordinators, and general administrators. The motive was that even though these three roles are separate in the software, the tasks made by these roles might be done by the same person, as they rotate their work responsibilities and/or have very similar interactive patterns in COSMIC. The following paragraphs will summarize how the workshop participants described these roles and their relation to COSMIC.

4.2.1 Administrators

Administrators work in COSMIC all the time, and they are skilled users. Even beginners are fairly good at interacting in the system as it lies in their professional interest to be efficient. They sometimes use mousetraps (a built in mouse to the keyboard- in order to be more efficient in their work). In general, they see positively on learning and excelling in the system, but not always, mostly this is dependent on the users workload and age. This group already uses KBS, but they might not pursue learning more KBS than those that they know, and it is not granted that they get any education in learning KBS even though it would be beneficial. Overall, they can see the benefit of knowing KBS, but they might not know all that there is. The administrators would save time and body by using more KBS because they then would not have to reach for the mouse as much. A more frequent use could also increase product satisfaction. Situations were these users would have to make use of KBS is mostly when navigating through the system and doing indirect patient work.

4.2.2 Primary Care Doctors

The doctors in this user group work in COSMIC all throughout the day, mostly in connection to before and after patient appointments. They also do tasks such as order tests, write referrals, check test results, etc. in COSMIC. This is a group that is moderately good at navigating in the system. Generally speaking, they do not see the administrative work as their primary task or area of interest. Rather it is seen more as a necessary evil that needs to be done. Preferably, they would want someone else to keep documenting for them. They do not use any KBS, and this is mostly because they don't know that they exist. Some doctors are proficient in the system and have a willingness to learn more KBS, but in those cases, it could be due to the generational aspects of computer proficiency. Most likely, they would enjoy the efficiency that a more frequent KBS use would entail as they are a group that request the amount of clicks in the system to be kept at minimum. A challenge for this group is that some might not have trust in the system and might not see KSB as something applicable and useful for themselves. They would need to see how KBS could apply to them and their work in their context in order to want to use KBS.

4.2.3 Primary Care Nurses

Primary care nurses have similar roles as outpatient care nurses; therefore this role is applicable to both. The nurses also work daily in COSMIC. Generally, they are better at navigating in the system than the doctors but worse than the administrators. They have systematic behaviors and patterns in the system and dislike changes that disrupt their routines. It is the most stressed and pressed occupational role in the whole healthcare system, so they don't feel like they have time to learn new things. They don't use KBS, but it is not because they don't want to use them, rather they don't know of their existence. As they are the most pressed group, they would see the most gain in learning KBS

because they need all the extra time they could get. An issue with learning more KBS is that they already have a lot of on their plates and learning is another task in itself. They are tired of change and are happy with the routines that they already have. The solution would need to be very accessible for the nurses to want to pursue learning KBS. In summary they would have immense use of KBS but it's currently not presented in a fruitful way.

4.3 Thematic Analysis

In the thematic analysis four overarching themes was found: *Benefits Everyone*, *Key Users*, *Documentation*, and *Visibility*.Below are combined results transcripts of the interviews as well as statements from the interview. The different themes are not presented in any particular order. To every excerpt, there will be a short explanation of the statement and its context. At the end of each theme, there will be a small discussion. The notations of speakers will follow the pattern presented in the methods.

4.3.1 Benefits Everyone

When asked which users would have the most use of keyboard shortcuts there seemed to be some consensus that most users would have use and benefit of knowing keyboard shortcuts. It's just a question as to what extent. In the individual interviews, when asked if any users would have use of KBS, the participants made it clear that there is benefit for almost all users to learn them.

```
11.I1    Yes yes, It's clear that everyone would have use of
         Learning keyboard shortcuts, is my thought at least, as
         long as you use Cosmic more than 15 minutes a day. Then of
         course you would find use in learning the shortcuts
```

I1 states that it is in their opinion that anyone who use Comic more than 15 minutes a day would have use of learning KBS, but that users that rarely spend time in the system wouldn't see much of a difference or gain in learning KBS.

```
20.I3    Yes, I think that if we make it [keyboard shortcuts]
         accessible enough and good enough, I think everyone will
         benefit from it. If we can sort of take down the barrier
         of it being complicated and difficult to learn. Then I
         think we can make it available to more people.
```

I3 highlights that its more so about breaking down the barrier of learning KBS then everyone would benefit from it. Implying that the way users have to learn KBS at the moment is not beneficial enough or not incentivising enough. When the workshop participants were asked to grade user roles based on their personal benefit of learning KBS and their abilities in time to learn KBS, W3 made the statement below.

> **48.W3** But the sad thing is all those ***points to post-it with users*** are there ***points to the box there with great benefit and no time***. Nobody really has time to learn new things, but everyone would benefit from it, which means that you are forced to take time or it won't happen.

The issue with learning KBS is seemingly not with how beneficial they are to use because most users would find benefit. W3 states that one of the problems, rather, lies in the time it takes to learn them and that there is no time to do so.

> **13.I2** It is almost easier to exclude. It is about those who do not have frequent use of the data, like where they are only in few times per shift and document everything. I might be able to point out the assistant nurse group as one that might not have as much benefit much use of keyboard shortcuts

The excerpt from I2 is following the question as to who would have use of learning more KBS. I2 claims that it is easier to exclude user groups than to list the users that would have use. The interviewee points out nurse assistants as one of the few user roles that would see little benefit.

Summary

In summary, the workshops and the interviews concluded that there is benefit from learning keyboard shortcuts. This could be derived from the fact that most users would gain from time optimizing their tasks, and using KBS is one way of becoming more efficient. If there is no need to perform the task faster, then, there is no need to learn KSB. A few of the experts also touched on the fact that there are time limitations and other barriers that currently are blocking the possibilities to learn KBS. In conclusion, it seems that enabling more COSMIC users to learn KBS would have a positive outlook.

4.3.2 Key Users

When specifically asking which users would have the most use of KBS, the occupational roles such as health care secretaries, system administrators, and waiting-lists coordinators were some mentioned. They have roles where their main task is to work in COSMIC or other administrative systems and are mentioned by some of the participants as "COSMIC-ninjas," but because they already are very proficient in the system, they might not be the key users in making a difference. I2 exemplifies roles

> **35.I2** Could point out as one that may not have as much benefit it would definitely be those who are most often referred to as cosmic ninjas. It is partly those in the medical group such as younger doctors, interns, ward doctors and perhaps even more medical secretaries and care administrators.

that have good knowledge in COSMIC and are fast at navigating through their systems. They mention both younger doctors as being such ninjas, as well as the administrators. Here the interviewee talks

> **11.I1** Yes yes, It's clear that everyone would have use of Learning keyboard shortcuts, is my thought at least, as long as you use Cosmic more than 15 minutes a day. Then of course you would find use in learning the shortcuts

about that it is these administrative roles, such as medical secretaries, that have it in their interest to know and to be good at KBS. I1 also question if, for that very reason, that group might not be the best to target to learn new shortcuts. As the workshop concluded, the people in the administrative roles work exclusively in COSMIC and other healthcare software, making them advanced usage COSMIC users. Most of them already know shortcuts as their job demands efficiency and repetitive work.

> **117.W2** Yes, but the COSMIC has been designed and designed and Adapted mainly with this group in mind because they have a lot of time, but they also have time to influence and feedback... back and kind of shape the the fruit in comparison to maybe other roles that unfortunately have not gotten the shape of COSMIC quite as much as they had wanted according to their own needs.

The UX designer W2 in the workshop expresses the user group medical secretaries and health care administrators as a group that COSMIC is tailored to as they tend to have a lot of influence on the product. Their opinions matter as they spend the most time there, but subsequently, the system is already adapted to their use in mind.

Summary

To conclude this theme, it seems as though the administrators have use of KBS because their roles and responsibilities demand efficiency. They are very proficient users in the system, and therefore, they already are good at using KBS. Even though some of the administrative users would see benefit of learning more KBS, it is not the user group that would see the most improvement in making KBS more accessible.

4.3.3 Documentation

Health care workers have to document in patient records as accordingly to the Swedish patient data law. Employees such as doctors sometimes see this as a secondary task to providing care.

132.M	We'll get to that next. What is the the person's attitude?
133.W3	It is like this... a doctor's primary task is to to care for and diagnose and care for patients. That's what is Their area of interest, then we have we have a law that says you have to keep documentation about what you do, even then it should be smooth and simple and self-explanatory as possible. And therefore the attitude is that... Someone else should solve this for me. I should just do as little as possible with this.

In the excerpt above, W3 is discussing doctors attitude toward documenting in COSMIC. They explain that it is their experience that doctors have an attitude of not wanting to do the first-hand administrative work and that they prefer to have as little involvement in COSMIC as possible. From this excerpt, one could assume that there is little willingness to sit down and learn KBS. I2 also reiterates this in their interview.

In the excerpt above, I2 explains why they think that some people never learn KBS and their attitude towards documenting. In their example, they talk about how a senior doctor might take advantage of their junior doctors ability to move quickly on the computer as they prefer not to do any documentation. This, in turn, leads to a result that the senior doctors never learn to be faster on the keyboard and see

17.I1 Of course, if they [the nurses] could do it faster, they wouldn't think it was.... They think that Documentation steals time, they are often focused on the care task itself, which is number one. Documentation is number 2. Just as the doctors often complain that there is too much administration.

more obstacles to doing their own documentation because having someone else do it is simply easier and faster. I1 shares this opinion and mentions that nurses also see documentation as a secondary task. I1 claims that the nurses also don't see documentations the primary task, but rather, it is something that just steals time from the real work which is to take care of patients.

17.I1 Of course, if they [the nurses] could do it faster, they wouldn't think it was.... They think that Documentation steals time, they are often focused on the care task itself, which is number one. Documentation is number 2. Just as the doctors often complain that there is too much administration.

Summary

Documenting in the software is not something that all users want to do, but it is seen as just something that has to be done. As such, this attitude can color the users willingness to learning new things. Some users that can push over the documenting responsibilities will do so, and therefore, they will never get the opportunity to improve their abilities with the software.

4.3.4 Visibility

When discussing the core of why many users don't use KBS, the answer is sometimes that they don't know of their existence. W3 states the following during the workshop: W3 highlights that there is an

155.W3 News from COSMIC does not reach end users at all. I did not know that COSMIC had the keyboard shortcuts until I started working here.

information gap information gap between the products developers and the product as news doesn't seem to reach the end-users in an efficient way. They state that it was not until they started working

at Cambio that they realised that COSMIC had KBS even though W3 worked as an end-user for 6+ years. W1 discusses a conversation where they found out that health care administrators do not get

160.W1 I have taught physiology to health care administrators and The person who is responsible for teaching them the basic Duties they work at the medical clinic in *city* so I asked the question like this: Do they get to learn all the quick Commands on the care administrator training? because I can imagine that it is one of those things that they get to learn there, they answered no, I have not seen it at any time in my training or in COSMIC anywhere.

taught keyboard shortcuts either in their education nor in the system itself. Those users still have in their interest to learn KBS, but there is nothing in the software that supports the learning. Later on in the workshop, W1 and W2 talk about KBS in regards to the doctor user group. W1 says that they

136.W3 Do they use keyboard shortcuts? No

137.W1 No, I asked 2 doctors both said blankly no, no doubt.

138.W3 And why? It is because I don't think they know they exist.

139.W1 No, I don't. I would take poison on the fact.

would *take poison* on the fact that the doctors don't use KBS. Taking poison is a Swedish idiom for reassuring those around you that something is true. The two participants agree that the reasons why doctors don't use KBS is because they don't know that they exist.

104.W3 I don't think they[nurses] know keyboard shortcuts either. In fact, and it's probably not because they don't want to but it because they don't know.

Similarly, this was said about the nurses as seen in the excerpt above. It seems like visibility is an issue when it comes to KBS. W3 says that they think the reason why nurses don't use KBS is because they simply don't know them.

Summary

The previously discussed time constraints seemed to be one of the key aspects of users not being able to learn KBS. The excerpts above highlight that part of the issue, and it seems to be that the users

don't have access to information about KBS to begin with.

4.4 Concept Phase Synthesis

The workshop highlighted that there is use for KBS, but that different users in COSMIC are faced with different challenges. One of the challenges is time limitations. Very few user roles have time to learn something new in the system unless someone allocates time. The groups have different knowledge of KBS and according to the workshop participants some issues would be solved just by shedding light on which KBS are available in a appropriate and contextualized way. The doctors as a group seems to want to have information accessible and, in particular, information that highlights their needs. The nurses don't know of the existence of KBS, and they need a straightforward way of learning them without compromising their workflow. The administrators already have knowledge about KBS, so they need accessible information to learn more KBS.

The themes from the thematic analysis discussed attitudes towards the system and administrative duties such as how most users could see benefits from learning more KBS. The issues at hand seems to be dependent on that health care personnel have very little time which both entails that they should be open to learning KBS and limits their possibilities to do so. Another issue is visibility, the users simply don't know that KBS exist and how to find them. The findings give a nuanced image of the problem at hand and paint a picture of the needs of the users.

It is worth mentioning that the interviews were dynamically structures based on the answers of the participants and their backgrounds. Some questions that arose during the workshops, the interviewees were not equipped to respond to individually. It was therefore hard to reach the same goals as the workshop had in the interviews, and as such, the results that were yielded from interviews is smaller in amount.

5. Processing Phase Results

This chapter will present the findings of the second phase of the study; the processing phase. Firstly, the design requirements will be presented. Secondly, the design concepts created will be presented.

5.1 Design Requirements

This section describes that data requirements, functional requirements and product qualities requirement that were set on the findings of the concept phase.

Data requirement

- Informaion about keyboard shortcuts - The design should contain information about KBS and what keyboard keys you can access them through

Functional Requirements

- Create a low-level prototypes of how the design concepts could be implemented in COSMIC.
- The design concepts should reflect the user's roles and how they operate in the system. A user should not be presented with all KBS if it is not relevant to them.
- The design concepts should not disturb or disrupt the workflow of the users.

Product Quality Requirements

The product quality requirements as focused on the experience attributes.

- Accessible - The design should be accessible to users of different technical abilities.
- Professional - The design should be adapted to it's professional setting and give a professional feel.
- Give a COSMIC feel - The design should be experienced as something that could be present in COSMIC.

5.2 Design Concepts

This section will combine the learnings of research question number one: *What examples of techniques for encouraging more frequent use of keyboard shortcuts can be found in scientific literature published between 2003-2023?* with the findings of research question number two: *How could such techniques be implemented into the user interface of COSMIC?*. The findings of the two research questions will be the basis for two design concepts that are possible implementation solutions for teaching COSMIC users to learn more KBS. In the sections for the design concepts, the ideas will explained along with the initial sketches that was made and the computer prototype of the finished concept. The computer prototype is meant to present the concept in a more realistic way in order to get evaluated, but it does not go into detail regarding integrating the concept into the system. Both computer prototypes were made using the design guidelines that the COSMIC UX designers have established.

5.2.1 Design Concept 1 - The Visual Wiki

As discussed in the theoretical background; a good way to teach KBS is to visualize them. Participants in the workshop and in the interviews vocalized that part of the issue is that people don't use KBS because the don't know that they exist. The existence of KBS in COSMIC is subtle and there is no real documentation within the application to look for new shortcuts. Novice users does therefore not have an approachable way of learning more KBS in the system alone. For this first design concept I had the goal to create something that would fill that gap, by giving KBS a home in a visual wiki. Meaning giving them a physical area in the product where the user can see which KBS are available.

In this design I wanted to make sure that the keys involved in the shortcut was visualized to aid the user with mentally mapping the KBS. By either just displaying the keys or by visualizing the entire keyboard. The concept should also be accessible to different stages of workflow and be available as a help along side with work. To fulfill the functional requirements the concept also need to reflect the users role to only present the user with relevant information.

To iterate ideas and visualize the concepts, sketches was made. See figure 5.1. The sketch visualize how going from the general COSMIC-window to opening up a side window with KBS. The sketches are exemplifying different ways of visualizing the functions of describing the use of KBS.After sketches was made the concept was made in to a final computer-prototype that represent the concept in more realistic manner. The image in figure 5.2 represent the whole frame, the image in 5.4 is a zoomed in version showing the different components in the concept, lastely in 5.3 the interactive hovering effect is displayed.

What the final concept contains is an overview of available KBS. The view can, in the prototype, be accessed by clicking the question-mark icon or by using the KBS *ctrl + k*. The frame has a title describing the purpose of the window in text: *Here you can search, find and try keyboard shortcuts.* Underneath the title there is a display that portrays a physical keyboard, marked as 1 in figure 5.4.

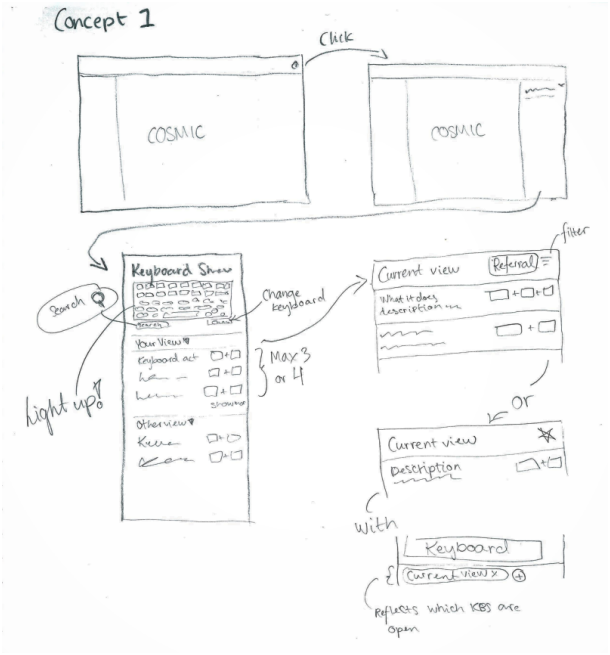

Figure 5.1: Concept 1 Sketch.

Figure 5.2: Concept 1 prototype in client frame.

The keyboard takes inspiration from ideas behind KeyBoardNav where it's described that visualising the keyboards location promoting neural mapping. As seen in 5.3, when hovering over a description of a KBS, the represented keys on the keyboard light up. Underneath the keyboard, we see cards of categories marked as 4 in figure 5.4. These hold the information about individual KBS in a given view. The idea is that if the user has the view "Referral" up the KBS category for that will be displayed in this view projecting the top three KBS for the view. The KBS all have a description and corresponding keys that represent the size and the look of the keys on the keyboard. The show more button is supposed to indicate that the view is expandable to show more KBS. Right now, it is limited to 3 KBS shown at a time to reduce information overload. In 5.4, frame 2 is supposed to visualize that there is flexibility in which KBS descriptions is shown by adding or removing view. In this concept, the idea was that one's visible cards are mirroring the views that the user has active. Even though this is the general idea, it is hard to represent in a prototype. If the user wants to add more views, they can do so by pressing the plus-icon. The purpose of this idea is to play towards the reflect-ability of the concept. There is also a star at each view card that indicates that the view can be favored. This was an idea towards making the concept slightly more personalized. At the bottom of view, there is a search bar indicating that, if the user is looking for a very specific shortcut, they can search for it. This was a way to compensate for the fact the the design otherwise does not give the opportunity to find a very specific KBS if there was one in mind.

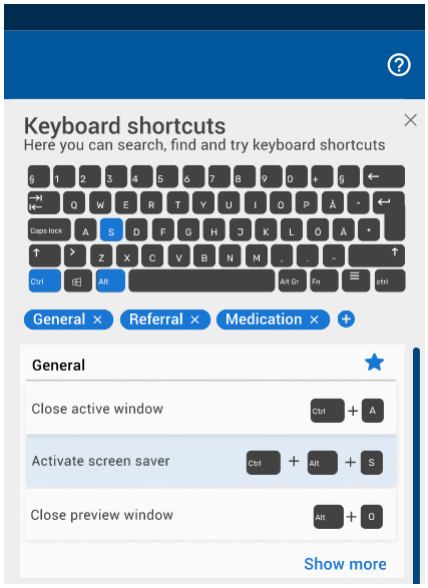

Figure 5.3: Concept 1 while hovering over KBS description.

Overall, this design concept is designed with the curious user in mind that wants to learn more but does not know where to start. It is also made for someone that is motivated to improve their efficiency

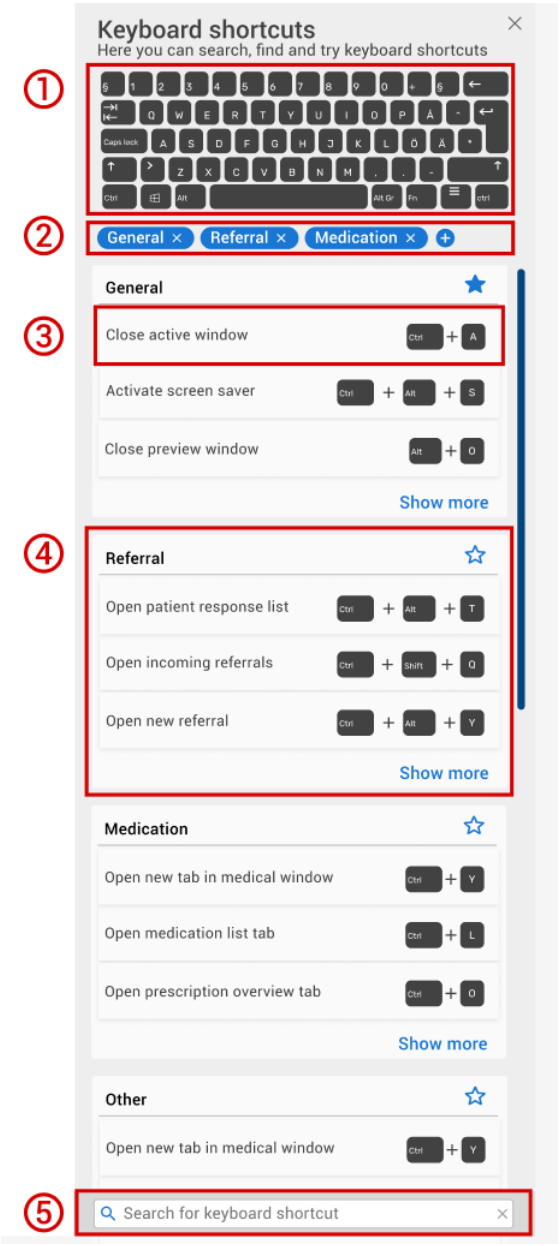

Figure 5.4: Concept 1 with components marked out.

in the system such as nurses. The hope is that a design like this would be a helpful tool for someone who is wanting to learn as they are working, and this would, in turn, help to build a better mental model for understanding the existing KBS. With this concept comes a challenge of how to integrate the functions in the system. I have deliberately distanced myself from the integration challenges and tried to focus solely on the concepts on their own, due to time constraint.

5.2.2 Design Concept 2 - The All-Knowing Search

The second design concept is something that could work as a complement to other ways of learning KBS specifically an all-knowing search. The concept is based on a more passive approach of learning KBS. The users in COSMIC want efficiency and easy access to information. This concept, therefore, proposes a search that focuses on actions, and the KBS come within the package. In figure 5.5 , we can see the sketch made for the concept.

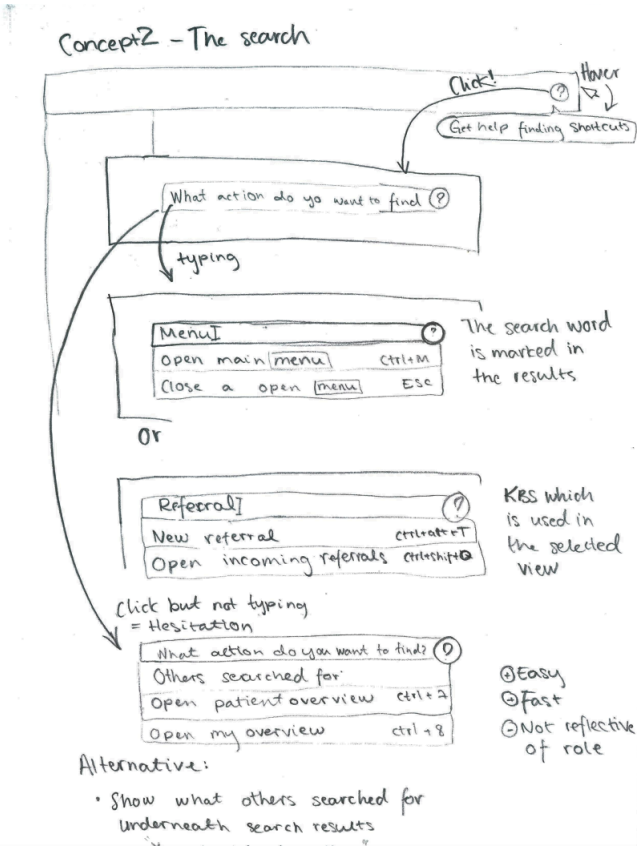

Figure 5.5: Concept 2 sketch

The prototype of the concept looks as following. In this concept, the user press the question-mark button the frame in figure 5.6 pops up and everything behind the frame is put in shade to focus on the frame. The user is presented with the question *What action do you want to do?* in a search bar. Below, there are three actions that are listed as suggested actions. The first action is marked in light blue to show that it is marked thus indicating that the user can go up and down in the list. The suggested actions are supposed to be based on the views that are open in the program, although this is not apparent in the prototype.

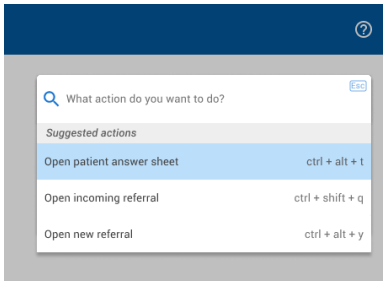

Figure 5.6: Concept 2 prototype

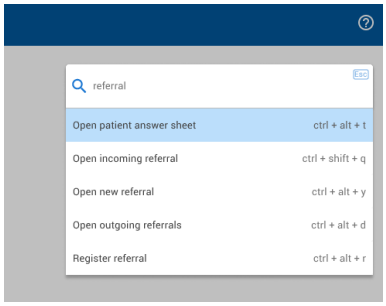

Figure 5.7: Concept 2 prototype when searched

The concept builds on the idea that, once the user searches for something, results will be presented with their corresponding keyboard shortcuts. To do the action, the user can either click on the option, press enter when the option is selected as shown in 5.7, or simply do the KBS that corresponds with the option. The idea with this concept is that specific action that could be accessed with a KBS is more accessible. With this concept a user might not need to use KBS to do an action, but it would be faster to learn it than to go into the search menu. Hopefully, slowly nudging the user toward using more keyboard navigation, but not forcing it.

6. Detailing Phase Results

This chapter will present the findings of the third and last phase of the study; the detailing phase. This section will present the results of the evaluation of the design concepts.

6.1 Design Concept Evaluation

As mentioned in the methods, a version of user testing was implemented in order to evaluate the generated design concepts. The focus during the testing was not on the details but the concepts as whole. The prototype concepts, as previously mentioned, had underlying ideas to them that was not presented in the prototype. For example, concept 1 built on the idea that some aspects of the concepts are mirroring what the user is doing in the application. Such a thing is just an idea, so during the testing, in the role as a moderator, I made sure to give room to participants to express their thoughts about the concepts before presenting any ideas behind them. In the following section, the pros and cons presented by the participants, as well as other note-worthy information. The results will also be summarized.

In figure 6.1 above, we can see that all the participants think that the first concept would be useful for someone who is curious or for someone who might be new to the system. C3 and C2, who both recently have been end-users in COSMIC, both thought that it would be an efficient way of learning KBS. C2 also stated that they would use it themselves. The display of the keyboard was seen as something that was extra positive for users with low technical skills. C1 stated that they thought it was good that there are multiple ways to look through the available KBS.

When asking about improvements, the answered varied. C3 and C2 brought questions about how the reflective aspect of the concept is the right way to go. C3 thought that maybe an alphabetical order would be better. C2 stated that the user that needs help with a specific keyboard shortcut probably needs help to get to the next step, and not where they are right now which might mean that the concept reflecting the currents views are not helpful for someone wanting to go to the next view. C2 also thought that it might be better for the KBS suggestions should be generated based on role rather than context. Another aspect that the participants highlighted is how useful this would be for someone who is a superuser, and that the concept is best suited for someone with limited knowledge in COSMIC.Participant C3 thought that the concept could be made more customizeable and suggested

	Positive	Negative	Other
C1	+ Good for someone who is curious. + Good that there are multiple ways of finding your way to a KBS (Search and looking through the categories)	- The search function is limited and might not be enough for the average user - Might be hard to see the details on a laptop - Unsure of how it would work with the rest of COSMIC	- Perhaps the view should respond in some way if a KBS is performed, like show the user what that KBS means.
C2	+ Good concept for someone who is new to COSMIC. + Good that the suggestions are context based. + Would use it themselves. + Gives a modern feel. + Helpful that you can see the KBS and the keyboard	- Perhaps better to have alphabetical order - Is lacking how the system can help the user in the next step, not just right now	- Maybe the KBS that are presented should be based on the role and not the views that are open.
C3	+ Think it would be an efficient way of learning. + Good recognition of how other things look in COSMIC. + Good to be able to see keyboard. for low-technical users + Likes that you can favorite categories.	- Might be too intricate for advanced users - Would have wanted a tooltip when hovering over things	- Would enjoy seeing animation - Would like to be able to favorite individual KBS to personalize further.

Figure 6.1: Concept 1 Evaluation results

that the user should be able to favorite individual KBS instead of whole categories. They suggested that the user could have their own tab in this concept where all of their favorite KBS were listed to make their own personal guidebook.

	Positive	Negative	Other
C1	+ Good that you don't have to learn anything to use it. + Could work well as a complement to Concept 1.	- Not a lot of personalizing elements - Might not be an efficient way of teaching KBS but a good tool in other aspects	
C2	+ Simple and easy to access	-Reminding of how KBS are taught in the system right now, which is not enough - Is not very visualizing	- The user needs to know what they need and know how to put it into words
C3	+ Useful for fast results	- Not for someone who has low technical skills - Not self-explanatory for everyone	

Figure 6.2: Concept 2 Evaluation results

The second concept, as seen in 6.2, was not met with as much positively as the first concept. The pros, as stated by the participants, seems to be that it is simple, fast, and that the search is familiar in it's design. The negative aspects of this is that it lacks the personalizing elements, and it does not focus as heavily into the learning of KBS. Rather, it is just something that is there. C2 stated that this reminds them of what already exists in COSMIC as there is tool-tips for what KBS represent an action in some menu selections of the product. Other than that, C2 thought it lacked the visualizing elements, and C3 stated that this might be mostly useful for advanced users. It seemed though, in the evaluation, that the both C1 and C3 thought it could be complementary to concept one. C3 thought that by advancing the search in concept one might solve that.

To summarize, concept one is the only one that fulfills the design requirements in a way that would be useful for COSMIC users. There is room for improvement, especially, regarding how the concept reflects the user in its role and/or context. There is also an argument that it is mostly accessible to novice to intermediate users as the participants thought it was not fully suitable for a superuser. Concept two did not fulfill the overall purpose of the design on it's own, but it enables proficient users to make quick searches. With the evaluation made, results from this study has been fully presented.

7. Discussion

In this section, the results will be discussed from the two research questions. Following a general discussion will be presented along with a methodological discussion. Lastly an outlook of what future research can do will be presented under *Future Work*.

7.1 COSMIC Users and Benefit Using KBS

The first research question: *What COSMIC users would benefit the most from increasing their use of keyboard shortcuts* was investigated through a workshop and later three interviews. The results from the workshop and the interview showed that most users would see benefit from learning KBS. With that in mind, three user roles where identified as having the most interest and utility in learning based on the time spent in the system, therefore, making them more efficient. Those roles where identified as nurses, doctors, and (to some aspects) healthcare administrators. When describing the three roles, it became apparent that the nurse group probably would have the most use out of the three. In general, the participants thought that this group knew very few KBS, and they would see the most gain out of learning more KBS as they are one of the most time-pressured occupational group within the health care system.

In one of the interviews, the term *COSMIC Ninjas* was referred to people who are extremely fast and efficient in the system such medical secretaries as well as some young doctors. These superusers have become efficient because their job requires fast documentation. Although this group is very dependent on KBS, they already know them and would not see the most benefit out of increasing the use of KBS. The doctors as a user role, just as the nurses, would see benefit from becoming more time efficient. Although there are negative attitudes towards documentation within this group and therefore the motivation to learn new thing in the system is low. The key user role therefore is the nurses, while still accommodating the doctor roles and the administrators.

In the thematic analysis of the workshop and interview, four themes were identified that concerns the complexity of KBS in COSMIC. Those themes are *most users would benefit from knowing keyboard shortcuts, administrative users are not the key users, documentation is seen as a necessary evil, and,*

lastly, keyboard shortcuts are not visible enough. The themes highlight how most people would have use, but KBS are not visible enough in COSMIC and attitudes towards the documenting in COSMIC affect the willingness to develop new skills in the system. The thematic analysis also brought up that it is somewhat a generational question and that many users (because of their technical skills) are novice to intermediate users. An overarching difficulty is that lack of time is prevalent for all groups. Most users do not have time to try and learn KBS; it needs to be integrated into their work. Overall, the findings of this research question highlight that there is usefulness to learning KBS for most users but that the nurse group might be the most important group to focus on, with doctors and administrators coming in second. With this in mind, no doctors or administrators took part in this study, so there might be inherent bias to responses. On that note, the workshop and interviews still gave useful insight to which users would have benefit in increasing KBS.

7.2 Implementations into COSMIC

To answer the second research question: *How could such techniques be implemented into the user interface of COSMIC?* the findings of the first two questions where put into design concepts that then was evaluated. Firstly, design requirements where formulated. In order to get a novice user to excel and become closer to a superuser, the individual needs to internalize interface information in order to be able to construct plans in the interface. This entails that they need an understanding of the conceptual model that underlies the system (Dreyfus,1980). In order achieve that, in the sense of KBS, by breaking the pattern of active user paradox, the previous studies suggest a number of methods. The main take-home message was to visualize KBS in a way that would then would promote memory. Also, it was to show that it is positive to give the user a way to try the combinations of keys that generate a KBS in order to prime the muscle memory of the KBS. Based on the findings from the workshop and the interviews, it was concluded that another requirement for the COSMIC users is that the design must be reflective of their work. COSMIC is a big product, and as such, an individual user does not need or want to see aspects of the product that is not relevant to them.

On the basis of the design requirements, two design concepts where generated; this was done first through sketching and then through a computer prototype. The prototype was designed with the overall design principles and guidelines that COSMIC was built on. Some components were created with the help of COSMIC's internal design system. The design concepts were created with limited interactive aspect, mostly due to time constraints. The participants of the evaluation was informed of where the interactions were missing.

To evaluate the design concepts, an evaluation was made inspired by usability testing. The participants where given the opportunity to freely judge the pros and cons of the concepts as well as asked specific questions evaluating if the design requirements had been filled. The comments were presented

in lists of positive, negative, and other categories. The evaluation showed that concept one was the most appreciated. The participants thought that the concept would be suited for someone who is rather novice in their interactions, and they like that it was contextual. The participants thought that the design requirements were fulfilled, but that some improvements could be made to how the concept is reflective of the user by either reflecting the role more or understanding what the next interactive step would be for the user. One participant also highlighted that it would be nice to have more personalizing aspect wherein the user can make their own list of favorite KBS. Lastly, the participants commented that the concept might be more adapted for a novice user and not the advanced super-user.

The first concept was built with the nurse user group in mind, but the evaluation proved that, perhaps, the concept needed to be better suited to advanced users as well. The second concept did not recieve as positive of a response as the first one. The participants liked the search function for fast results, but they did not think it was personalized enough with some questioning if it even would be useful to learn KBS. The idea behind the second concept was that it would be complementary to the first one giving the superusers a way to easily learn KBS. The evaluation somewhat agreed with this and one participant thought that the reason why it was not as good was because a novice user might not know how to put their needs into words. The results of the design concepts and evaluation might, therefore, be synthesized into that the search function could be a good tool, but that it should not be the sole way of teaching KBS as it is not good enough on it's own.

7.3 General Discussion

In the results, firstly, the concept phase results was presented. This consisted of workshop materials as well as a thematic analysis of the workshop and three interviews. The materials presented gave a picture of the COSMIC users having use of KBS as they constantly are in need time efficiency. The user roles with the most interest and use of KBS were identified as primary care nurses and doctors as well as user with administrative duties as their main occupation (e.g medical secretaries and administrators). Based on the findings in the concept phase, the processing phase was initiated with design requirements that identified parameters of the users needs as well as concept sketches of design implementations. Following the sketches, computer prototypes were made of two design concepts in the detailing phase. The first one being a visual wiki that display KBS in an interactive way and gives the KBS a home in the product. The second design concept is a search that focuses on giving the user an opportunity to search out specific KBS. The detailing phase also consisted of a smaller evaluation where participants with knowledge in COSMIC got the chance to evaluate the design concepts. The evaluation showed that there is room for improvements for both concepts, where the first one could have more personalizing aspects, and the second one should be combined with other ways of teaching KBS. To conclude, the design process is a long process with many steps. Although a lot of materials where produced, there is always more to do and to improve.

The difficulties with learning KBS comes from that, once a user learns a specific pattern of interactions, users are not motivated to change their ways. Another aspect of the problem is that KBS are not exposed enough to the user to learn them in the first place. The background presented a few ways of overcoming these difficulties as present by previous studies. The papers pointed at giving novice users a an easy way to initially be exposed to KBS. Contrastingly, it was highlighted that the intermediate and superusers need quick ways of identifying KBS. The novice user needs exposure and visualization of KBS, and some articles propose giving the user an environment to practice KBS. The background also pointed to ways of giving the user feedback of how good they are at using KBS and ways to include the keys of shortcuts in icons in the application. Some of the previous work built on applications that are external and only purpose is to teach KBS which cannot directly be applicable into COSMIC. The concepts behind the different ways of teaching KBS is, therefore, what later drove the design process. Partly by trying to cognitively understand how the methods help the user, and also how the listed aspects can be made relevant in COSMIC.

What this study have shown is that another seemingly important aspect to take into consideration is the context that KBS are in. The results showed that a burning issue for many COSMIC users is that they don't want to be presented with information that isn't relevant. Therefore KBS needs to be presented in a way that reliefs them of any extra work, and only makes the workload less. What context the user has, what role and interactive patterns they use should be of assistance to understand which information should be presented. The shortcuts are only as good as the help they can give, therefore the user needs should be the focal point for teaching KBS.

7.4 Methodological Discussion

Apart from the methodological criticism made in the discussion, I'd like to address the selection of participants. The study used convenience sampling. For this thesis, I did not have access to the end users, but to compensate for this, people with close knowledge of COSMIC users, such as UX designers and former users working as consultants, were recruited. The participant pool was rather small. Therefore, a larger sample size would most likely have yielded more nuance in the material. There would have been value in validating some statements with COSMIC end-users. One example of this can be made from the results from the workshop and interview. Various statements were made about doctors having a little willingness doing administrative work, yet there was no doctor to validate or reject the assumption made during the workshops. More perspectives would have given the thesis a higher level of validity and nuanced result.

A thematic analysis is usually done together in pairs or smaller groups of researchers to get more eyes on the material (Braun & Clarke, 2022). As the analysis already is subjective, more perspectives on the data can make the analysis more nuanced and less biased by a single individual. Even tough I

strived to to be as objective as possible, the material will still likely be colored in some way as I was the only one doing the analysis. With that being said, thematic analysis will always be somewhat subjective.

For the concept evaluation, the time limit of the thesis was closing in and for that reason only three people where recruited, two of which had previous experience in COMSIC. Preferably, a user testing should consist of representative end-users, but if that is not possible, surrogate users with similar knowledge can take part (Arvola, 2021). According to Arvola (2021), in order to identify 80% of usability issues in a qualitative evaluation, it is usually enough with five participants to cover all issues in a medium sized prototype. As I only have three participants, one could argue that it is not enough. The concepts that was proposed in this thesis are rather small so perhaps three is somewhat enough, but regardless, I think the results could have had more nuance with more participants. The findings in the evaluation might not be enough to either give the concepts a green or red light as there was only three participants. On the other hand, it does give insight to what some users might think.

During the semi-structured interviews and the workshop, I had a goal of what was to be discussed. One difficulty was to get the interviews to be as dynamic as the workshop had been. I gave the interviewees a lot of freedom to talk about the things that they thought was relevant to the topic of KBS and COSMIC get the most out of it. A lot of information said in the interview was helpful to give me, as a researcher, a broader prospective. Nonetheless, some material was irrelevant to the study itself and was not included in the end. Some interviews where, therefore, not as information rich as others. Another aim of the interviews and the workshops was to bring in different perspectives. This led to a lot of variation of knowledge where some participants had very expansive knowledge and some less so. This however could be a strength to the study because there were so many different perspectives that were generated.

Another aspect to note, regarding the evaluation of the concepts, even though the participants was informed that the concepts were not fully interactive and that the focus was on the idea behind the concepts, there was a lot of comments on detailed aspects of the concepts that would suggest that maybe it did effect the overall attitude. If there was time to further develop the prototype concepts, there might have other aspects that would have become focal points of the evaluations.

7.5 Future Work

First and foremost, a good starting point for future work is to develop the aspects of the design concepts based on the results of the evaluation. Looking back on the design concept, I wished that I had incorporated more feedback to the user to reinforce the conceptual model of how KBS work. In the processing phase, where the concepts where created, I felt limited by the interactive possibilities of

the prototyping tool as well as the time. If any of these concepts were to be implemented, I would suggest adding elements that reflect which KBS the user already is mastering or recently have been using. In concept one, this could have been done by highlighting the keys that were pressed when doing a KBS on the miniature keyboard, or in other words, highlight and reinforce the action that was just made.One question that this thesis did not touch on is: *how do we create KBS that are memorable?* Because COSMIC already has hundreds of KBS, it was not within the scope of this study to restructure these, but it is an important point of noting that the KBS need to have some thought behind them in order to make them more memorable. Although it might be a massive challenge to consider, it is my opinion that how KBS are created hold significance to the users ability to learn them. Another interesting aspect to consider for future work is where else than academical articles could we gather information about teaching KBS. For example, I think the world of video game design may have interesting findings about how to teach users interactive patterns. I also think that taking an extensive search in other applications would have given insightful ideas to how to tackle the problem.

During my research, the overarching goal has been to get an understanding regarding how novice users can excel to superusers through KBS. A question worth asking is if KBS is actually the way to go for a user to excel in the system? Certainly, it saves time, but does it save enough time? There must be other ways for users to become superusers than just KBS. For whomever might investigate KBS implementations in the future, I would suggest evaluating how much of a role KBS has when wanting to achieve better system proficiency.

8. Conclusion

To conclude, this thesis has investigated keyboard shortcuts (KBS) in the electronic health record system called COSMIC. The aim of this thesis was to understand which users would have use of KBS, and how users can learn within COSMIC. The study also aimed to understand which of these techniques would suit the users considering the sensitive environment the employees are in, and that efficiency is at high priority. Workshop and interviews with people who have a lot of knowledge concerning COSMIC and its users highlighted that most users would see gains from learning more KBS, but the question remained just to what scale. Participants picked out the primary nurses as one user group who would see the most gain as they currently have low use of KBS and would see the most value in saving time through KBS. The thematic analysis yielded four themes regarding the users and their attitudes: *Most users would benefit from knowing Keyboard Shortcuts*, *Administrative users are not the key users*, *Documentation is seen as a necessary evil*, and lastly *Keyboard shortcuts are not visible enough*. The analysis gave insights to how the user relates to KBS and highlighted that the main issue is that very few people are aware of the existence of KBS in the product and there is a need for visualization.

To put the findings into implementation, design requirements were set up to reflect the users needs. From the requirements sketches and a computer prototype of the concepts where made. Two designs concepts were created was named *a visualizing wiki* and *an all knowing search*. They were meant to represent an idea of a design solution, rather then an detailed product. The prototypes of the concepts were evaluated with three participants. The first concepts got positive results for learning KBS along with some improvement suggestions. The participants thought it would be a good way to teach KBS for a novice users. The evaluation on the second concept showed that the concept would not be sufficient on it's own but perhaps in combination with concept one. The participants thought that concept two did not give enough ques to a novice user to learn KBS, but might be a good tool for users who want quick results in COSMIC, such as medical secretaries and administrators. In conclusion the strength of this study is the preparatory stages that gave data about the users and what the need in order to learn KBS. The underlying issues to KBS in COSMIC will be an essential point for potential further development. The leanings from the early stages of this study and the design concepts that was created can hopefully stand as a good starting point for understanding what users need in order to learn KBS.

Bibliography

Ahlsell, L. B., Eriksson, N., Eriksson, R., Sörby, H., Wendelin, F., & Östberg, A. (2018). *Digitalisering i vården - en studie av faktorer för användande av digital teknik i vården från vårdpersonalens perspektiv*. Chalmers University of Technology. https://publications.lib.chalmers.se/records/fulltext/255868/255868.pdf

Appert, C., & Zhai, S. (2009). Using strokes as command shortcuts. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. https://doi.org/10.1145/1518701.1519052

Arvola, M. (2021). *Interaktionsdesign och ux : Om att skapa en god användarupplevelse*. Studentlitteratur.

Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. Sage Publications.

Brinkmann, S. (2023). Introduction to Qualitative Interviewing. In *Qualitative Interviewing: Conversational Knowledge Through Research Interviews*. Oxford University Press. https://doi.org/10.1093/oso/9780197648186.003.0001

Cambio. (n.d.). About us. https://www.cambiogroup.com/about-us/

Card, S. K., Moran, T. P., & Newell, A. (1980). The keystroke-level model for user performance time with interactive systems. *Commun. ACM*, *23*(7), 396–410. https://doi.org/10.1145/358886.358895

Carroll, J., & Rosson, M. B. (1987). Paradox of the active user, 80–111.

Cederberg, J. (2023). Nästa år byter halva sverige journalsystem. https://lakartidningen.se/aktuellt/nyheter/2023/01/nasta-ar-byter-halva-sverige-journalsystem/

Dreyfus, S., & Dreyfus, H. (1980). A five-stage model of the mental activities involved in directed skill acquisition. *Distribution*, 22.

Giannisakis, E., Bailly, G., Malacria, S., & Chevalier, F. (2017). Iconhk: Using toolbar button icons to communicate keyboard shortcuts. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 4715–4726. https://doi.org/10.1145/3025453.3025595

Grossman, T., Dragicevic, P., & Balakrishnan, R. (2007). Strategies for accelerating on-line learning of hotkeys. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. https://doi.org/10.1145/1240624.1240865

Krisler, B., & Alterman, R. (2008). Training towards mastery: Overcoming the active user paradox. *Proceedings of the 5th Nordic Conference on Human-Computer Interaction: Building Bridges*, 239–248. https://doi.org/10.1145/1463160.1463186

Lane, D. M., Napier, H. A., Peres, S. C., & Sandor, A. (2005). Hidden costs of graphical user interfaces: Failure to make the transition from menus and icon toolbars to keyboard shortcuts. *International Journal of Human–Computer Interaction*, *18*(2), 133–144. https://doi.org/10.1207/s15327590ijhc1802_1

Lewis, B., d'Eon, G., Cockburn, A., & Vogel, D. (2020). Keymap: Improving keyboard shortcut vocabulary using norman's mapping. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–10. https://doi.org/10.1145/3313831.3376483

Linell, P. (1994). *Transkription av tal och samtal : Teori och praktik.* Univ., Tema kommunikation. https://login.e.bibl.liu.se/login?url=https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,uid&db=cat00115a&AN=lkp.230562&lang=sv&site=eds-live&scope=site

Malacria, S., Bailly, G., Harrison, J., Cockburn, A., & Gutwin, C. (2013). Promoting hotkey use through rehearsal with exposehk. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. https://doi.org/10.1145/2470654.2470735

Malacria, S., Scarr, J., Cockburn, A., Gutwin, C., & Grossman, T. (2013). Skillometers. *Proceedings of the 26th annual ACM symposium on User interface software and technology*. https://doi.org/https://doi.org/10.1145/2501988.2501996

Norman, D. (2018). Natural mappings and stimulus-response compatibility in user interface design. https://www.nngroup.com/articles/natural-mappings/

Odell, D. L., Davis, R. C., Smith, A., & Wright, P. K. (2004). Toolglasses, marking menus, and hotkeys: A comparison of one and two-handed command selection techniques. *Proceedings of Graphics Interface 2004*, 17–24.

Ørngreen, R., & Levinsen, K. (2017). Workshops as a research methodology. *Electronic Journal of E-Learning*, *15*(1), 70–81.

Patientdatalagen. (2008). Sfs 2008:355. Retrieved January 26, 2023, from https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/patientdatalag-2008355_sfs-2008-355

Peres, S., Tamborello, F., Fleetwood, M., Chung, P., & Smith, D. (2004). Keyboard shortcut usage: The roles of social factors and computer experience. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *48*. https://doi.org/10.1177/154193120404800513

Personlig kommunikation Höckergård, A. (2023). Concersations with a cambio uxer.

Preece, J., Rogers, Y., & Sharp, H. (2016). *Interaktionsdesign : Bortom människa-dator-interaktion.* Studentlitteratur, Poland.

Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: Ii. perceptual learning, automatic attending and a general theory. *Psychological Review*, *84*, 127–190. https://doi.org/10.1037/0033-295x.84.2.127

SKR. (2022). Vision e-hälsa 2025. *Swedish Association of Local AuthoritiesRegions*. Retrieved January 26, 2023, from https://skr.se/skr/halsasjukvard/utvecklingavverksamhet/ehalsa/visionehalsa2025.8859.html

Tak, S., Westendorp, P., & van Rooij, I. (2013). Satisficing and the use of keyboard shortcuts: Being good enough is enough? *Interacting with Computers*, *25*, 404–416. https://doi.org/10.1093/iwc/iwt016

Thoring, K., Mueller, R., & Badke-Schaub, P. (2020). Workshops as a research method: Guidelines for designing and evaluating artifacts through workshops.

Vetenskapsrådet. (2017). *God forskningssed*. Mtm.

A. Appendix

A.1 Consent Form - Workshop

Medgivande till deltagande i studie

Studien ”Kortkommandon i COSMIC” syftar till att undersöka om det finns COSMIC användare som skulle ha nytta av att ha designtekniska metoder som främjar en ökad användning av kortkommandon. Studien utförs som en del av kursen ”Kandidatuppsats i kognitionsvetenskap” vid Linköpings Universitet, kurskod: ”729G40”. Ansvarig för studien är Julia Grentzelius, handledare vid universitetet är Björn Johansson, kursansvarig är Arne Jönsson. Handledare på Cambio är Anders Höckergård.

Deltagandet i studien är frivilligt och det utgår ingen ersättning för deltagande. Studien innebär deltagande på en workshop. De uppgifter som sparas om deltagarna är roll och erfarenhet i COSMIC, samt videoinspelningar, anteckningar och annat material producerat vid workshoptillfället., Deltagare pseudonymiseras i transkriptioner av inspelningar och i publikationer. Linköpings universitet och Cambio är personuppgiftsansvarig och data lagras i 15 år vid Linköpings universitets molnlagring. Ingen data förs över till tredje land. Data kan dras tillbaka och klagomål eller frågor kan framföras genom att ansvarig för studien, alternativt handledare, kontaktas. Ett tillbakadragande av samtycke kommer leda till att personuppgifter insamlat med detta samtycke slutar behandlas, dock kommer uppgifter som redan ligger till grund för resultat i studien inte att påverkas. Den rättsliga grunden för personuppgiftsbehandlingen är deltagarens samtycke.

Efter att ha tagit del av informationen om projektet ”Kortkommandon i COSMIC” samtycker jag till att delta i studien. Jag är medveten om att jag alltid kan avbryta mitt medverkande utan förklaring. Jag ger mitt samtycke till att de anteckningar, video- och ljudinspelningar som görs av mig och material som produceras på workshopen kan användas i följande syften (jag kryssar i den användning som jag godkänner):

- ☐ Som data till studien
- ☐ Transkriberade utdrag ur inspelningen kan publiceras i vetenskapliga texter, i pappers- såväl som elektronisk form
- ☐ Vid presentation i vetenskapliga texter, i pappers-, elektronisk form samt vid muntliga presentationer

Ort och datum _____

Namnteckning _____

Namnförtydligande _____

A.2 Consent Form - Interviews

Medgivande till deltagande i studie

Studien "Kortkommandon i COSMIC" syftar till att undersöka om det finns COSMIC användare som skulle ha nytta av att ha designtekniska metoder som främjar en ökad användning av kortkommandon. Studien utförs som en del av kursen "Kandidatuppsats i kognitionsvetenskap" vid Linköpings Universitet, kurskod: "729G40". Ansvarig för studien är Julia Grentzelius, handledare vid universitetet är Björn Johansson, kursansvarig är Arne Jönsson. Handledare på Cambio är Anders Höckergård.

Deltagandet i studien är frivilligt och det utgår ingen ersättning för deltagande. Studien innebär deltagande på en intervju. De uppgifter som sparas om deltagarna är roll och erfarenhet i COSMIC, samt videoinspelningar, anteckningar och annat material producerat vid workshoptillfället. Deltagare pseudonymiseras i transkriptioner av inspelningar och i publikationer. Linköpings universitet och Cambio är personuppgiftsansvarig och data lagras i 15 år vid Linköpings universitets molnlagring. Ingen data förs över till tredje land. Data kan dras tillbaka och klagomål eller frågor kan framföras genom att ansvarig för studien, alternativt handledare, kontaktas. Ett tillbakadragande av samtycke kommer leda till att personuppgifter insamlat med detta samtycke slutar behandlas, dock kommer uppgifter som redan ligger till grund för resultat i studien inte att påverkas. Den rättsliga grunden för personuppgiftsbehandlingen är deltagarens samtycke.

Efter att ha tagit del av informationen om projektet "Kortkommandon i COSMIC" samtycker jag till att delta i studien. Jag är medveten om att jag alltid kan avbryta mitt medverkande utan förklaring. Jag ger mitt samtycke till att de anteckningar, video- och ljudinspelningar som görs av mig och material som produceras på workshopen kan användas i följande syften (jag kryssar i den användning som jag godkänner):

- ☐ Som data till studien
- ☐ Transkriberade utdrag ur inspelningen kan publiceras i vetenskapliga texter, i pappers- såväl som elektronisk form
- ☐ Vid presentation i vetenskapliga texter, i pappers-, elektronisk form samt vid muntliga presentationer

Ort och datum _____

Namnteckning _____

Namnförtydligande _____

A.3 Interview Guide

Intervjuguide

- Vill du börja med att berätta lite om hur du hamnade på Cambio?
- Vad har du för roll nu och vad är dina arbetsuppgifter?
- Har du arbetat inom vården? Vill du berätta om din roll?
  - Har du tidigare arbetat som slutanvändare i COSMIC?
  - Vad hade du för roll då?
  - Hur såg dina arbetsuppgifter ut i COSMIC?
  - Hur ofta arbetade du i COSMIC?
  - Vilka typer av uppgifter gjorde du i COSMIC?
- Har du någon egen erfarenhet av att använda kortkommandon i COSMIC
  - Vilka använde du?
  - Vad var din inställning eller känsla?
- Vilka användare skulle ha bäst nytta av att kunna ha implementationer som hjälper dem att lära sig fler kortkommandon?
- Vad har de för roller?
- Hur arbetar de i COSMIC?
- Hur ofta arbetar de i COSMIC (tid)?
- Hur mycket tid har de tillgängligt?
- Finns det användare som skulle ha nytta av att lära sig kortkommandon, oavsett tidsmöjligheter?
  - Vad har de för roller?
  - Hur arbetar de i COSMIC?
  - Vad skulle det ge för nytta.
  - Hur ofta arbetar de i COSMIC (tid)?

Individuella roller

Översiktligt

- Vilken typ av avdelning jobbar personen på?
- Hur ofta arbetar personen i COSMIC?

Hur duktig är den här personen på teknik?

- Hur duktigt är personen på att använda COSMIC?
- Vad har personen för inställning till att lära sig nya saker i systemet?
- Hur ofta använder personen kortkommandon?

Resultat för användare

- Vad skulle det ge för resultat om den här personen lärde sig fler kortkommandon?
- I vilka situationer skulle personen ha nytta av att använda fler kortkommandon?
- Vad har personen för svårigheter eller farhågor i med att ha metoder för att lära sig kortkommandon i COSMIC?

Avslutande frågor

- Vad är det viktigaste för mig att ta med mig i detta arbete?
- Vad krävs för att användaren ska ha möjlighet att lära sig fler kortkommandon?
- Är det något mer som jag bör veta?

A.4 Concept Evaluation Guide

Konceptutvärdering - Guide

Förtestfrågor

- Vad är din roll på Cambio?
- Vad har du för klinisk bakgrund?
- Har du varit slutanvändare i COSMIC eller annat journalsystem?
    - Använde du dig av kortkommandon när du jobbade i Cosmic?

Koncept frågor

- Utan att rör på musen, vad tänker du att du har framför dig?
- Vad tror du att de olika komponenterna är?
- Vad tror du att det här ska göra?
- Testa att gå över knapparna med musen?
- Tror du att det här sättet att presenterat kortkommandon hade varit hjälpsamt för dig?
- Vad ser du för nackdelar med att presentera det på det här sätter?
- Vad ser du för fördelar?

Avslutande frågor

- Tycker du att koncepten hade varit passande för personer med olika teknisk kunskap?
- Tycker du att koncepten kändes professionella?
- Tror du att de här koncepten hade varit störande eller påverkar arbetet negativt? Om ja, på vilket sätt?
- Tror du att de här koncepten skulle vara bra anpassade för den roll som man själv besitter?
- Tror du att de här koncepten hade passat i COSMIC, rent stilmässigt?
- Vad gillade du med de här konceptet?
- Vad skulle kunna förbättras?
- Har du några övriga tankar eller kommentarer?