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Ensuring Universal Design in ICT-Solutions

Towards Identifying Critical Success Factors

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Foreword

This master thesis makes up the finale 30 credits of a two year master study in Interaction Design at NTNU Gjøvik. The study aims to provide insights into the practices regarding successful implementation of Universal Design in Norwegian ICT-projects, by building on a previous student work published at the NOKOBIT Conference in 2016 (Appendix E).

First and foremost I would like to extend my deepest gratitude to my thesis advisor, for remarkable support and guidance throughout the development and completion of this research, as well as for the rewarding collaboration in the second part of this study. Thank you for many fruitful discussions and advice you have given during this process.

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Last, but not least, I would like to take this opportunity to thank my colleagues, friends and family who have all supported, encouraged and believed in me through a rather stressful time – this has meant a lot to me.

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Oslo, June 1st, 2017
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Abstract

Universal Design (UD) of Information and Communication Technology (ICT) is a fundamental principle that seeks to ensure accessibility for all. With an increasing digitalization of society, there is also a rapidly increasing need for ICT-solutions that are accessible to all. As a consequence, user-centered design and UD has gain popularity steadily over the last decades. Web content accessibility standards and guidelines have been created and UD legislation is in place in several countries. However, research suggests that there are limited insights into the practices regarding implementation of UD in ICT-projects.

This study aims to provide insights into UD practices and verify a set of previously identified promoting and obstructing factors for UD. The study builds on an interview study with 31 individuals affiliated with 21 ICT-projects that have been successful in ensuring UD. The data from these interviews is analyzed in-depth through thematic content analysis, in search for theoretical interpretations that may generate the basis for a proposed best practice for UD in ICT-projects. Second, this study explores the predictability of compliance to the identified factors promoting UD success.

The study identifies 13 promoting and 6 obstructive factors affecting the ability to promote, ensure and achieve UD in practice, spanning four levels – external, organizational, project and individual. The findings coincide and expand previous research findings. This study highlights a link between user-centered design, usability and universal design. The main findings promoting UD practices can be summarized in the following six factors; UD Anchoring, Adequate Resources, UD competence and Motivation, UD and Usability Focus, Interdisciplinary Collaboration, and Quality Assurance. The four levels provide insight into factor relationships, and suggest that measures have to be taken at several levels to succeed, particularly how UD anchoring is an important influence on the other factors.

The study prototypes and tests a self-assessment evaluation tool aiming to explore the measurability of ICT projects compliance to the identified promoting factors. The hypothesis being that projects affiliated with UD success will return higher test scores, and projects not affiliated with UD success lower scores. This hypothesis thus the evaluation form's tentative accuracy are as such confirmed, but will need extensive testing in order to be verified.

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1. Introduction

The concept of digital inclusion has existed for several years in various forms, however the discipline known as Universal Design (UD) has received increasing consideration over the last decade. Universal Design (UD) is a complex and interdisciplinary field, involving several definitions and different approaches depending on the problem at hand. Rapid development and adoption of ICT-solutions have contributed to the surfacing of digital divides and new inequalities amongst users, and thus increased the focus on UD within ICT-projects. In relation to ICT-solutions, marginalized users include persons with physical or cognitive limitations, low socio-economic status, low literacy skills, non-native speakers, elderly and children (Fuglerud and Sloan 2013; Cremers et al. 2014; Scott, Spyridonis and Ghinea 2015; Abascal et al. 2015).

There are commercial benefits of ensuring universally designed solutions, as inaccessible solutions risk excluding a potentially large part of the population. Furthermore it is unethical to exclude users with disabilities form accessing the same benefits of modern technology as others. In Norway, as well as in other countries, measures have been taken to assure UD of ICT-solutions through official legislation. Web content accessibility standards and accessibility guidelines have been generated with the goal of providing a single shared standard for accessibility. On July 1st 2013 a Norwegian legislation took effect, proclaiming that as of 2021 all ICT-solutions aimed at the general public, both new and existing, are to be universally designed. As a result, Norwegian companies are required to alter their practices around the development and design of ICT-solutions in order to of integrates universal design principles in their design and development processes.

However, despite efforts at legal, institutional and technical levels, there are still numerous websites that are not yet accessible (Chen et al. 2015; Nordli, 2016). As few as 5 of Norway's 50 most visited websites met the minimum criteria for universal design according to a 2014 survey by the Oslo-based consultant agency Making Waves (Aune, 2014). A 2015 web accessibility evaluation on 304 Norwegian websites by the Norwegian Agency for Public Management and eGovernment (DIFI) also reported that Norwegian standards for UD was discouraging (DIFI, 2015). While there were large variations in the results, with scores ranged from 18 to 79 percent, the average result amongst the websites was 51 percent of possible

obtainable points in DIFI's measuring system (DIFI, 2015). Thus, increasing the general focus on UD and making web accessibility guidelines mandatory does not seem to be sufficient to ensure universally designed ICT-solutions.

Persson et al. (2015) point out that a political stance on the subject of UD has already been made by important entities such as the USA, Japan and China, the UN and the European Commission. The fact that several countries have non-discrimination legislations in place that require a minimum of accessibility, leaves the question of *how* to achieve it, not whether or not accessibility is important. Though the knowledge of technical accessibility guidelines seems to be increasing in Norway, other relevant design principles for UD are still unfamiliar to many. Further, any specific definition of *what* a universally designed ICT-solution is, and whether this should go beyond fulfilling web accessibility guidelines (as of today WCAG 2.0 AA-level) is lacking in Norwegian legislation. As is guidelines on how UD should, or could, be ensured. There seems to be a gap between the Norwegian legislation with its standards and definition, and the actual practice of how to ensure and implement UD in ICT-projects.

Agile development currently is a widespread approach to IT development (Schulz et al. 2014; Scott, Spyridonis and Ghinea, 2015). A survey performed by Hewlett Packard Enterprises amongst ICT development teams in the US claims that agile is the new norm (Jeremiah, 2015). At the same time, Interaction Design (IxD) and User Experience (UX) are emerging as new interdisciplinary fields in relation to ICT engineering, utilizing a variety of methodological approaches. Universities are offering an increasing number of programs devoted to these growing disciplines. However, research has identified a potential lack of insight into the founding principles of user-centered design as well as the role of interaction design (IxD) within agile teams, (Thorkildens 2014; Frøshaug 2015, Furuheim 2016).

There are similarities between the issues faced in the field of UD and UX. Achieving universally designed UX in ICT-solutions relies heavily on user centeredness, and user involvement is usually recommended. Therefore, there is a high risk of facing the same challenges when adopting UD in an agile development process as for implementing UX-practices. Other studies point out that agile software development in itself is **not** sufficient for creating a good user experience (Salah, Paige and Cairns 2015; Eriksson 2016). Agile methodology may tend to focus on the end product and the team building it, while a user-

centered designer will always approach a development process with the end-user of that product in focus (Eriksson, 2016).

According to Gray (2016) the academic discussions in the UX field have primarily focused on the creation and testing of methods, not on the actual implementation of these methods in practice. Lately, however, UX research into practices, approaches and methods used to adapt human-centered principles to corporate environments is increasing (Gray, 2016). Increased knowledge about adequate and suitable project process methodology is argued to be important for the further development of all UX-related disciplines (Thorkildsen, 2014). Similarly, guidance for the actual implementation of UD into agile processes is lacking. Through exploring such questions related to universal design, the field of interaction design may contribute to digital inclusion.

As there is limited knowledge on how to ensure universal design in practice, the overall topic of this thesis is investigating how universal design may be successfully achieved in development processes. The thesis is building on and adding to pre-study investigating practices in award winning Norwegian ICT-projects having successfully achieved UD (Harder and Begnum, 2016). In particular, the thesis studies which practices and factors that should to be present in an ICT-project in order to increase the likelihood of a achieving a universally designed ICT-solution. Finally, the study explores the possibilities of indicating the likelihood of achieving universally designed ICT-solutions through prototyping an evaluation tool measuring the compliance of ICT-projects to universal design success factors. The following research questions are defined:

1) Which practices should be implemented in order to successfully achieve universally designed ICT-solutions?
    a. What are key promoting and obstructive factors for UD?
    b. What is the relationship between the factors?
    c. Which are the critical success factors?
2) How may ICT-project compliance to identified UD best practices be measured?
    a. Does the prototyped evaluation tool indicate likelihood of UD success?

1.1 Key Definitions

The thesis uses United Nations' definition of Universal Design from the Convention on the Rights of Persons with Disabilities, Article 2*: "'Universal Design' means the design of products, environments, programs and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. 'Universal design' shall not exclude assistive devices for particular groups of persons with disabilities where this is needed." (UN, 2006).*

The focus of the thesis is limited to UD of ICT-solutions. An **ICT-solution** is viewed as a partly or fully digitalized service, a website or part of a website or an application. An **ICT-project** is defined as a project dedicated over time to a specific ICT-solution. An **ICT-project** may build a new ICT-solution or improve on an existing one. A project is in this study defined as having **successfully achieved a universally designed ICT-solution** if it has a) won a design award for its ICT-solution where UD is a main or part criteria, or b) have received an honorable mention or nominee in relation to a design award for its ICT-solution where UD is a main or part criteria, or c) have received an honorable mention from a relevant and reputable organization or official authorities for efforts related to ensuring UD in an ICT-solution.

Practices are understood as the methods, cultures, procedures or processes identified in an ICT-project. A **promoting factor** is an identified positive or helpful practice for ensuring UD, while a negative factor is understood as an **obstructive factor** for ensuring UD. Critical **success factors** for UD is practices deemed necessary or crucial in order to succeed with implementation of UD in a project. A **best practice** is viewed as a set of practices that can be recommended to ICT-projects as especially helpful in ensuring UD, and is based on the universal design success factors identified in the study of multiple successful projects. Project practice **compliance** is understood as adherence to the identified success factors.

2 Theory, background and existing literature

2.1 Universal Design Definition

The term Universal Design (UD) which has been widely used over the last decade, first originated in the mid-eighties, by the American architect Ronald Mace; *"Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design"* (Mace, 1997; D'souza, 2004; Elvestrand, 2008). Today the term is widely based on the seven principles compiled by Mace and a group of American architects, product designers, engineers and environmental design researchers at the North Caroline State University (Mace et al. 1997; Elvestad, 2008):

1. Equitable Use
   The design is useful and marketable to people with diverse abilities.
2. Flexibility in Use
   The design accommodates a wide range of individual preferences and abilities.
3. Simple and Intuitive Use
   The design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. Perceptible Information
   The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. Tolerance for Error
   The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. Low Physical Effort
   The design can be used efficiently and comfortably, with minimum fatigue.
7. Size and Space for Approach and Use
   The design has appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

In Article 2 of the UN Convention on the Rights of Persons with Disabilities from 2006, Mace's definition is slightly extended, and includes a section about Universal Design not excluding the use of devices needed by persons with disabilities. The "one solution for all" aim thus includes accommodation to assistive technologies (ATs). This thesis uses the UN definition (UN, 2006).

There are several other overlapping terms with different origins used to describe the concept of UD, such as Inclusive Design, Design for All, User-Sensitive Inclusive Design, Universal Usability and Ability-Based Design among others. An example is the term Barrier-free Design which originated after the Second World War, inspired by observations of how those severely injured and handicapped in the war functioned independently in in the rehabilitation centers that were made accessible to them, but in the society at large they were met with obstacles and barriers (Elvestrand, 2008). Different terms seems to have different geographical origin; an example is Inclusive Design widely used in the UK, while Universal Access seems more common in Asia (Persson et al. 2015).

2.2 Universal Design Legislation

Public ICT-solutions and digitalized services are rapidly increasing in Norway. The UN has classified Norway as an advanced e-Government country (UN e-Government Survey report, 2014) and ICT-solutions are being linked to civil rights services, such as voting. It is therefore crucial that no part of the population is being discriminated against. The International Telecommunication Union (ITU) recognizes the importance of ensuring that the one billion individuals affected by disabilities in varying degrees can use the same ICT-solutions as the general public, as a mean of empowerment (Msimang, 2014).

Universal Design is not mandatory in all countries, and in many cases legislation may be limited to certain providers, for example only the public sector, making a coordinated international effort necessary (Vanderheiden and Treviranus 2011; Abascal et al. 2015). The Norwegian government has proclaimed an ambitious goal for Norway to be universally designed by 2025, and in order to achieve this a Disability Anti-Discrimination Act (Anti-Discrimination and Accessibility Act) was put in to effect in 2008 (Norwegian Ministry of Children, 2013).

2.2.1 Norwegian Universal Design of ICT Legislation

The current Norwegian Anti-Discrimination Act state that all ICT-solutions targeted to the public should be universally designed (Norwegian Ministry of Children, 2013). When this study refers to UD legislation, it is however referring to the §4 of the 'Regulation on Universal design of Information and Communication Technology (ICT) Solutions' by The Ministry of Local Government and Modernization (2013), which specifies regulations for the Anti-Discrimination Act in relation to ICT (Norwegian Ministry of Government Administration, 2013).

The minimum requirement for UD in this regulation is based on principles of the Web Content Accessibility Guidelines (WCAG) 2.0 guidelines. The WCAG defines how to make web content more accessible to individuals with disabilities (W3C Recommendation, 2008). However, the fulfillment of these guidelines might not be the equivalent of ensuring universally designed and universally usable web sites. As such, there is no specific definition of what UD of ICT as a finalized product or service should look like. When merely the minimum requirement is specified by Norwegian legislation, it is up to each ICT-project to define the final acceptance criteria for UD, and the end result may therefore vary from one IT project to the next. Lazar et al. (2015) also point out a shortcoming in the accessibility regulations for several countries, namely that they are limited to technical guidelines, while organizational aspects like enforcing the implementation of compliance monitoring and process guidelines are left out. This recognized shortcoming applies to the Norwegian National Regulations which only covers technical accessibility requirements.

2.3 Universal Design Practices and Methodologies

2.3.1 Standards and Guidelines

There is a broad consensus that accessibility standards and guidelines are helpful (Røssvoll and Fuglerud 2013; Schulz, et al. 2014; Scott, Spyridonis and Ghinea, 2015). In order to guarantee accessible ICT-solutions the objective is to reach conformance with the W3C Web Content Accessibility Guidelines (WCAG). However, several researchers have identified that standards and guidelines alone are not sufficient in order to ensure a universally designed ICT solution (Garrido et al. 2013; Røssvoll and Fuglerud, 2013; Schulz et al. 2014; Aizpurua,

Arrue and Vigo, 2015; Jung et al. 2015; Abascal et al. 2015; Nordli, 2016). Some researchers therefore make a distinction between technical accessibility and universal usability, claiming that both need to be in place in order for a solution to be accessible for a disabled user (Røssvoll and Fuglerud, 2013).

2.3.2 Technical Accessibility

Petrie, Savva and Power (2015) analyzed 50 different definitions of web accessibility in order to better understand what researchers and practitioners consider key components of web accessibility. Their analysis ended up extracting six core concepts used in several definitions, and incorporated them into a unified new definition for web accessibility:

"All people, particularly disabled and older people, can use websites in a range of contexts of use, including mainstream and assistive technologies; to achieve this, websites need to be designed and developed to support usability across these contexts." - Petrie, Savva and Power (2015:3)

A cross-sector survey with 613 participants, involved in web development projects from industry, government and academy in Brazil, observes a lack of awareness of accessibility issues in web development (Freire, Russo and Fortes, 2008). The study strongly supported the necessity of spending more efforts on educating developers in assistive technologies and how disabled users interact with them, and points out how having developers see a user struggle with what they themselves have developed can be very effectual. Chen et al. (2015) also claim that education is the key to create awareness and knowledge to ICT professionals in order to ensure digital inclusion. A view which is supported by Putnam et al. (2012) who conducted a survey about how accessibility is considering in practice, targeting professionals from user experience (UX) and human-computer interaction (HCI) creating ICT-solutions. They argue that a better understanding about how accessibility is considered among professionals has implications for how well prepared academic programs in UX and HCI are to make their students consider and advocate for inclusive design. As the study did not find any association with geographic location or job titles they suggest that findings may generalize to a wide range of education and training programs.

There have been various attempts at creating more technical approaches to solving the problem of Universal Design of ICT. Vanderheiden and Treviranus (2011) proposed the development of a Global Public Inclusive Infrastructure (GPII) in order to tap into the unprecedented ability to gather resources and match demand with supply. They claimed that there was a pressing need for a paradigm shift. There have also been done research on the use of refactoring of code as an incremental and systematic process of identifying opportunities for quality enhancement and producing safe transformations towards universal access (Garrido et al. 2013). Gkatzidou, Pearson, Green and Perrin (2011) presented an Abstract User Interface (AUI) meta-model, claiming it could guarantee accessibility by taking advantage of technologies based on a User Markup Language, by using the UsiXML framework for example to integrate accessibility requirements in the meta-model. Schulz and Fritch (2014) published requirements for an accessible and inclusive e-ID to safely access public and private services on the Internet, as part of a large European project called FutureID.

The most common and widely used technical approaches to UD of ICT are however focused on ensuring technical accessibility through automatic code validation against web accessibility criteria. Such automated validation tools is widespread online, and may be used on its own as a basis for manual expert universal design and code inspections. There are also technical tools supporting manual or partly automatic inspections of visual design, for example related to color contrast and visual impairments. Tools have been updated along with changes to web accessibility criteria (for example from WCAG 1.0 to WCAG 2.0).

2.3.3 Inclusive Design

According to The Norwegian Center for Design and Architecture (2010) the UK government defined Inclusive Design as “products, services and environments that include the needs of the widest number of consumers,” in 2000. The term originated in the period right after the Second World War, goes beyond disability and focuses on delivering mainstream solutions to all excluded groups. Inclusive Design is often used interchangeably with UD and Design for All (DfA), because they all have similar purposes.

Inclusive Design and Universal Design are both closely connected to UX and IxD, and the design disciplines complement each other well. As for IxD and UX, Inclusive Design is focused in usability – not just on technical accessibility and code validation. Fuglerud and Sloan (2013) identified a gap between the theory of Inclusive Design and the industry practices, and point out that the legislative requirements have a heavy focus on standards without any emphasis on the development process.

Fletcher et al. (2015) looks at the challenge of inclusive design in the US context, and points out that to most Americans accessibility is understood as a legal rights and responsibility framework, which is about the law, not design. They point to an alternative approach to creating guidelines consisting of a more effective guidance model to be included in the design process; Section 508 of the Rehabilitation Act and Section 255 of the Communications Act of 1996.

Seven key principles for an inclusive design process are identified in literature: 1) holistic and interdisciplinary teams and/or process, 2) based on user-centered design principles, 3) adopting and applying accessibility standards and guidelines, 4) using an iterative development, 5) focus on users with disabilities early, and throughout the entire design process, 6) use of empirical evaluations with various impairments represented and 7) focusing on the entire user experience (Fuglerud and Sloan, 2013; Røssvoll and Fuglerud, 2013; Schulz et al. 2014; Scott, Spyridonis and Ghinea, 2015).

2.3.4 Checklists

Several studies have been performed with the goal of creating various theoretical frameworks and checklist to supply the standards and guidelines for various parts of UD, including Universal Design for Learning (UDL) (Mi et al. 2013; Msimang 2014; Hersh 2014; Bernd et al. 2015; O Shea et al. 2016). Scott, Spyridonis, Ghinea (2015) has developed a framework for designers called VERITAS that claim to offer an efficient and intuitive approach to inclusive design, by simulating and systematically analyzing how users with various disabilities interact with ICT-solutions. VERITAS creates a report based on data it receives, after having the designer uses three tools to feed the framework the right parameters. Fogli, Provenza and Bernareggi (2013) proposed a design pattern language for accessibility, using

W3C specifications, aiming to constitute a UD resource for web designers in the development process.

A contrasting view is presented by Dolmage (2015), who is skeptical to the concept of UD checklists. The University of Washington has a project called DO-IT (Disabilities, Opportunities, Internetworking, and Technology) which takes on a checklist approach to UD (Burgstahler, 2012). Several other colleges have re-published and recycled this list, and Dolmage points out how this may have caused the list to become a canonical text that defeats the rhetorical purpose of UD, and stops what he claims should be registered as an action that grows out of engagement and effort. Does presenting a checklist allow for the manifestation of a view saying that UD will be 'done' when all the boxes are checked?

2.3.5 Universal Design Practice Barriers

Nordli (2016) conducted a case study on the Norwegian Public Broadcasting Corporation (NRK) that identifies barriers inhibiting achievement of universal design in practice. It specifically points towards employees with scarce UD awareness, issues with organizational structure and collaboration and general practices that does not facilitate for UD implementation. A lack of policies or documents regarding UD is also suggested as obstructive for UD, as well as the identification of several time-consuming, which is unfortunate in a profession and environment characterized as being stressful and time sensitive. In summary, his findings indicate that there are barriers related to accessibility and UD on three levels; UD awareness barriers, organizational barriers and technological barriers, that all obstruct current and future UD practices at NRK.

2.3.6 Other Universal Design Approaches

There are also arguments for merging methods from different disciplines in order to achieve Universal Design. Cremers et al. (2014) argue that inclusive design methods enriched with qualitative methods from anthropology that enable personalized systems is the most suitable approach. Bernd et al. (2015) explore how social and systemic innovation, in addition to the already existing technical innovation, is necessary in order to make technology affordable and socially accepted. Stephanidis and Antona (2013) proposed a framework for designing

sustainable IT systems based on a set of their proposed design principles shown in Figure 1 and Figure 2. Their principles are based on combined characteristics of sustainable design principles and universal design principles.

Table 1. Sustainability, universal design and their corresponding characteristic matrix

Sustainability	Universal Design	Design Principle Properties
Reduce gap between natural system model and practice	Equitability	Doing design following nature as a mentor guideline
Being conservative in using resources	Error Tolerance	Condense the use of resource in system design
Expand towards diversity	Approachability	Design for majority of users
Optimal use of local environment	Flexibility and Simplicity	Simple and flexible system that is customizable
Influence over time	Reduced Effort	Reducing adverse effects over time and enabling easy alternation of design
Systems thinking	Transparency	Understand synergies and emergent properties

Figure 1. Intra-Discipline Characteristics (Stephanidis and Antona 2013)

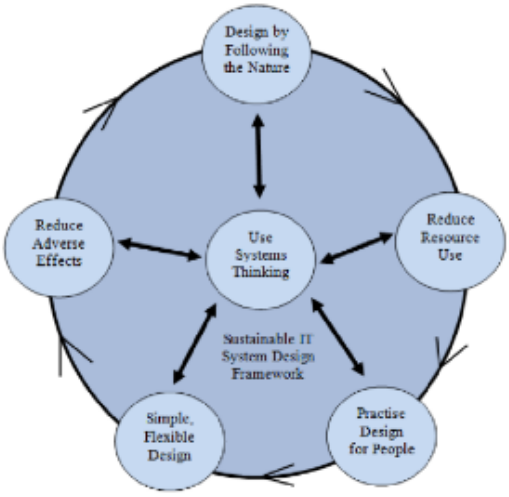


Fig. 1. Proposed framework for designing sustainable IT system

Figure 2.Intra-Discipline Design Framework (Stephanidis and Antona 2013)

2.4 Interaction Design and UX Design

The formal discipline Interaction design (IxD) has been around for less than two decades (Saffer, 2009). The discipline is related to Human-Computer Interaction (HCI), which became increasingly important as the age of personal computers started. The HCI field has since then grown in a rapid fashion along with the technology development.

Today, HCI is commonly regarded as a part of the field known as User eXperience (UX) design. UX is viewed as inter-disciplinary, drawing on disciplines such as design, informatics, psychology, technical studies, industrial studies, leadership studies, production, communication studies and system engineering (Torkhildsen, 2014). As Figure 3 shows, disciplines related to IxD are among others Information Architecture, Industrial design, Cognitive psychology and Visual (or graphic) design. The core of Interaction design is usability, which is closely linked to UD, a discipline that focus on usability for all users.

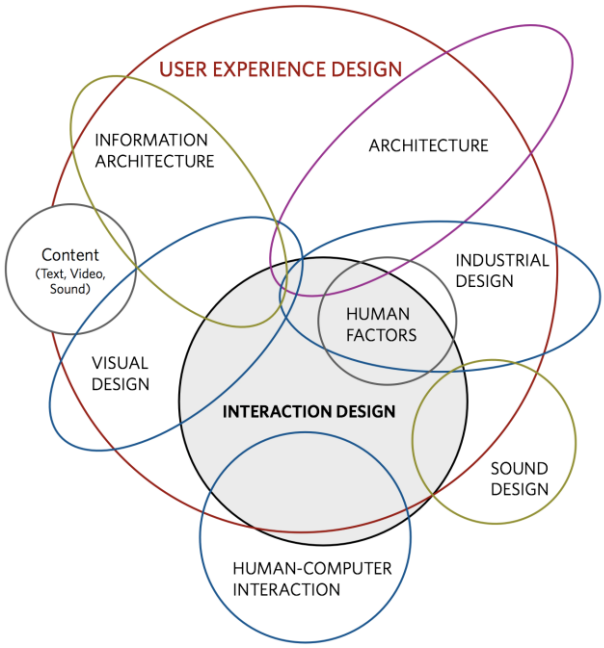


Figure 3.The Discipline of User Experience (Saffer 2009)

2.5 User-Centered Design

User centered design (UCD) is a design methodology grounding the design process in information and knowledge about the user. Common UCD methods are user testing, observation and interviews. Within IxD several user-centered approaches exists. At one end

of the spectrum is a human-centric approach where the users are taken into account when designing, but are not directly included in the process, and low-contact methods (such as surveys and marked research) are common. On the other end of the spectrum are design approaches with a high degree of direct user involvement and high-contact methods (such as workshops with the users). Examples are participatory design where the user is considered a design expert and involved in all phases, co-creative approaches where emphasize is on including users in the actual design process, and user-sensitive design utilizing empathic design techniques as well as developing personal relationships with users.

2.5.1 Agile User-Centered Design

An agile development process is characterized by an incremental approach to ICT development. Within agile methodology an iterative process is used, working in sprints to finish smaller deliverables, that later comes together to form the final solution. Agile User-Centered Design is the use of user centered design methods within the agile process. Bordin and De Angeli (2017) points out how Agile User-Centered Design can present some challenges, given that UCD is generally not that concerned with the actual implementation of software, while agile development on the other hand is not particularly concerned with user experience.

With agile being the norm in software development projects, the assumption is made that the same issues that are present within the field of agile UCD will be present when adding UD perspectives to UCD approaches in agile projects. There is still no agile user-centered approach that is deemed entirely adequate at this point in time (Bordin and De Angeli, 2017). According to da Silva et al. (2015) there is an emphasis on the Research stage in the interaction design process in agile UCD, and the most common usability techniques used are usability testing and prototypes.

2.6 Measuring Project Success

In a smaller interview study targeting successful ICT-projects in Norway, Harder and Begnum (2016) identified seven tentative UD success factors: 1) Proper resources with a profound understanding of what Universal Design is, accompanied by thorough 2) anchoring

and 3) top-level understanding of UD on a business level, which allows for an 4) early and continuous focus throughout the development process, with good 5) team collaboration who are free to do 6) frequent user testing, alongside 7) various methods of internal and external quality assurance. These coincide well with the seven principles for Inclusive Design previously identified from literature, and also with Khang and Moe (2008) findings on the link between Organizational level dedication, Individual level competence and project success.

According to Khang and More (2008) several researchers have identified that the competence of team members, as well as the project manager, can be linked to project success. Critical individual competence identified includes technical, administrative and interpersonal factors (Khang and Moe, 2008). They also argue that if the team and project management are not dedicated to project success, the competence level is insignificant, because motivational factors include a clear and common understanding of the project goals and objectives.

The Harder and Begnum (2016) preliminary study found that obstructive factors where often the opposites of the promoting factors, and suggested looking into hygiene factors versus driving motivators upon factor validation and study extension (Herzberg, 1968). Hertzberg's motivation-hygiene theory, also known as Herzbergs's dual-factor theory, revolves around employee motivation and is an offspring of the Maslow pyramid of needs (see Figure 4). Herzberg identified how someone being satisfied or dissatisfied at work might arise from different factors. What motivates people at work may be different to, and not simply the opposite of, factors causing dissatisfaction. Hygiene (or maintenance) factors are those factors needing to be present to not cause dissatisfaction. Motivational factors increase satisfaction, and are relying on hygiene factors already being sufficiently present.

Project success can also be linked to the institutional competence of the team itself, such as good communication systems, effective planning and scheduling, lack of bureaucracy, team cooperation and lack of conflict. Furthermore literature has identified top-level support and sufficient resources as key environmental factors, along with technical conditions, facilities, economy and information. (Khang and Moe, 2008).

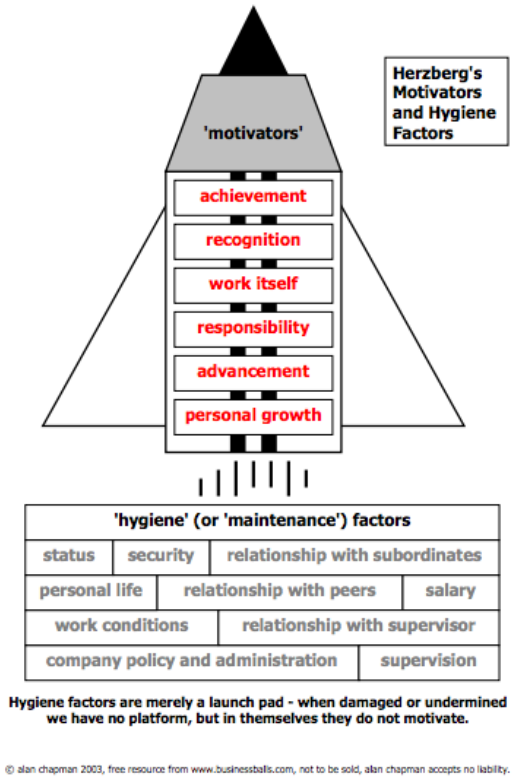
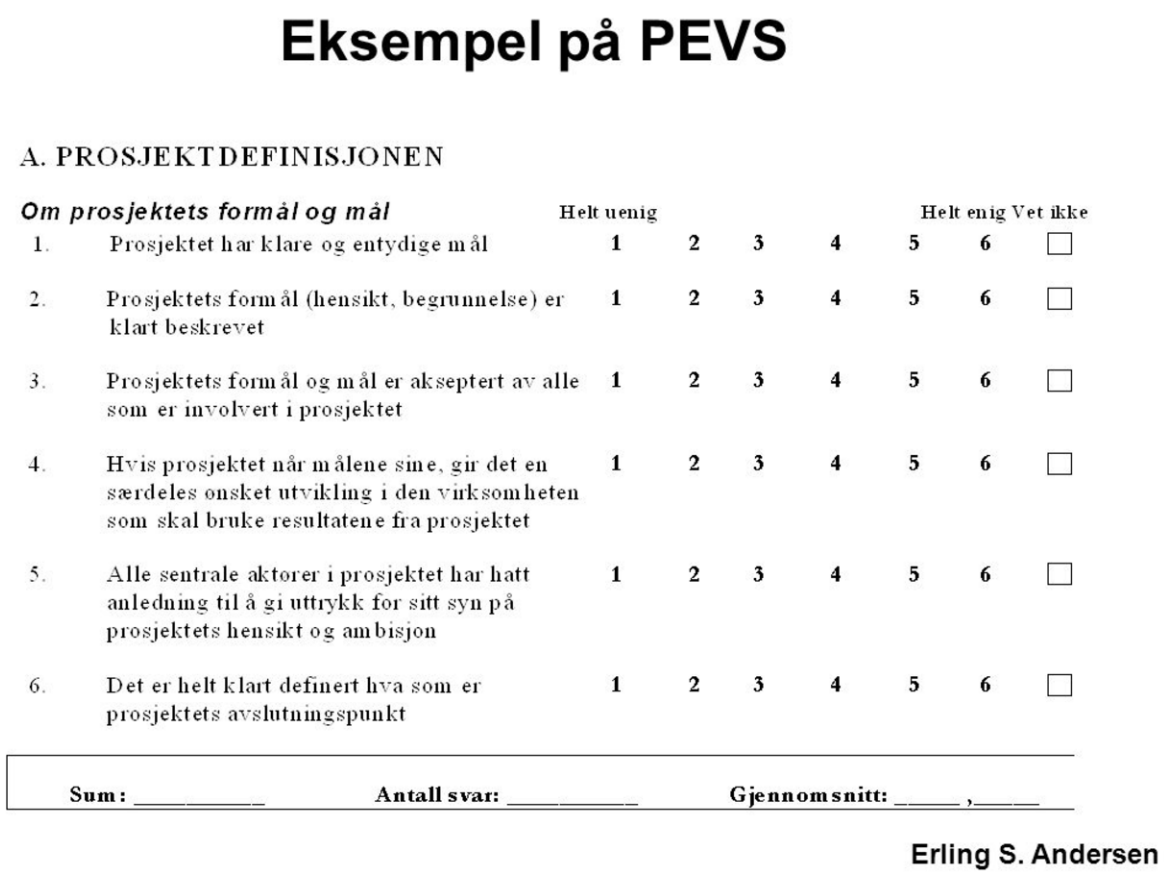


Figure 4.Hertzberg's Motivation and Hygiene Factors (businessballs 2016)

Defining criteria to measure and indicate a project's success is recognized as challenging (Khang and Moe, 2008). Critical Success Factors (CSF) is used as indicators of aspects that are crucial in order to succeed with a project (Andersen, Dyrhaug and Jessen, 2002). However, CSF's are often mostly focused on either the effectiveness of the implementation process or the overall project success; including the team's performance and ability to follow the given time frame and budget, or by the team's own perception of how well the project went. A retrospective focus is not concerned with factors linked to earlier life-cycle phases of a project. Consequently, there is a lack of opportunity to measure progressively in a project diagnose potential problems early on (Andersen, Dyrhaug and Jessen 2002; Khang and Moe 2008).

As a consequence of this retrospective nature, Andersen and Jessen (2000) suggested to separate the task-oriented evaluation from the individual-oriented one. They propose creating a tool for project success evaluation, aiming to evaluate the current project status and also predict possible future outcomes. Their Project Evaluation Scheme (PEVS) is a questionnaire

with five identified categories. Each of the five categories is divided into two subcategories, and within each of the 10 subcategories there are 6 questions formulated, resulting in a total of 60 critical success factors. The scheme had adopted a scale of choices per CSF, ranging from 1, disagree completely, to 6, agree completely in order to measure the CSF's (Andersen and Jessen, 2000). Figure 5 shows an excerpt from the PEVS questionnaire.



Eksempel på PEVS

A. PROSJEKTDEFINISJONEN

Om prosjektets formål og mål	Helt uenig					Helt enig	Vet ikke
1. Prosjektet har klare og entydige mål	1	2	3	4	5	6	☐
2. Prosjektets formål (hensikt, begrunnelse) er klart beskrevet	1	2	3	4	5	6	☐
3. Prosjektets formål og mål er akseptert av alle som er involvert i prosjektet	1	2	3	4	5	6	☐
4. Hvis prosjektet når målene sine, gir det en særdeles ønsket utvikling i den virksomheten som skal bruke resultatene fra prosjektet	1	2	3	4	5	6	☐
5. Alle sentrale aktører i prosjektet har hatt anledning til å gi uttrykk for sitt syn på prosjektets hensikt og ambisjon	1	2	3	4	5	6	☐
6. Det er helt klart definert hva som er prosjektets avslutningspunkt	1	2	3	4	5	6	☐

Sum: _____ **Antall svar:** _____ **Gjennomsnitt:** _____ ,_____

Erling S. Andersen

Figure 5. Excerpt from the PEVS questionnaire (slideplayer 2015)

3 Methodology

The aim of the thesis is to provide rich insights into how Norwegian ICT projects in practice have successfully ensured their ICT-solutions are in compliance with the Norwegian UD legislation, and based on this move towards identifying critical success factors in an ICT-project related to increasing the likelihood of a achieving a universally designed ICT-solution.

3.1 Study design

The thesis study is divided into two distinct parts. The first and largest part of the thesis is focused on providing insight into practices from Norwegian ICT-projects having successfully achieved UD. The first research focus is thus on investigating (1) which practices should be implemented in order to successfully achieve universally designed ICT-solutions.

To investigate (1) empirical data is collected from the actual experiences of ICT project participants and qualitative data on the practices they view as contributing to, or hindering, successful implementation of Universal Design. Here, the thesis is continuing a preliminary interview study (Harder, 2016) conducted during a specialization course and prior to the thesis. The sample in the preliminary study is 13 informants. An article based on the preliminary findings from the pre-study was published as a conference paper at NOKOBIT in 2016, after adding the thesis supervisor as a second researcher in order to up the inter-coder reliability and as such increasing the validity of the study (Harder and Begnum, 2016), see Appendix E.

By replicating the preliminary interview study and increasing the number of informants, the complete findings from the thesis study will be more valid, reliable and generalizable. The two study samples will be referred to as sample A for the pre-study and sample B for the thesis sample. The first research aim (1a) is to verify or improve the tentative set of promoting and obstructive factors for UD suggested by the pre-study (Harder and Begnum, 2016) through comparing on from the two study selections.

The second research aim (1b) is exploring relationships between the identified factors from the qualitative interview descriptions in the larger selection, spanning both samples A and B.

For example, the pre-study suggested factors could be organized on three levels; Organizational, process or individual. Further, the data indicated some factors influence others and that negative factors might mainly be a lack of positive factors.

Finally, the thesis looks into (1c) determining critical success factors based on the larger sample. Through categorization of identified positive and negative practices, promoting and obstructive factors are suggested and rated against each other in order of perceived importance.

The second part (2) of the study explores the possibilities of indicating the likelihood of achieving universally designed ICT-solutions. This part suggests a predictive project success self-evaluation tool specific for UD in IT-projects. The self-assessment tool is based on a feature analysis of the findings in part one. In order to explore the measurability and predictability of best practice process factors on ensuring UD identified critical success factors from part one (1c) is used.

Based on the findings from part one of the study, the evaluation tool aims to measure how well equipped a project is to comply with UD best practices. Through prototyping an evaluation tool measuring the compliance of ICT-projects to identified universal design success factors, the ability to predict UD success is explored. Finally, the study tests the suggested self-evaluation tool (2a) in order to tentatively confirm or refute initial validity.

The second part of the thesis study is done as a collaborative process with the thesis supervisor who was added as the second researcher before publishing the preliminary findings. Researcher 1, the thesis author, does the initial work and includes Researcher 2 for peer review, revisions and discussions in order to increase reliability. Researcher 2 will continue further studies based on the data from this study, and it is therefore expedient for her to be familiarized with the data and the analysis process.

3.2 Methodological Approach and Scientific Perspective

Due to the nature of the study's research topic an exploratory and qualitative overriding research approach is considered the most appropriate. An exploratory design is appropriate

for qualitative research as it enables the researcher to change the course of action throughout the study if new insights are found that makes this appropriate or necessary (The National Ethics committees, 2010). A qualitative research design is chosen over a quantitative one as a function of the study's objectives.

Interview is the method of choice for data collection, in order to allow for a deeper conversation about the theme, and the opportunity to gather reflections and elaborate detail about specifics. A survey study could have provided more informants. On the other hand it might also provide more shallow replies, with no opportunity for follow-up questions. According to Lazar, Feng and Hochheiser (2010) conversations with a smaller amount of participants can provide useful perspectives and data that surveys might miss.

A case study was also considered, but then the study would have to concentrate on fewer cases, which would make the findings less generalizable. A case study provides first-hand knowledge, through methods like observation, which reduces the possibility of informants leaving out or forgetting to mention certain aspects. However, in order to secure data from projects with relevant practical UD experience, the study only includes projects affiliated with UD success. Consequently, this study aims to identify factors in projects that have already been rewarded or acknowledged for their efforts in ensuring UD. Thus, conducting observations and participatory data collections are less viable methods for this thesis study.

According to The National Ethics committees (2010) qualitative methods often consist of interpretations (hermeneutics) and human experience (phenomenology). In a phenomenological study you seek to understand someone's experience and perception of a situation or a phenomenon from their perspective, (Leedy and Ormrod, 2013). This study aims to gain knowledge about, and extract the essence of, universal design process through exploration of human experiences, using members of successful IT projects. Thus the study can be said to have phenomenological traits (Andersen 2010; Gee, Loewenthal and Cayne, 2015). There is systematic retrieval of empirical data through interviews, as well as processing and interpretation of the material as written text in the form of interview transcripts.

3.3 Sample Selection

Two different samples are identified in the study; ICT-projects that have successfully achieved UD and ICT-projects that have been unsuccessful in achieving universally designed ICT-solutions. The main focus of this study is on the project successes, explored in the first part.

3.3.1 Part 1: Identifying Universal Design Success Factors

As described in section 1.1 Key Definitions, a project is in this study defined as having successfully achieved a universally designed ICT-solution if it has a) won a design award for its ICT-solution where UD is a main or part criteria, b) have received an honorable mention or nominee in relation to a design award for its ICT-solution where UD is a main or part criteria, or c) have received an honorable mention from a relevant and reputable organization or official authorities for efforts related to ensuring UD in an ICT-solution. These are viewed as ICT-projects having successfully achieved UD.

Study part 1 includes samples A and B of ICT-projects having successfully achieved UD. The inclusion criteria used in the pre-study for selecting informants in sample A are continued in the thesis for selecting informants in sample B. Inclusion criteria for participation in part one of the study are:

1. The informant is affiliated with an ICT-projects having successfully achieved UD.
2. The informant is an interaction designer, designer, developer or in a similarly closely related position to UD work in the ICT-project.
3. The informant is available during the data-gathering period defined for the study.

As such, a prerequisite for participation is that the projects have received an award or honorable mention for efforts related to UD.

It should however be noted that though the award or honorable mention must be awarded the projects either by official authorities or by a relevant and reputable organization, the UD success criteria differ between the different solutions, honorable mentions, awards and nominations. In addition, some awards are UD specific, mainly focusing on design for all and inclusive aspects, while other awards include UD as one of several criteria. In order to make

visible the different honorable mentions and awards represented in the study sample, an overview of these is found in Table 1.

In order to maintain the various projects anonymity, the projects will not be linked to the specific award, or the year that they won. The time range for the various awards span from 2010 until 2017, however more than half of them are from 2014 or later. Two award names will be kept out of this report entirely, due to privacy concerns involving traceability. Some projects are affiliated with more than one award. The following overview thus shows six out of the eight awards included projects have won, been nominated for, or received honorable mentions for. The left column summarizes the number of projects from this study affiliated with each award.

The Innovation Award for Universal Design and The Design for All Award, both distributed by Design and Architecture Norway (DOGA), are specifically targeted towards universal design. The represented projects have won these awards in competition categories related to interactive design and interaction design. The Badge for Good Design, also distributed by DOGA, has a broader design award focus and is including UD as a sub-criterion. The Farmand Award has a category with more specific UD criteria, targeted towards public services. The Norwegian Agency for Public Management and eGovernment (DIFI) also focuses on public services and public websites, and emphasize WCAG specific criteria in their annual rankings and awards. Of the two unnamed awards, one is related to young designers and the other is an international award.

Original name of award	***Translated name***	***Distributor***	***Projects***
Innovasjonsprisen for Universell utforming	The Innovation Award for Universal Design	DOGA	5
Design for alle-prisen	The Design for All Award	DOGA / The Delta Center	3
Årets Digitale Tjeneste – Kvalitet på nett	Digital Service of the year – Online Quality	DIFI	1
Årets Statlige Nettsted - Kvalitetsmåling	Public Website of the year – Online Quality evaluation	DIFI	6*
Merket for god design	The Badge for Good Design	DOGA	6

Farmandprisen – offentlige virksomheter	The Farmand Award - Public Services.	Farmand AS	3

Table 1. Overview of awards and frequency of affiliated projects.

***Includes projects that received 5 or 6 out of 6 possible stars in DIFI's online quality evaluation.**

Consultant agencies were highly represented in the pre-study sample A, largely due to the fact that larger companies hire a lot of designers and developers from various consultant firms, and they are therefore often linked to small- and large-scale project in both the private and public marked. Consultant agencies are also often linked to awards, as they often seem to nominate projects they are affiliated with for PR-purposes. As such, it was thus viewed as advantageous to prioritize inclusion of participants from large state agencies in order for the projects to be as representative as possible. Large state agencies seem heavily invested in developing public digitalized solutions and are viewed as contributing to setting the organizational standards and overall framework for UD in Norwegian ICT-development.

3.3.2 Part 2: Measuring Project Compliance to Success Factors

In the second part of the study, both successful and unsuccessful projects are included in a sample aimed at evaluating prototyped tool for indicating likelihood of success. In order to aid future projects assess their ability to have UD successful projects, a predictive project success evaluation tool similar to the PEVS questionnaire is prototyped. The rating process is inspired by Hertzberg's motivation-hygiene theory (Hertzberg, 1968). The self-assessment questionnaire rates the critical success factors identified in study part one. The prototype is then applied to the answers provided by the successful sample from study part one. This first sample should produce high scores. For further validation the prototype is applied on a sample of projects not affiliated with success in regards to implementation of UD. This second sample of projects should receive low scores.

In the case of defining projects that are unsuccessful in achieving universally designed ICT-solutions the definition will to a larger extent have to be based on general media coverage. However, due to the time limitations and scope restrictions, this study will not be able to perform extensive testing on unsuccessful projects. Prerequisites for participation in this part two of this study includes:

1. Successful projects must be drawn from sample A or B, or meet the same criteria for successfully achieved UD as previously defined.
2. Unsuccessful project must have received negative press for their UD efforts, by a reputable source connected to UD quality.
3. The assessor is an interaction designer, designer, developer or in a similarly closely related position to UD work in the ICT-project.
4. The assessor must be available during the test period defined for the study.

3.4 Data Collection

The data collection for this study was performed through interview studies. A preliminary study consisted of 13 interviews from 13 projects, and constitutes sample A. The study was then continued with 18 new informants, making up sample B. Sample B included a further 8 new ICT-projects. A total of 30 in-depth personal interviews have been conducted. One of the informants, in sample A, cancelled the face-to-face interview and opted to fill out and return the interview guide in writing. All the informant's answers are included in the data material, resulting in a total of 31 informants, and covering a total of 21 ICT-projects.

In order to verify the original findings from sample A, the 18 new informants were interviewed using the pre-existing interview guide from the pre-study. This interview guide can be found in Appendix C. The interview guide consists of two parts. This thesis focuses on answers from the first part of the guide, which are largely exploratory and open questions regarding UD related practices, but the data set also includes categorical questions about methods, user groups and informant background. After analyzing the preliminary data, one new question regarding the use of agile methodology was however added to the interview guide before the second round of interviews in selection B. This added question was sent via e-mail to the 13 informants in selection A. All the 13 informants gave their response, and their answers were included in the total sample analysis.

The same questions were asked in the same order to get the advantage of a dataset that is as undemanding as possible to analyze (Valenzuela and Shrivastava, 2008). Due to time constraints the interviews were kept fairly structured to ease the interpretation and analysis load for the researcher. However, conducting a fully structured interview was not considered

advantageous, as this would remove the option to follow interesting leads. Therefore, the interviews were conducted in a semi-structured matter. Semi-structured, in-depth personal interviews were selected in order to maintain a solid foundation and framework, exposing the respondents to the same questions and themes, while simultaneously allowing for flexibility and follow-up questions (Rogers, Sharp & Preece, 2011). The goal was to get in-depth information about the topic, which a fully structured design might stand in the way of. The structure also makes it easier to compare responses across participants (Lazar, Feng and Hochheiser, 2010).

All interviews were recorded, after retrieving written consent from the informants. In addition to securing the opportunity to listen to the interviews again and getting full transcripts; the security of having audio-recordings gave the interviewer a chance to be more present in the situation, allowing for better dialogues and detection of body language, which also helped with the overall interpretation of what the informants wanted to portray. After conducting 12 in-depth, personal interviews, the researcher already had an aggregated sense of what the majority agreed on before starting the analysis. This was helpful while coding and categorization selection A.

3.5 Data Analysis

3.5.1 Thematic Content Analysis

The goal and result of qualitative content analysis is, according to Zhang and Wildemuth (2016), the recognition of significant themes and categories within a body of content, which can support the development of new theories and models through careful data preparation, coding and interpretation. The results may also validate existing theories and provide important insights into particular phenomena. A thematic content analysis is used to analyze the findings from these interview studies. This study draws on *audience content;* feedback collected, directly or indirectly, from an audience group (Lazar, Feng and Hoccheiser, 2010). The content in this study is gathered through audio-recordings of the interviews. In the HCI field, both text-based and multimedia-based information may be collected from participants (Lazar, Feng and Hoccheiser, 2010). A thematic content analysis is performed after converting the audio recordings into text-based media content in the shape of interview transcripts.

The Norwegian legislation making UD of ICT mandatory is still fairly new, and the deadline for complying with it is not yet expired. Due to the adolescence of the discipline there are few pre-defined codes in the existing literature. While working on new topics with limited literature, there may not be any established theories to build coding categories on in advance, making emergent coding the most appropriate approach (Lazar, Feng and Hoccheiser, 2010). *Emergent coding* or ("open coding") was therefore the chosen approach for selection A. This was also chosen in order to avoid having pre-defined factors interfere or lead the researcher when exploring the text. The codes were identified in the data material during the analysis, and subsequently structured into a nomenclature; a list of numbered categories that represent all the possible answers to a question (Lazar, Feng and Hoccheiser, 2010). The code list helped sort and group related answers, and make a hierarchal structure.

However, for this study the goal is to reproduce the first study in order to verify its findings, and therefore an adjustment is made to the coding procedure. Instead of using a completely emergent coding technique for the 18 new transcripts, the codes and categories identified by Harder and Begnum (2016) are now used to code the data *a priori.* In *a priori* coding, codes are pre-defined before the analysis, and may for example be based on existing theories (Lazar, Feng and Hoccheiser, 2010). This data analysis does not use a strict a priori coding scheme, as previous codes and categories are based on this one sole study. If the codes and categories could be further confirmed by other studies it might be considered appropriate to use a priori coding alone. However, for the purposes of this study the predefined codes and categories are used, while still allowing new codes or categories to emerge.

3.5.2 Tools for Content and Statistical Analysis

When selection A was analyzed the data was handled manually. As the data material increased with selection B, the need for a more sophisticated data handling method also emerged. Therefore, in order to gain better control of the large data set, and secure a data analysis process less prone to human error, the transcripts were imported into a program for qualitative data analysis called NVivo. NVivo is designed to help the researcher organize thoughts and analyze unstructured, non-numeric, qualitative data like interviews. Using the program made the analysis process more efficient, saved time and made all the data

searchable, thus more accessible. The software also makes it easier to see contexts and can help reveal new insights. The pre-existing codes and categories were added into the program as nodes, and the informants as cases. Each relevant section in the transcript was connected to a node and linked a case.

In addition, the data was fed into a comprehensive data management and analysis tool from IBM, called SPSS (Statistical Package for the Social Sciences) for easy access to descriptive statistics and calculation of statistical significance. In order to use SPSS the data must be in a format that the program can read and is therefore converted from semantic to numeric data. The responses are all assigned a numerical code, meaning that variables such as for example gender are converted into numbers (1 = male, 2 = female). Before entering the data into the software, a codebook is prepared to summarize and document the decisions made on how the variables are defined and labeled, see Appendix D. The data is entered at an aggregated category level.

Using sophisticated tools provides numerous opportunities when it comes to further data analysis. Thus, even though this study is somewhat limited, part of the total contribution for future research is the creation of NVivo and SPSS files for further content analysis and statistical analysis.

3.5.3 Identification of Key Factors and Critical Success Factors

In order to identify certain factors as key for Universal Design success in ICT-solutions, this study base the analysis on empirical data from informants who have, by this study's requirements, done just that; succeeded with UD implementation for an ICT-solution. The key factors are in reality therefore mainly determined by the informants themselves, and based on their reflections and concerns. The researcher's job is in this case to collect and process the data. By analyzing the individual cases and comparing them, higher-level patterns can appear (Lazar, Feng and Hochheiser, 2010).

The qualitative data analysis in this part of the study consists of recognizing recurring thoughts and concerns among the informants; and the repetitive tendencies in the data will be identified as factors that are **essential** for the project to meet the minimum standards of UD.

Less frequently mentioned factors are then assessed in relation to the interview responses and either classified as factors that **should** be present or factors that are just **nice to have**, but not necessarily essential for achieving the goal.

Key factors are primarily selected based on how many informants mentioned them, and not based on the frequency of times they were mentioned. There are several overlapping codes within each category. If one of the codes is mentioned several times by one informant, the total frequency of mention may provide a skewed impression of importance for the entire category.

In order to define a tentative limit as to what constitutes enough mentions to be classified as key by the frequency analysis, the decision was made to regard a factor as a key factor if more than two thirds of the informants mention them i.e. more than 20 of the 31 sources. This seemed a fitting threshold for critical importance. In order to further secure the importance, the factor category must in addition to this have more than 40 mentions, i.e. mentioned on average more than twice by each source.

Input from Researcher 2 on hygiene and motivational factors are used to determine critical cuccess cactors (CSF) for the self-assessment tool. A factor is classified as a CSF if it is defined as a key promoting factor **and** has a corresponding obstructive factor pointing to the lack of the factor in question. An obstructing factor may therefore be included as a CSF even if it is not selected on its own, and vice versa for promoting factors. In other words, factors viewed as being either positive or negative depending on presence (motivators) or level of presence (hygiene factors) is considered CSFs if either obstructive or promoting factor frequencies fulfill the key criteria.

3.5.4 Developing an Self-assessment Evaluation Tool

The self-assessment tool is developed in a collaborative process with Researcher 2. A first draft is created by Researcher 1, based on the findings from Part 1 of the study, including identified key promoting and obstructing factors. The draft is then revised by the second researcher, and adjusted to include CFS identified based on the second researcher's identified

hygiene and motivation factors. The tool consists of simple questions formulated to capture whether or not a project is complying with the identified CFS.

3.6 Research Ethics

This study is of a qualitative nature, and involves conversations with several individuals. In these conversations, the researcher will be asking them about their current, or previous, work situations and their personal opinion about practices in concrete ICT projects. Several have also asked specifically to be kept anonymous. It is therefore crucial to treat the informants and the projects they represent with respect, and keep all personal data safe and anonymous as required.

It is also important to thoroughly explain the purpose of the research and the use of the retrieved information. All participants invited to join this study has therefore receive written information about the nature and aim of the study, see Appendix A. This information is provided in order to clarify the purpose of participation before scheduling and starting conversations. The information given to the informants includes background and purpose, interview layout, privacy information including voluntary participation, options for anonymity, and description of how the data is stored and disposed of. It also informs the participants of the fact that the thesis advisor will be using the data in her doctoral studies. This information was also given in a less formal oral presentation before the interviews.

Written consent was required from all informants prior to conducting and recording the interviews, see Appendix B. Here, informants verify that they have received information, understood the purpose of the study and consented to participation. The consent form collected specific consent for audio recording, as well as presented them with the option of requesting anonymity.

This study collects identifiable personal data such as name and work place information, as well as voice recordings. The data material will be transferred to the thesis supervisor at the end of the thesis, who will build further on these findings in her doctorate studies. The informants have received information about this and consented. The thesis advisor is going to

continuing working with the data, and the study is therefore reported to the Data Protection Official for Research for all Norwegian universities (NSD) as part of her doctoral studies.

3.6.1 Reliability

Reliability says something about how reliable and representative the results of a study are. According to Weber an ultimate goal regarding reliability in qualitative research is ensuring different persons would code the same text in the same way (Lazar, Feng and Hochheiser, 2010). Stability or intra-coder reliability is a method of checking if a coder is consistent. One way is to investigate whether a coder will remain consistent if asked to code the same data multiple times. Another method is to examine whether two different coders code the same data in a consistent way. This is called reproducibility, inter-coder reliability or investigator triangulation. Theoretical triangulation utilizes coders with different backgrounds or theoretical perspectives. If agreeing, the results may be viewed as very reliable.

This study aims to provide understanding and knowledge through interpretation of the gathered data. When data is being interpreted using thematic content analysis, there will always be a liability connected to the researcher's ability to stay completely objective. The interview guide therefore consists of clear questions, in order to keep the participants answers from being characterized by subjective opinions. However, due to the researcher's background in interaction design and experience working in ICT-projects, there might be a risk of subjective interpretations in terms of understanding terms and methods mentioned by the participants. Therefore bracketing (setting aside all prejudgments) is required (Creswell, 1998).

In order to enhance the reliability of this study, the thesis supervisor was included as a second researcher after the pre-study in the specialization course was completed. With a second researcher who could code the transcripts from sample A separately, inter-coder reliability could be calculated between two different researchers.

The calculations gave an overall overlap of 98 % amongst the codes grouped as promoting; out of the 150 promoting codes that were identified, 88 % had a perfect or nearly perfect overlap, while the other 10 % were overlapping, without an exact match. This was identified

as a consequence of Researcher 1 detailed codes related to understanding the concept of UD more, while the focus of Researcher 2 was on organizational culture and resource prioritizing. Only 3 of the codes were noticeably different however; Researcher 1 codes innovative abilities where Researcher 2 on had one code on access to ATs and another on the link between securing usability and UD.

There was a 95 % overlap calculated among the 57 codes grouped as obstructive. Three diverging codes are identified here as well; Researcher 1 coded one on handling resistance, where Researcher 2 codes one related to lacking utilization of available UD resources and one on the challenge of WAI violating frameworks and tools.

To further control the quality of the categorization process, codes and code-categories were thoroughly discussed, and codes cooperatively sorted and categorized. This resulted in a total of 13 promoting and 6 obstructive categories. These were used as a starting point (a-priori codes) for independent coding of selection B in this thesis.

Furthermore, all interviews were semi-structured and the participants were asked the exact same questions. All participants granted permission for the interviews to be recorded, so the interviews are all transcribed verbatim in order to minimize the possibility of unconscious interpretations by the researcher while taking notes. To secure that all the transcriptions are compatible, and also ensure the thesis contribution was conducted independently, the thesis author transcribed them all. This helped make sure that all codes are based solely on actual statements from the informants, not on interpretations made by the researcher.

3.6.2 Generalizability

Generalizing is when conclusions about large populations are drawn on the basis of knowledge found in a smaller population (Leedy and Ormerod, 2013). In order to generalize finding, the selection sample representing the smaller populations has to be representative for the entire population.

The aim of the study is to identify best practices and thus some general recommendations and a measuring tool for successful implementation of Universal design in ICT-projects. In order

for this to be possible, the projects have to be as representative as possible. It is unwise to generalize on behalf of all Norwegian ICT-projects, based on any selection of projects, because it is impossible to define what constitutes a "typical" ICT-project.

This study has included as many informants and projects as possible within the available time frame for the thesis, in order to insure the best possible basis for generalizability. In order to secure a solid contribution and move towards valid and generalizable insights, the main focus has been to collect a fairly large data set. However the study will avoid drawing conclusions and assume that these findings are truly generalizable for all Norwegian IT projects.

3.6.3 Validity

Validity tells you how well you can measure the findings the study aims to produce. The internal validity defines to which degree the research design and the data allows the researcher to draw precise conclusions about cause and effect or other relationships within the data (Leedy and Ormrod, 2013). External validity tells you to which degree you can generalize the findings onto other populations and contexts than those represented in the study; such as other participants, situations or at a different point in time (Lazar, Feng and Hochheiser, 2010).

Using multiple data sources in order to support the interpretations of the same type of data is knows as data source triangulation (Lazar, Feng and Hoccheiser, 2010). This study reproduces and verify findings that already have several pieces of evidence pointing in the same direction, and it uses several participants representing various projects in order to so.

Furthermore this study produces a strong chain of evidence consisting of a large database with all the collected raw materials and the procedures organized and well documented, including library files from both Nvivo and SPSS software, notes, audio recordings with full verbatim transcriptions, analysis documentation and tabular presentation of the data and descriptive analysis. This database does not only make a linkage that forms an evidence chain showing how the findings are firmly grounded in the data. In addition, a database like this also increases the reliability (Lazar, Feng and Hoccheiser, 2010).

Lastly, the finished evaluation tool is applied to the project samples within the study's population (part one of the study), as well as a small sample from outside the study's population (part two). This test aims to compute compliance and/or maturity scores to the identified critical success factors. The tool validation and verification analysis aims to gather, compute and compare the scores from the sampled projects. If the tool works well, successful projects will receive high scores. Unsuccessful projects should receive low scores. If the values reported from successful and unsuccessful cases correspond with findings, this indicates a successful tool.

Finally, as outlined in the success-sample selection and inclusion criteria, there are no clear objective measurements of what Universal Design of ICT-solutions entails. Instead of working to define, derive or identify such measurements, this study has relied on evaluations of award committees on design awards related to accessibility, universal design and design for all. As such, it may be critiqued that this study does not necessarily point to success criteria for achieving Universal Design, but rather success criteria for getting an award, high rating, nomination or honorary mentions from award committees and UD evaluators. On the other hand, if the prototyped evaluation tool receives low scores from projects that have been reported to authorities or to media as unsuccessful, or that have been publicly critiqued by disabled end-users, their organizations or profiled DU experts, one may argue that the validity of the criteria as UD success indicators are strengthened.

4. Results

The following chapter presents the results found in this study. First, section 4.1 describes the sample. Then, extended insights from part one (1) of the study is presented. Section 4.2 describes the coding of identified positive and negative practices from the qualitative data transcripts. Section 4.3 looks at their categorization. These sections emphasize understanding codes from the data and organizing code categories into factors on different levels.

In section 4.4, the focus is on validating and refining preliminary findings from the pre-study on factor categories, by looking into factor category frequencies. Overlaps and relationships between factor levels, factor categories and specific factors in the categorization structure derived from the a-priori coding scheme are also described in section 4.4 (1b). Section 4.5 further focuses on identifying which of the promoting and obstructive factor categories are key, by looking into thresholds frequencies (1a). Based on a frequency analysis on the top-down categories derived from the a-priori coding scheme, promoting and obstructing key categories that should contain critical success factors (CSFs) are identified.

After validating previous findings based on utilizing the a-priori coding scheme in sections 4.2-4.5, Researcher 2 iterates back to a bottom-up categorization, based on Researcher 1's final codes and top-down derived categorization scheme, in order to better reflect new information and understanding. Results from this re-organization are presented in section 4.6. Researcher 2 mainly conducted this re-organization, using NVivo as facilitating re-categorization tool, as Researcher 1 had already transferred all the data into the software. As such, it should not be regarded as a major part of the thesis, but rather as a collaborative expansion. The collaboration with Researcher 2 also represents an inter-coder reliability check of 4.2 results, by adding a second researcher approving the coding made by Researcher 1 against the transcription content.

Section 4.7 presents identified critical success factor (CSFs) for UD based on the new data organization (1c). This work was also done in collaboration with Researcher 2, but as a joint effort. Frequencies and thresholds were iteratively discussed between the researchers in order to arrive at critical success factor identification.

Next, results from the second part of the study (2) are described. Section 4.8 presents the prototyped predictive project UD success self-evaluation tool based on the identified CSFs from part one (UD-CSF). Section 4.9 shows test results from assessing the 31 informants answers against the UD-CSF evaluation tool, as well as self-assessments made by 12 informants from non-successful UD projects in order to further indicate the tools initial validity (2a).

4.1 The Sample

Table 2 provides an overview of the study's informant profiles. Informants 1-13 are from the initial preliminary study sample A. Informants 14-31 are from the extended thesis sample B. This chapter presents the combined dataset from both selections.

No	Age	Gender	Title/Discipline	Company	Project
1	30-39	Female	Functional Designer	Consultant Agency 1	5, 11
2	> 30	Female	Interaction Designer	Consultant Agency 1	5, 11
3	40-49	Male	Interaction Designer	Consultant Agency 2	4, 8, 9, 21
4	30-39	Male	Interaction Designer	Consultant Agency 3	10
5	40-49	Female	Visual/Graphic Designer	Consultant Agency 2	4, 8, 9
6	30-39	Male	Developer	Consultant Agency 4	1, 12
7	50-59	Male	Developer	Consultant Agency 2	4, 8, 9
8	> 30	Female	Developer	State Agency 1	1
9	40-49	Male	(Web) Advisor	State Agency 2	2
10	40-49	Male	Senior UD Advisor (Developer)	State Agency 1	1
11	30-39	Female	Developer	Private Agency 1	3
12	40-49	Male	Developer	Private Agency 1	3
13	30-39	Male	Interaction Designer	Private Agency 2	6, 7
14	30-39	Male	Developer	Consultant Agency 8	15
15	40-49	Female	Project manager	Consultant Agency 8	15
16	40-49	Male	Creative Director	Consultant Agency 5	16
17	30-39	Male	Interaction Designer	Consultant Agency 5	16
18	30-39	Female	Interaction designer	Consultant Agency 4	14*
19	30-39	Male	Creative Director	Consultant Agency 4	20
20	30-39	Male	Developer	Consultant Agency 9	6

No	Age	Gender	Title/Discipline	Company	Project
21	30-39	Male	Developer	Consultant Agency 7	2
22	40-49	Female	Interaction designer	State Agency 4	8
23	40-49	Male	Communication advisor	State Agency 4	8
24	> 30	Female	Developer	Consultant Agency 4	14*
25	50-59	Female	Interaction designer	Consultant Agency 10	13
26	50-59	Female	Interaction designer	Consultant Agency 10	13
27	30-39	Male	Interaction designer	Consultant Agency 6	17, 18
28	30-39	Female	Graphic/Interaction designer	State Agency 3	20
29	30-39	Female	Interaction designer	Consultant agency 7	19*
30	30-39	Female	Interaction designer	Consultant agency 7	19*
31	30-39	Female	Project manager	Private Agency 3	13

Table 2. Informant Profiles

The informants consist of 15 designers; 13 of whom are interaction designers, one a functional designer and one a graphic designer. 9 informants are developers, and both front-end and back-end developers are represented. There are seven informants with other project roles; two project managers, two creative directors and three advisors; one senior UD advisor with developer background, one web advisor and one communication advisor. The disciplines are coded from what the informants report as their main discipline, but it should be noted that some of the informants may have cross-disciplinary roles and skillsets as well as diverse backgrounds. Figure 6 shows the distribution of disciplines and companies across informants.

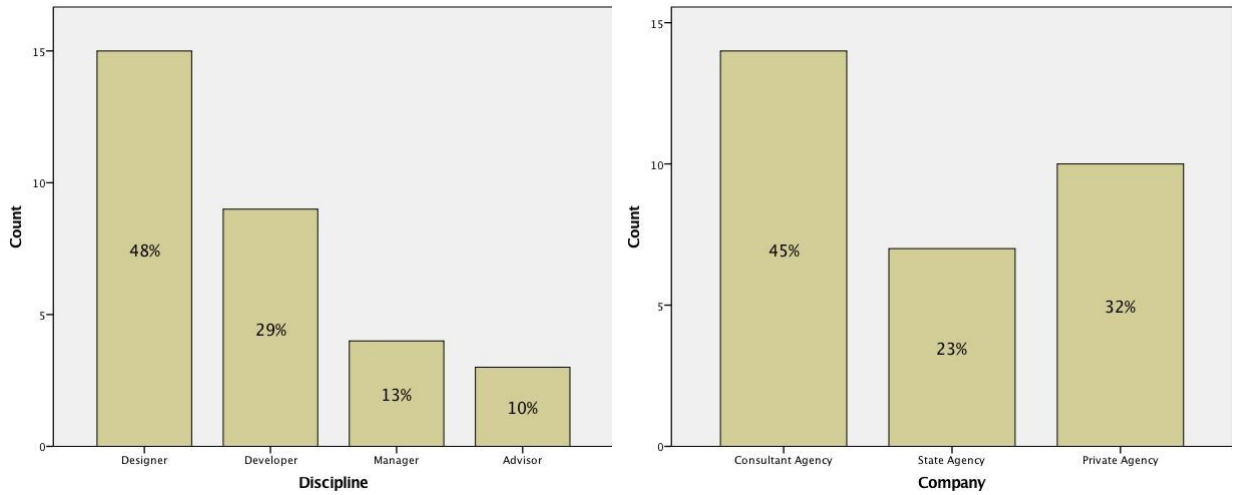


Figure 6.Distribution of disciplines and companies

The companies are categorized as either Private, State or Consultant Agencies. Private agencies contain companies from the private sector, and are composed of privately owned companies, both profit and non-profit, i.e. not part of the government. State agencies consist of organization that is partially or entirely owned and operated by the government. A consultant agency is a company employing experts (consultants) that are hired by organizations for a fee in order to provide professional advice and industry-specific or subject-matter experts. Out of the 31 informants, 21 are from consultant agencies; they are associated with projects from both public and private sector. Out of the 21 projects in this study 13 of them are linked to project from the public sector, while 8 are linked to the private sector. The Company column refers to where the informants are employed; the consultants are therefore linked to their own workplace, not the company that meets the selection criteria for the study, even though they are affiliated with the success of that company in this study.

Eight informants are affiliated with more than one ICT-project having successfully achieved UD, and some informants are affiliated with the same projects, see Table 2. Several informants in both selections have asked for their information to be kept confidential, thus all information describing informants, companies and projects are anonymized. This is done by converting the information into numbered codes.

Two projects are included based on success criteria c) only ("have received an honorable mention from a relevant and reputable organization or official authorities for efforts related to ensuring UD in an ICT-solution "). These have not a) won a design award where UD is the main, or part of the, criterion or b) received an honorable mention or nominee in relation to such a design award. They are still considered highly relevant success examples on the basis of their large target audience, strong UD focus, positive practices reported from other agencies and general positive media coverage related to UD. These projects are marked with an asterisk (*) in Table 2.

Table 3 provides an overview of the self-reported UD experience, competence and motivation from the informants.

No	Age	UD Experience	UD Competence	UD Motivation
1	30-39	9 years	5	Personal
2	> 30	4 years	5	Personal
3	40-49	5 years	6	Personal + Legislation
4	30-39	4 years	5	Personal
5	40-49	5 years	5	Legislation
6	30-39	10 years	6	Personal
7	50-59	13 years	7	Personal + Legislation
8	> 30	1 year	4	Legislation
9	40-49	15 years	5	Legislation
10	40-49	13 years	6	Personal
11	30-39	2 years	5	Personal + Legislation
12	40-49	8 years	6	Personal
13	30-39	16 years	7	Personal
14	30-39	9 years	1	Personal + Legislation
15	40-49	8 years	5	Legislation
16	40-49	4 years	4	Personal
17	30-39	9 years	4	Personal
18	30-39	5 years	5	Personal + Legislation
19	30-39	0 (always)	4	Personal
20	30-39	0 (always)	7	Personal
21	30-39	4 years	6	Legislation
22	40-49	11 years	6	Legislation
23	40-49	9 years	5	Legislation
24	> 30	2 years	4	Personal + Legislation
25	50-59	30 years	6	Personal
26	50-59	30 years	6	Personal
27	30-39	9 years	5	Personal
28	30-39	5 years	5	Legislation
29	30-39	5 years	5	Legislation
30	30-39	4 years	5	Personal + Legislation
31	30-39	4 years	6	Personal + Legislation

Table 3. UD expertise and motivation

Years of UD experience are rounded up. There are five informants with less than 5 years of UD experience; the largest group consists of 18 informants who have 4-9 years of experience, while eight informants have more than 10 years of experience. It should be noted that the table indicates that two informants have no experience with UD. To clarify, when asked about experience they both offer up similar reasoning, namely that they do not regard UD as something that is separate from the rest of the UX design process, hence they do not work with UD at all. They therefore report 0 years of UD experience, however both indicate that they have *always* worked for design that includes everybody, and that UD should be an automatic consequence of proper work.

There seem to be a correlation between the informant's years of experience and their reported competence. The competence mode increase steadily with years of experience up to 13 years, where the mode begins to diverge, see figure 7. Similarly the mean competence reported also increase with the informant's age, see figure 8.

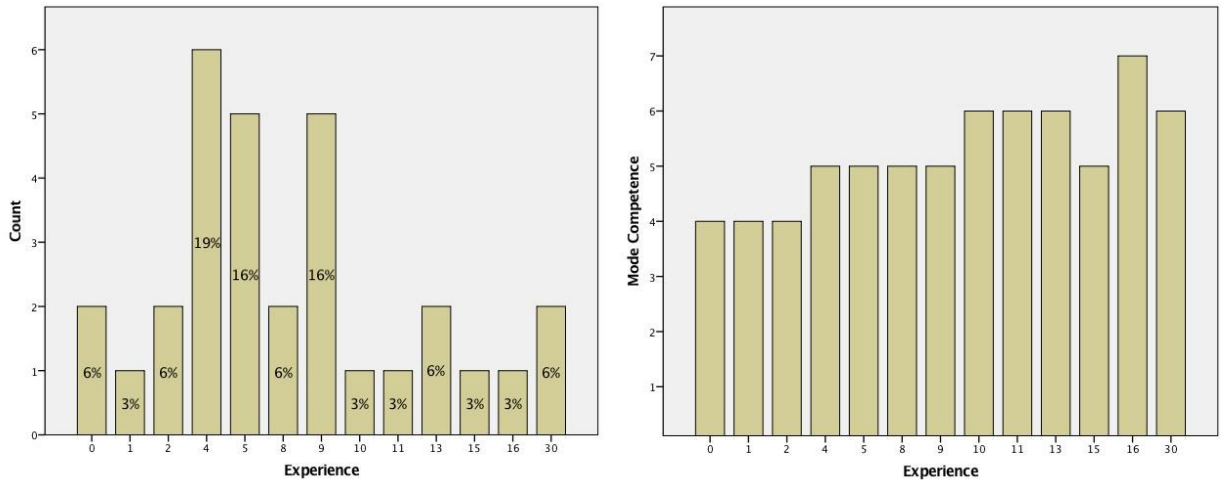


Figure 7. Distribution of experience and the competence mode across years of experience.

The mode competence The UD competence column in Table 3 shows how the informants assess their own competence with regard to universal design of ICT on a Likert scale from 1-7, where one is inadequate and 7 is excellent. Most informants report that they rate themselves based on their perception of the mean of Norwegian UD competence. The graphs in figure 9 show the distribution of self-assessed competence, 43% of the informants assess themselves as having above average UD competence. All the informant assess themselves as average or

above, the one informant who assessed himself as having very low competence said in the interview that although he probably knows more than average about UD, in a greater context "*it is like mathematics – the more you learn, the more you understand how much more there is learn*".

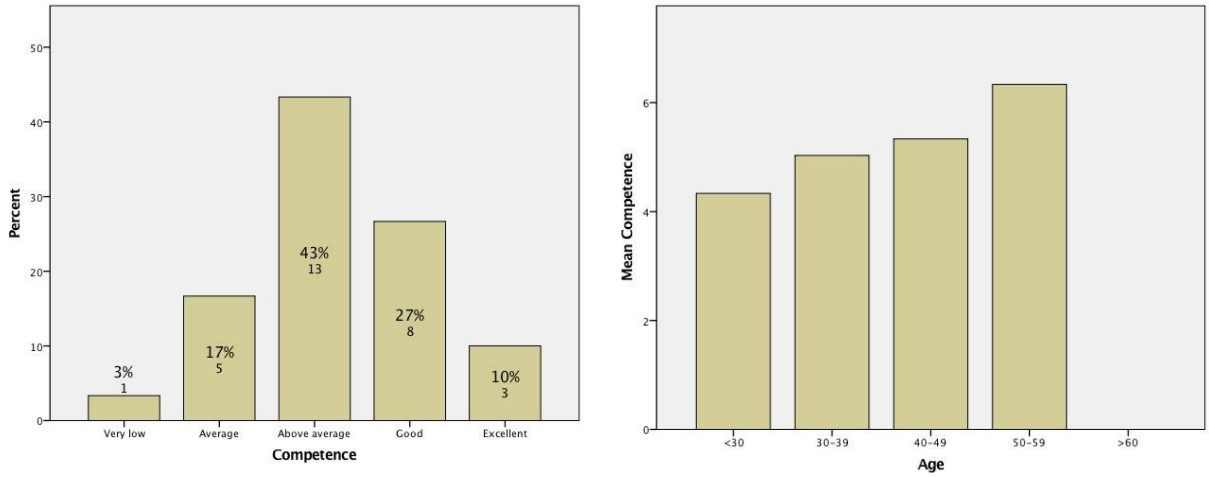


Figure 8. Distribution of competence and mean competence across age groups.

In Table 3's motivation column there are identified two batch categories, where 'Personal' motivation includes those who report or show signs of having, or always having had, a genuine interest in making design and services accessible to all. The category also includes those who think UD is a natural part of UX, and those who report school subjects as a motivation source. The 'Legislation' code refers to those reporting that legislation was their main reason for starting to work with UD. The category also includes those who name the firm, customer or client as the UD motivation source, due to assuming legislation is the firm's main motivation for imposing UD efforts from its employees and consultants. Figure 10 clarify that almost half of the informants have a personal motivation for working with UD. The total is brought up to 71 % when including those who report both codes as factors for motivation, see figure 9.

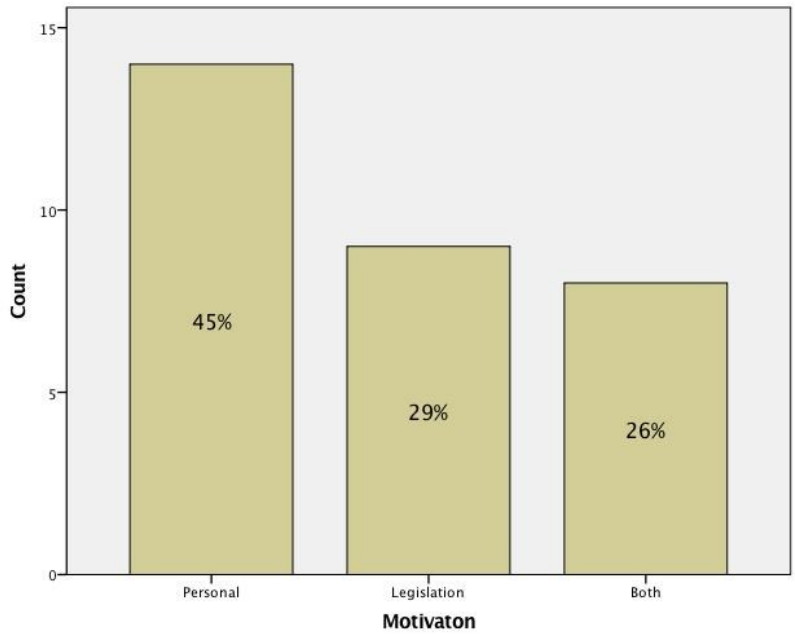


Figure 9. Distribution of reported UD motivation

4.2 Validating and Adjusting Preliminary Codes

After increasing the sample size (N) from preliminary findings, the first step is to verify whether previously identified tentative codes and categories remain consistent and relevant, or if they need to be altered, combined or renamed to better reflect the extended findings. Sample A and B are both coded into the NVivo software to gain better control of the large dataset, and help facilitate the evaluation of the codes and categories.

The codes from the preliminary analysis of sample A's responses fit with answers provided by the informants in sample B. Through categorization of coded positive and negative practices, promoting and obstructive factors are suggested. The next sections present the iterative improvement of promoting and obstructive codes, categorization and factor identifications, identified based on the larger N.

4.2.1 Promoting Codes

Four new promoting codes are identified through the increase in N. With this, the number of positive codes is increased from 150 in the pre-study to 154 with the final thesis sample. The first (code 153) about understanding *UD business value* is added to the existing category

Anchoring. Further three codes (151, 152 and 154) interpreted as promoting *external* factors are identified. One is regarding large frameworks, mainly Google and Apple, supporting and taking UD seriously, one is about a more positive angle in the general press making UD more commercial and marketable, and lastly one is on the possibilities new technology such as VR glasses and motorized wearables can affect how UD is tested and demonstrated. These are added to the category Legislation at Organizational level, which trigger an expansion of this category.

Further, a few original codes are slightly altered or expanded; Code 37 about simplification of html and not being blinded by "fancy" technologies is expanded to include simplification of content and process and not being blinded by industry "buzz words." Code 97 regarding early UD focus now also includes having a phase in the beginning dedicated to insight and research. Code 102 regarding usability in general, and about seeing a link between UD and UX, now also include service design approaches promoting UD. Code 117 about internal quality control of colleagues now include having a project participant with special UD responsibilities, while code 120 about testing at an early phase also include testing an *existing* solution to learn from it. Code 130 referring to user testing with disabled users is expanded to specify user tests with **or** without aids.

4.2.2 Obstructive Codes

Three new obstructive codes (58, 59 and 60) emerge through sample B. The codes refer to the legislation and how there may be no real consequences for not complying with it, how the WCAG standards are too extensive and thus demotivating, and how there is not enough focus on UD in public sector acquisitions, and are correspondingly identified as external factors.

Altered obstructive codes include code 4 about negative attitudes towards UD, which is expanded to include internal and external negative attitudes – such as negative press. Codes 9 about collaboration issues with graphic designers now embrace the fact that developers have more concrete requirements than designers.

Code 13 about availability includes test users, test lab and human resources, and is expanded to also include lack of availability due to geography issues. Code 33 regarding how it is

obstructing for UD when reduced cost and time is prioritized over quality now also include quantity over quality prioritizing – when having *many* features as possible is valued over having of as *good* features as possible.

Further, code 35 about lacking resources; available test users, and test lab now also includes the lack of a checklist tool for support during the process. Code 55 concerned with existing tests and tools not always taking actual user needs into account are now expanded to include informants' desire to be able to apply more discretion and common sense to WCAG requirements that do not seem logical, relevant or that users directly contradict. Finally, code 53 regarding graphic design being a priority over UD, now includes UD requirements as restraining for creativity and creative processes.

4.3 Validating and Adjusting Preliminary Categories and Levels

In order to better reflect the new content, validated coded information was iteratively adjusted and categorized. The next sections present results from the first iteration.

4.3.1 Promoting Categories and Category Levels

The three new promoting codes concerning UD promoting factors present outside the actual projects are added to the category Legislation at Organizational level. However, they are viewed as **external** factors. Thus, a new category level was identified and extracted, resulting in an added External level of promoting categories.

As such, the promoting categories are now divided into four levels, instead of the preliminary three. The final factor level categories are divided into **External**, **Organizational**, **Process** and **Individual** practices. There is one factor category on external level, four categories on organization level, six on process level and two categories on individual level. Note that codes in the category **Resources** are relevant both for organizational aspects and for specific project processes, thus the category could also be placed on process level.

The finalized categories and levels from the overall thematic analysis of UD *promoting factors* across a larger N are presented in Table 4, Table 5, Table 6 and Table 7. New codes are marked with asterisk (*) in the tables.

Category	Description	Codes
Legislation & Framework	Legislation gives priority Framework, feedback and support from both supervisory authority and large market vendors New technology as helpful tool	27, 145, 146, 147, 151*, 152*,154*

Table 4. External Level Promoting Factors

Category	Description	Codes
Top Level Understanding	UX/UD-departement UD specialist group Ensuring UD competence Disabled co-workers Good-practice library	1, 18, 20, 28, 48, 49, 64, 76, 78, 86, 89, 109, 133, 143, 149
Resources	Available ATs, Human resources, Economic resources	19, 94, 95, 96, 115
UD Anchoring	Understanding, awareness and competence at all management levels Internalized UD culture UD strategy Usability strategy	2, 6, 10, 11, 41, 45, 69, 71, 77, 79, 80, 81, 82, 83, 84, 90, 91, 102, 138, 153*
Reputation	External recognition (awards, nominations...) Presentation, conferences Visibility (internal/external)	7, 70, 73, 74, 85, 87, 88, 144

Table 5. Organizational Level Promoting Factors

Category	Description	Codes
UD Focus	Early; from needs analysis Throughout project process Requirement specification Costumer/resource priorities In solution- and UI-design Across groups; design for all UD process maturity Agency collaboration	4, 12, 47, 54, 57, 59, 60, 92, 97, 98, 99, 100, 101, 108, 148
User Focus	Personification of users (persona/user stories) Early testing – from sketch Frequent user feedback Frequent QA-inspections Test accessibility + usability Continuous low-cost formative (guerilla) testing High-quality user testing with disabled users User needs prioritized Real user feedback	5, 21, 33, 34, 35, 38, 39, 42, 43, 50, 51, 61, 62, 63, 67, 68, 93,107, 119, 120, 125, 126, 127, 128, 129, 130, 132, 150
Quality Assurance	Clear UD quality demands Test code, design, content Early code/unit quality check Milestone (planned) controls Automated validation Internal inspections (peer-inspections, basic needs, simple ATs, accessibility) External expert inspections (advanced ATs and needs)	9, 22, 23, 26, 52, 53, 56, 116, 117, 118, 121, 122, 123, 124, 134, 135, 136
Agile	Iterative development with continuous feedback Flat structure: distributed, personal responsibility	24, 25, 36, 46, 72, 103, 105, 106, 131
Cooperation	Cross-disciplinary teams Interdisciplinary design, QA, discussions and user testing Established collaboration, roles and dialogue Co-location and full team-member positions	15, 29, 30, 58, 65, 110, 111, 112, 113, 114
Simplicity	Simple/Mobile UI/code first Start with common minimum	37, 104

Table 6. Process Level Promoting Factors

Category	Description	Codes
UD Competence	Understand UD principles Across groups; universal Beyond "disability" Education/experience	8, 40, 55, 66, 142, 143, 141
Personal Qualities	Enthusiasm Empathy Innovative Collaborative	3, 13, 14, 16 17, 31, 32, 44, 75, 137, 139, 140

Table 7. Individual Level Promoting Factors

4.3.2 Obstructive Categories and Category Levels

The three new obstructive codes are placed in the category Technical Challenges, which is expanded to also cover Legislation, providing a corresponding new level for the obstructing factors; External Level Obstructive Factors. The codes associated with obstructive practices are still sorted into 6 categories, but now there are four levels instead of three; external, organization, process or individual. This result in one category at external level, one at organization level, three categories on process level and one category on individual level.

The finalized categories and levels from the overall thematic analysis of UD *obstructing factors* are presented in Table 8, Table 9, Table 10 and Table 11. The new codes are marked with asterisk (*) in the tables.

Category	Description	Codes
Technical Challenges and Legislation	Frameworks, Legislation & trends not supporting accessibility.	12, 21, 56, 57, 58*, 59*, 60*

Table 8. External Level Obstructive Factors

Category	Description	Codes
Lack of UD Anchoring	Lack of UD understanding Lack of usability culture Resistance to UD	6, 8, 10, 11, 18, 20, 24, 28, 29, 31, 42

Table 9. Organizational Level Obstructive Factors

Category	Description	Codes
Lack of UD Focus	Lack of UD focus and priority Lack of user focus Lack of UD QA	2, 17, 30, 32, 44, 45, 48
Process Issues	Lack of interdisciplinary cooperation in design & tests Sequential process model with testing and UD at the end of development process	9, 15, 20, 23, 25, 26, 27, 33, 36, 37, 38, 39, 40, 43, 46, 52, 53, 54
Constraints	Time, Economy, Resources Lacking competence Lacking test equipment User unavailability	1, 13, 16, 19, 22, 34, 35, 41, 50, 51, 55

Table 10. Process Level Obstructive Factors

Category	Description	Codes
Lack of UD Competence	Lack of knowledge and understanding Lack of interest Negativity Inexperience	3, 4, 5, 7, 14, 47, 49

Table 11. Process Level Obstructive Factors

4.4 Validating Factor Category Importance

In order to validate the importance of preliminary factor categories, a frequency analysis is performed. Through iterative transcript reviews of sample A in the pre-study, the two researchers mapped frequencies describing 1) how many informants mention codes associated with each category, and 2) how many times in total codes associated with each category were mentioned. There were a total of ten reviews completed on the 13 transcripts as part of the initial pre-study analysis; four of them coding and categorizing and six of them frequency mapping.

In order to investigate how findings from selection A acts across a larger N, Researcher 1 reviewed the 18 new transcripts in a similar fashion, using NVivo as an assistive tool to map

out frequencies across all 31 transcriptions for the entire selection (N) across the A and B samples. Each category includes multiple codes and themes, and the frequency-of-mention per category embraces all included codes in the category. Informants who were interviewed about *one* project in a group are counted as two individual informants, unless they explicitly specify contradictory views during the interview.

The following sections present and describe tables containing the summarized frequencies for each category across each selection and all the 31 transcripts; the column **mentions** refer to the number of times a category was mentioned by the informants, while the column **informants** refer to the number of informants who mentioned the category. Note that the factor categories are sorted in ascending order by highest to lowest frequency to indicate which are considered the most important.

4.4.1 Factor Categories Promoting UD

Table 12 display frequencies for promoting factor categories on an External level. The majority of the codes counted in the category **Legislation and Framework** are regarding the UD legislation, and how it works as a useful tool for getting UD prioritized. Frameworks and guidelines, such as WCAG and "The UD School" developed by DIFI, as well as feedback and support by supervisory authorities are also mentioned as promoting. Informants working with apps, rather than websites, specifically mention how frameworks by large market vendors such as Apple and Google are very helpful when it comes to UD. By using these carefully designed guidelines *"you get a lot for free"* and numerous UD considerations gets taken care of by the operating system simply by following the guidelines. One informant reflects on how newer technology, such as VR glasses and mechanical wearables, can be used to test as well as demonstrate UD issues in the time to come.

As a higher percentage of informants from selection B than from selection A mentions this category as a promoting factor, as well has an increase in mentions, this study argues that the category importance is verified across a larger N.

Category	Mentions A + B = N	Informants A + B = N	Percentage of informants in selection
Legislation and Framework	18 + 41= 59	9 + 14 = 23	A = 69 % B = 78 % N = 74 %

Table 12. External Level Promoting Frequencies

Table 13 displays frequencies at Organization level. The importance of UD **Anchoring**, mainly having UD understanding and an established internalized UD culture, as well as a UD strategy and competence at all levels, is reported as promoting by 90 % of the informants.

Next, 87 % of the informants also specifically identify the need for available **Resources**, both human, financially and related to having enough UD competence, as well as available assistive technologies (ATs).

While 84 % report having an available UD-department, specialist group or other means of internal UD quality control as important. Disabled coworkers and best practice library including UD-secured code snippets, (small region of re-usable source code,) are mentioned as examples that have been promoting for successful implementation of UD (categorized as **Top-level Understanding** because informants points to people higher up in hierarchies as responsible for making this possible).

Finally, in the **Reputation** category 29 % of the informants mention external recognition like nominations and awards as promoting for UD internally, as well as general visibility internally and externally, such as presentations and conferences.

Category	Mentions A + B = AB	Informants A + B = N	Percentage of informants in selection
Anchoring	17 + 107 = 124	10 + 18 = 28	A = 78 % B = 100 % N = 90 %
Resources	28 + 49 = 77	11 + 18 = 27	A = 85 % B = 100% N = 87 %
Top-level Understanding	18 + 35 = 53	8 + 18 = 26	A = 61. 5 % B = 100 % N = 84 %
Reputation	12 + 6 = 18	3 + 6 = 9	A = 23 % B = 33 % N = 29 %

Table 13. Organization Level Promoting Frequencies

As a higher percentage of informants from selection B than from selection A mentions all of these categories as promoting factors, this study regards the category importance as verified across a larger N.

Table 14 presents the promoting factors identified on project process level. The informants identify User Focus and continuous Quality Assurance (QA) as the most important factors on ICT project process level. Early, frequently and continuously are words used repeatedly by informants to emphasize factors related to **UD Focus, User Focus** and **Quality Assurance** at Process level. There is in general a lot of focus on including users, running usability tests, as well as testing on those with special needs. *"…UD must be present from the very beginning of development, and permeate all aspects of the project delivery".* One informant further explain how "*focus on usability in general furthers universal design, because the two walk hand in hand. It is often easier to take usability to heart, and the thought of making it usable for all. That is a good gateway to the theme of UD".*

The importance of including specific UD quality demands and requirements criteria is acknowledged. Further, 97% express the value of **Quality Assurance** (QA), some focus on external quality control such as specialized expert UD evaluation, while others mention

automated tools and internal technical code reviews. There are a total of 24 mentions regarding Blindeforbundet, Funka Nu or MediaLT as collaborators for external testing, and several projects have used them for external QA. The importance of testing design and content is also mentioned. One informant explains: *"we chose two solutions; firstly we hired a specialist at UD in front-end development who would participate in the development team to our supplier. Secondly, we used specialists in UD as external quality advisors in the development of requirements, design, UX, etc. These specialists participated either in meetings with our supplier when different solutions were discussed, or were contacted directly to check whether a proposed solution was good according to UD."*

More than two thirds of the informants promote cross-disciplinary collaboration and dialogue (**Cooperation)** that opens up for interdisciplinary problem solving; providing a bridge between those who work with design, technical code and content. Involving developers in user testing is also specifically pointed out as a positive practice, both by developers themselves and by other project roles. Participation by developers allegedly increases their UD engagement and provides first hand evidence of the difficulties experienced by disabled users, which then results in increased empathy. Participation in user testing is also acknowledged as positive for other roles, particularly management roles, because it provides an understanding and empathy for disabled users, but is not as clearly emphasized.

Informants also report an intention to integrate UD in all the phases of development; from planning and requirements to design and coding, as well as user and technical testing. Less than half of the informants mention the category **Simplification.** Those who do, mention simplification of the ICT solution itself as useful, simplifying the process, using simple or easy tools or altering the requirements to make them more accessible to the team as promoting. They were asked if they used an **Agile** answer that the project used an iterative or agile process . Several mention a hybrid approach to agile development, using agile elements like an iterative process with continuous feedback, without strictly following any agile methodology. Having a flat structure, and personal responsibility, is also mentioned as positive in this category.

Category	Mentions	Informants A + B = N	Percentage of informants in selection
User Focus	53 + 78 = 131	12 + 18 = 30	A = 92 % B = 100 % N = 97 %
Quality Assurance	37 + 49 = 86	12 + 18 = 30	A = 92 % B = 100% N = 97 %
UD Focus	59 + 76 = 135	12 + 17 = 29	A = 92 % B = 94 % N = 93.5 %
Cooperation	37 + 31 = 68	11 + 14 = 25	A = 85 % B = 78 % N = 81 %
Simplification	6 + 23 = 29	5 + 9 = 14	A = 38% B = 50 % N = 45 %
Agile	10 + 16 = 26	5 + 9 = 14	A = 38 % B = 50 % N = 45 %

Table 14. Process Level Promoting Frequencies

At this level there is one of the categories that does not have a higher percentage of informants mentioning it in selection B than in selection A. **Cooperation** has a lower percentage in selection B, however as there is still 14 out of 18 informant who mention it, and these are answers to open-ended questions that does not provide possible answers, 78 % of the informants is still a strong indication as to the category's importance. Therefore this category is still verified across a larger N with the others.

Table 15 shows promoting factors on Individual level. All the informants mention in some way that you need at least one person with a strong professional UD enthusiasm to increase UD competence and engagement within the team and for the stakeholders. Some **Personal Qualities** are identified for people working on projects linked to UD successes; Empathy,

Enthusiasm a positive interest in UD and an openness to learn and evolve. All of the informants mention or show signs of possessing these qualities themselves during the interview.

Sufficient availability if **UD Competence** is stressed again. Key participants such as project owner, designers and developers need to have a holistic understanding of UD rather than a strict legislation and WCAG criteria focus.

Category	Mentions	Informants A + B = N	Percentage of informants in selection
Personal Qualities	25 + 32 = 57	13 + 18 = 31	A = 100% B = 100% N = 100%
UD Competence	34 + 51 = 85	11 + 15 = 26	A = 85 % B = 83 % N = 84 %

Table 15. Individual Level Promoting Frequencies

At this level, we find that **UD Competence** has a lower percentage in selection B, however it is a slight difference of 2 %, and as 83% is still a strong indication as to the category's importance. This category is therefore still verified across a larger N.

There seem to be a widespread conception among the informants that it is necessary to be motivated to ensure usability for all. There are several mentions of overlapping user needs and how UD benefits **all,** including individuals without impairments. Examples such as everybody benefitting from adaption to mobile technologies or small adjustments made for general user experiencing challenges in contexts of use e.g. by ensuring proper contrast the reading experience is also improved on mobile devices in sunlight. One informant says: "*In my experience, it is effective to compare UD to usability in general, and to look at it from an elevated perspective where UD is not simply about having 'visually impaired or blind people also able to use a website'. UD is the other side of usability, and when you focus on UD, you also focus on usability – that way the solution becomes better for everyone.*"

This notion is further validated by question four in the interview guide, where the informants were asked if they work with UD, and regard it as a separate discipline/field or if they considered it as an additional qualification/competence associated with their reported main discipline. Only one sole informant reported to regard UD as a separate discipline, while the remaining 30 all regard UD as an additional competence.

4.4.2 Factor Categories Obstructing UD

Tables 16, 17, 18 and 19 summarize the frequencies for practices obstructing UD mentioned in the interviews. First Table 16 presents the frequencies on an External level. The focus in this category is mainly on the **Legislation** being too complex, and difficult to follow. One informant describe that the first impression of the WCAG standards as a "*wall of text,"* that can be very overwhelming if presented without any processing of the requirements first e.g like "the UD school" by DIFI.

A couple of the informants also mention that there is no actual consequence for not complying with legislation, while four informants mention how the press sometimes writes about UD with a rather negative angle, for example that they focus on economical and cost concerns instead of the positive effects UD is aiming to accomplish.

Technical challenges such as frameworks or trends that do not support UD principles are also mentioned. One informants claim the whole concept of the WCAG standards is rather backwards, and that it is pointless to have 2 million developers around the world fix the same problems individually, when the web browser itself could in fact solve the problem. The point is further illustrated by how we today zoom in on a website using a built in function in the browser, instead of adjusting the font size manually.

Selection B has a higher percentage of informants mentioning it, than the preliminary study and the category importance is thus regarded as valid across a larger N.

Category	Mentions	Informants A + B = N	Percentage of informants in selection
Legislation + Technical Challenges	5 + 20 = 25	4 + 9 = 13	A = 31 % B = 50 % N = 42 %

Table 16. External Level Obstructive Frequencies

Table 17 presents the frequencies on an Organizational level, showing that a **Lack of UD Anchoring** on top levels is mentioned most frequently as obstructive for UD. Nearly all the informants indicate that if there is a lack of understanding or a resistance to UD, a UD-culture cannot develop in the organization, resulting in the likelihood that UD is not prioritized. Consultants refer this responsibility to the customer, while internal employees point upwards at upper management.

At this level, we find that **Lack of UD Anchoring** has a lower percentage in selection B, however, as 83% is still a strong indication as to the category's importance. This category is therefore still verified across a larger N.

Category	Mentions	Informants A + B = N	Percentage of informants in selection
Lack of UD Anchoring	26 + 32 = 58	13 + 15 = 28	A = 100 % B = 83 % N = 90 %

Table 17. Organizational Level Obstructive Frequencies

Table 18 shows that 93,5 % informants report concerns about resource **Constraints**, which might be construed as a consequence of the factor lacking UD anchoring found in Table 17. The informants indicate that constraints limit the capability to succeed with UD. Time and economic constraints are most frequently mentioned as important obstructive factors in this category. Further they identify available UD competent human resources and available test resources, including user unavailability, as obstructive.

Process Issues are mentioned by 74% informants, and they especially warn against sequential processes where UD is introduced late in the process, with little to no testing or quality

assurance at an early stage. Cooperation between different disciplines is pointed to as a very obstructive factor if it is lacking. Requirements are reported as vaguer for designers than developers; specifically for interaction designers who are concerned with technical aspects, as well as content and graphic design. This makes it difficult to allocate responsibilities across the non-technical disciplines. Lastly, a **Lack of UD Focus** is reported as obstructive by 71 %. This category includes general lack of UD focus and priority, user focus and UD quality assurance (QA) such as user testing or external expert evaluations.

As a higher percentage of informants from selection B than from selection A mentions all of these categories as promoting factors, this study regards the category importance as verified across a larger N.

Category	Mentions	Informants A + B = N	Percentage of informants in selection
Constraints	23 + 71 = 94	11+ 18 = 29	A = 85 % B = 100% N = 93.5 %
Process Issues	20 + 31 = 51	8 + 15 = 23	A = 61.5 % B = 83 % N = 74 %
Lack of UD Focus	18 + 17 = 35	8 + 14 = 22	A = 61.5 % B = 78 % N = 71 %

Table 18. Process Level Obstructive Frequencies

Lack of UD Anchoring at an Organizational level and **Lack UD Focus** at Process level are closely tied to **Lack of UD Competence** presented in Table 19 at an Individual level. As prioritizing of UD and sufficient resources are reported as necessary in ensuring that proper knowledge and skills are allocated to the employees. More than two thirds of the informants mention that a lack of knowledge and experience with UD will damage the team's ability to implement UD. Several informants exemplify how lacking knowledge about UD often is manifested in resistance and counterarguments such as "*why do we have to spend time on this when it only applies to 1% of the users*" and "*there are only 1000-1200 blind people in the country, why on earth should we do this?*"

As a higher percentage of informants from selection B than from selection A mentions this category as promoting, this study regards the category importance as verified across a larger N.

Category	Mentions	Informants A + B = N	Percentage of informants in selection
Lack of UD Competence	23+ 27 = 50	9 + 15 = 24	A = 69 % B = 83 % N = 77 %

Table 19. Individual Level Obstructive Frequencies

Collectively the participants seem to be in overall agreement, and mention a lot of the same categories despite open-ended questions. In order to further investigate possible differences between disciplines and/or companies, cross tabulations were run in the SPSS software across all categories, see Appendix F. The cross tabulations show that the participants to a large degree seem to agree despite differences in disciplines and companies, and that there is no apparent sign of noticeable deviations (disagreements) across the cases.

4.5 Identifying Key Promotive and Obstructive Factors

Using the previously presented categorization in Tables 12 through 19, the average and the median is calculated for the promoting and obstructive factor categories. The categories with a number of informants above the mean, is in this study regarded as indicators of critical success factor categories (CFS categories). When sorted by number of informants, the average number who mention promoting categories are $\approx$ 24 informants, the mean is 26 informants. The obstructing categories have an average of 23 informants, and the mean is 23.5. Key factors should therefore be within factor categories that are mentioned by more than the average informant mention. The colored promoting and obstructing factor categories in Table 20 indicates key factor presence.

Promoting Category	Number of Informants
Personal Qualities (Individual level)	**31**
User Focus (Process level)	**30**
Quality Assurance (Process level)	**30**
UD focus (Process level)	**29**
Anchoring (Org. level)	**28**
Resources (Org. level)	**27**
UD Competence (Individual level)	**26**
Top-level Understanding (Org. level)	**26**
Cooperation (Process level)	**25**
Legislation and Framework (External level)	**23**
Simplification (Process level)	**14**
Agile (Process level)	**14**
Reputation (Org. level)	**9**

Obstructing Category	Number of Informants
Constraints (Process level)	**29**
Lack of UD Anchoring (Org. level)	**28**
Lack of UD Competence (Individual level)	**24**
Process Issues (Process level)	**23**
Lack of UD Focus (Process level)	**22**
Legislation + Technical Challenges (External level)	**13**

Table 20. Colored categories indicate promoting and obstructing key factors placement

As mentioned in the data analysis section 3.5.3, a frequency threshold is determined for key and critical success factors in this study. A factor must be mentioned by at least two thirds of the informants to qualify as a key factor, as well as being mentioned on average more than twice by each source, i.e. more than 40 times. Due to so many of the factors being mentioned frequently, the initial cut-off for inclusion was further increased to 50 mentions in order to clearly identify the most critical factors. Consequently a category should be mentioned more than 50 times and by at least 21 sources in order for the factor to be categorized as key to UD success. The resulting key factor categories using these criteria are displayed in Table 21.

Key factors after adding number of mentions as criteria are presented in the colored areas in Table 21. The colored factor categories in Table 20 and 21 have a nearly perfect overlap. All the categories indicated as holding key factors (mentioned by more than 24 informants) remain critical when applying the key (critical success factor) threshold (mentioned more than 50 times by above 2/3 of informants) and only one new factor category is added (Legislation and Framework).

Promoting Category	Informants	Mentions
Personal qualities (Individual level)	31	57
User focus (Process level)	30	131
Quality Assurance (Process level)	30	86
UD focus (Process level)	29	135
Anchoring (Org. level)	28	124
Resources (Org. level)	27	77
UD Competence (Individual level)	26	85
Top-level understanding (Org. level)	26	53
Cooperation (Process level)	25	68
Legislation and Framework (External level)	23	59
Simplification (Process level)	14	29
Agile (Process level)	14	26
Reputation (Org. level)	9	18

Obstructing Category	Informants	Mentions
Constraints (Process level)	29	94
Lack of UD Anchoring (Org. level)	28	58
Lack of UD Competence (Individual level)	24	50
Process Issues (Process level)	23	51
Lack of UD Focus (Process level)	22	35
Legislation + Technical Challenges (External level)	13	25

Table 21. Colored categories indicate promoting and obstructing CSF categories.

4.6. Organizing the data: Re-labeling and Re-categorization

In order to identify key factors, individual data transcript cases are analyzed and compared to detect patterns and recurring thoughts and concerns among the informants. This process was initiated by Researcher 1 in the preliminary study (Harder, 2016), and continued in collaboration with Researcher 2 as presented in (Harder and Begnum, 2016). This process was re-iterated by Researcher 2 during a bottom-up code re-organization. Researcher 2 is the lead re-organizer of the data, but resulting re-organization and labeling was discussed with Researcher 1 (thesis author) prior to finalization. The thesis author in collaboration with Researcher 2 thus presents the results in 4.6 as background for 4.7 and 4.8.

4.6.1 Re-categorization by Researcher 2

In the preliminary analysis, similar codes from both researchers were merged into categories but kept as separate codes. This creates the problem of duplicate codes for the data set and means the data is only accurate on category-level as there may be multiple overlapping codes available. After coding using the initial coding list, all the content related to each code was therefore re-analyzed by Researcher 2 in order to verify the data belonging to each code, and the overlap between codes. Through merging nodes (codes), dual references are removed, making the frequency of mention more reliable. The basis for the re-organization was the codes and categories presented in 4.2 and 4.3 and entered into NVivo by Researcher 1.

Simultaneously and iteratively, the process of categorization was approached. Preliminary categories were re-investigated in order to better reflect the new data. Codes overlapping and pointing to the same themes were re-grouped or merged into new categories, creating a consistent hierarchy of themes.

The topic of priority and focus could be found on both Organizational and Project level, but was overlapping. Thus, they needed to be re-categorized. The Organizational level was deemed most fitting for these factors, related to Anchoring UD values, under the sub-category of priority and focus. It should be noted this category spans top-level management, costumer views and project management. Only codes related directly to budget and time resource priorities were kept on Project level, in the Resource category.

During this process, the new identified factor level was also added – the External level. The promoting factor category Legislation and Framework and the negative factor category Legislation + Technical Challenges classified as external were split into more nuanced categories based on the codes. Further, Individual factors were categorized in more detail and Project factors were re-organized. The final categorization can be seen in Figure 6. The color scheme used in Figure 6 is yellow for external, blue for organizational, red for project and green for Individual level factors.

4.6.2 Identification of Hygiene and Motivational Factors

During the re-categorization process, the relationship between promoting (positive) and obstructing (negative) factors was re-investigated. Now, the focus was to look for factors that may be on a scale from positive to negative (tentative hygiene factors). Positive factors were initially assessed as hygiene factors if opposite or overlapping negative factors could be identified, thus viewed as basic indicators of success likelihood by Researcher 1 and as necessary on a certain presence level by Researcher 2. Positive factors were initially considered motivators if no opposite negative factors could be identified, and viewed as drivers. Negative factors with no opposite positive factors were similarly viewed as limiting. No such limiting de-motivators were identified. However, the analysis showed that also driving motivators – factors that are promoting UD if present, regardless of the degree of presence – were described by informants as obstructive if non-present.

Thus, Researcher 2 continued to independently explore which factors are hygiene and motivators, using a more nuanced interpretation of hygiene and motivators. The interpretation at the time of writing this thesis corresponds to the section on Herzberg's two-factor theory in the thesis background chapter. Hygiene (or maintenance) factors are those factors evaluated as needing to be present to not cause dissatisfaction. Motivators (motivational factors) however increase satisfaction by being present on any level. Researcher 2's final hygiene and motivators identification is indicated in Figure 10: hygiene factors are in black text, while motivators are presented in colored text.

Figure 10. Re-organized data, CSFs, Hygiene factors and Motivators by Researcher 2

4.6.3 Re-labeling the categories

Factor categories and their sub-categories were re-named to better reflect relationships between promoting and obstructing factors. For example, the previous categories named Constraints (obstructive) and Resources (promoting) on Project level were now labeled Lacking Resources and Enough Resources.

In addition the level Process was re-labeled Project, as all the content in the re-organized data is project related, but not all is process related. This resulted in the following four final factor levels: External, Organizational, Project and Individual. Final labeling is included in Figure 6. Figures 11-18 are the NVivo frequencies for all factors in the final data categorization.

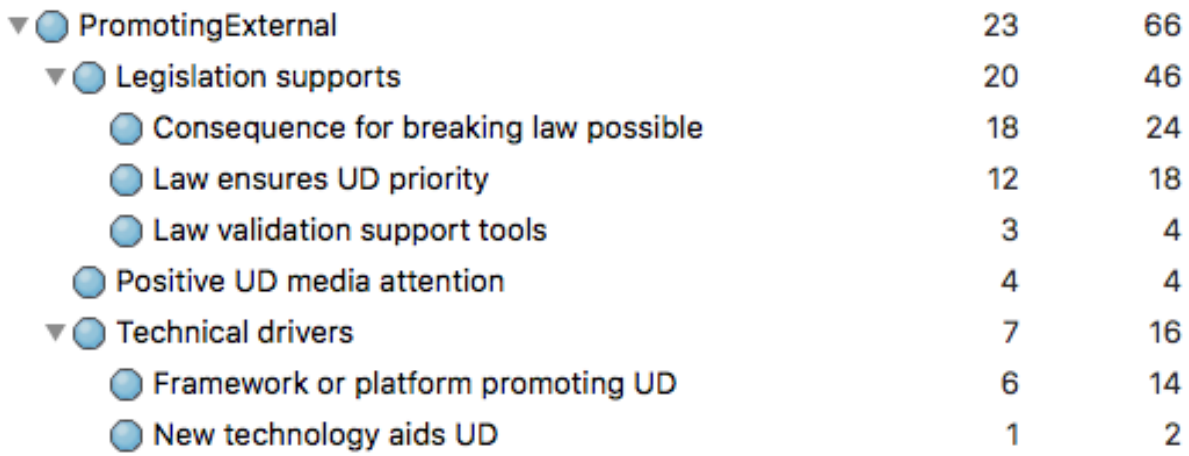


Figure 11. Re-categorized Promoting Factors at External level

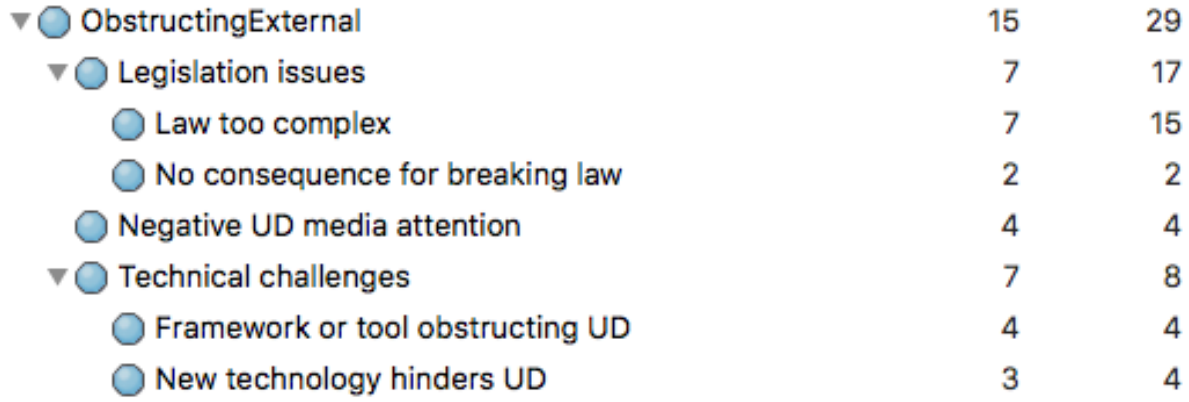


Figure 12. Re-categorized Obstructing Factors at External level

Figure 13. Re-categorized Promoting Factors at Organizational level

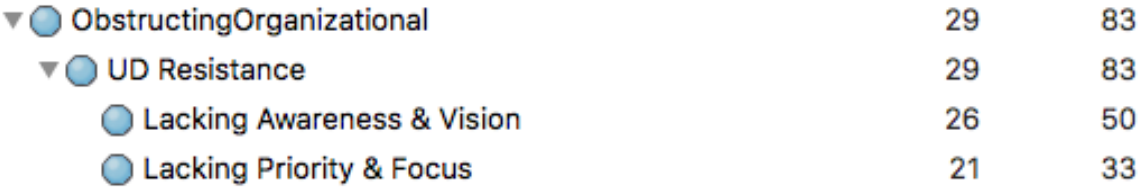


Figure 14. Re-categorized Obstructing Factors at Organizational level

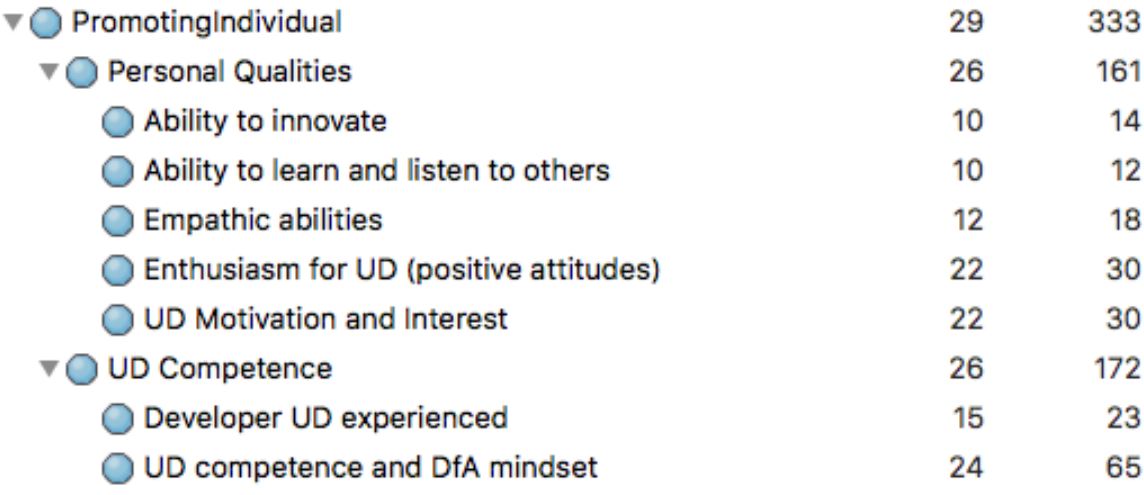


Figure 15. Re-categorized Promoting Factors at Individual level

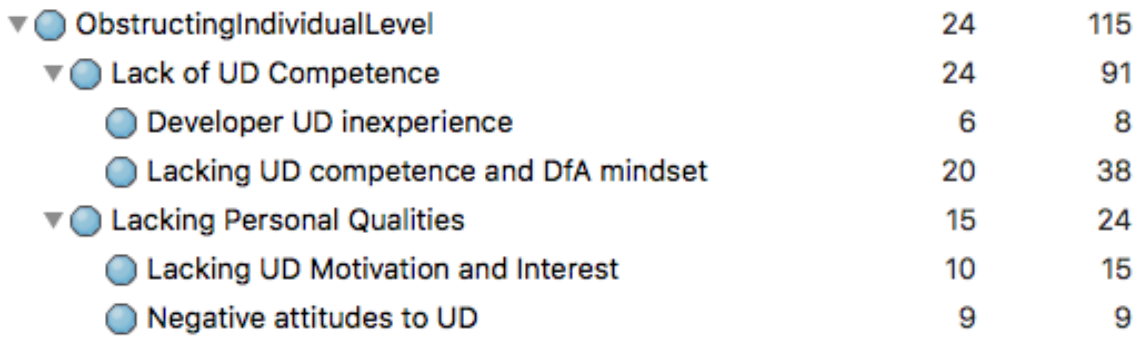


Figure 16. Re-categorized Obstructing Factors at Individual level

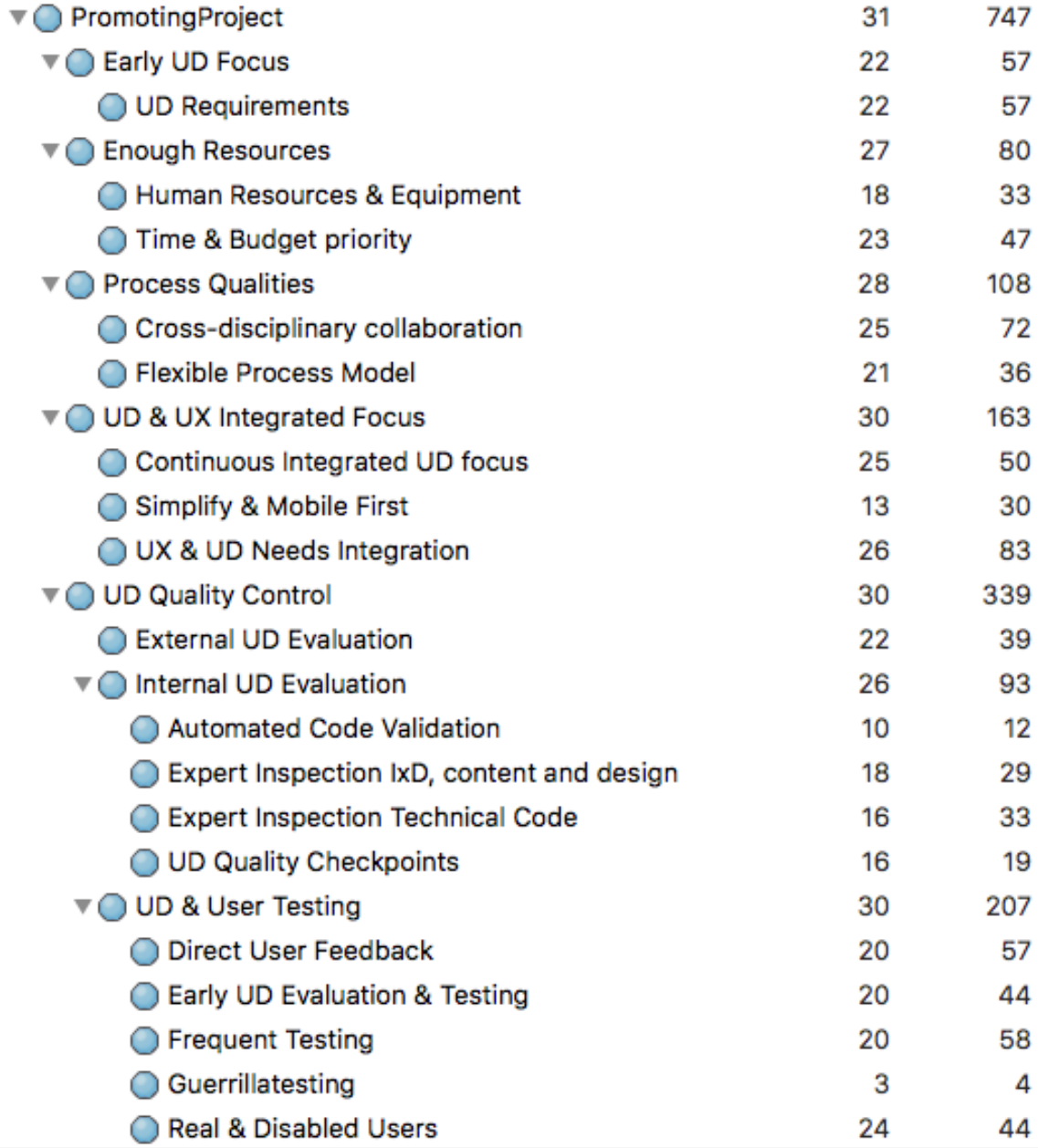


Figure 17. Re-categorized Promoting Factors at Project level

Figure 18. Re-categorized Obstructing Factors at Project level

4.7 Identifying Critical Success Factors

The critical success factor (CSF) criteria was applied to the new data organization in order to highlight which factors could be regarded as critical for UD success in Norwegian ICT-projects.

As specified in section 3.5.3, if a promoting factor is selected as key, the corresponding obstructive factor pointing to the lack of said factor, is also included as key even if not selected on its own, and vice versa. In other words, factors viewed as being either positive or negative depending on presence (motivators) or level of presence (hygiene factors) is considered CSFs if either obstructive or promoting factor frequencies fulfill CSF criteria.

The key factors are determined on the lowest possible categorical level where both the CSF selection criteria is present, in order to be as specific as possible. Thus, if a sub-category factor is fulfilling CSF criteria, the parent umbrella category is not usually highlighted as a CSF. However, if no single sub-category or factor is identified, but the overall category fulfills CSF criteria, the overall category is considered a key factor.

The identified CSFs and CSF categories used in the self-assessment tool are visualized in Figure 10 through being **bold**. The following CSFs are identified:

1) UD Awareness & Vision
2) UD Priority & Focus
3) UD Motivation & Interest
4) Enthusiasm for UD (positive attitudes)
5) Time & Budget Priority
6) Human Resources & Equipment
7) UD Competence & Design for All (DfA) mindset
8) Continuous Integrated UD Focus
9) UX & UD Needs Integration
10) Internal UD Evaluation
11) UD & User Testing
12) Cross-disciplinary Collaboration
13) UD Competence development
14) UD Requirements
15) External Promoting Factors

4.8 Developing a Self-assessment Tool for UD CSFs

The second part of this study, a predictive self-evaluation tool specific for UD in IT-projects (2) is prototyped, as a collaborative process between the two researchers.

4.8.1 Universal Design (UD) Critical Success Factor (CSF) Evaluation Tool: Draft 1

Researcher 1 created an initial prototype based on the key factor categories identified in part one of this study. This tool was heavily influenced by the PEVS evaluation scheme by Andersen, Dyrhaug and Jessen (2006), and consisted of seven questions aiming to indicate or predict how well a project is equipped to successfully implement UD. In order to do that the seven questions were designed with the intention of uncovering the project's status relative to the factors identified as key success factors in 4.5, using a Likert scale giving 0 to 6 points per question. The first draft of a UD success factor self-assessment tool is presented in Figure 19.

UNIVERSAL DESIGN (UD) CRITICAL SUCCESS FACTOR (CSF) EVALUATION

Indicate where your current project is on the scale:

		Agree					Disagree
1.	The requirement specifications specifically mentions UD, and there is early and continuous focus on UD in the project.	1	2	3	4	5	6
2.	The project has clear user focus, and frequently uses methods such as user testing (high- or low quality), accessibility testing with disabled users, user feedback and/or QA-inspections.	1	2	3	4	5	6
3.	There is a common understanding and anchoring of UD, and usability culture, at all management levels; resulting in an internalized UD culture and/or specific UD strategy.	1	2	3	4	5	6
4.	There are internal inspections (peer-inspections, simple assistive technologies, accessibility), external expert inspections (with advanced assistive technologies and needs), early testing, automated validation of code and/or QA for both design and content in this project.	1	2	3	4	5	6
5.	The team has UD competence – they understand and have experience with UD principles. The goal and focus is on making design accessible for everyone.	1	2	3	4	5	6
6.	The team have the resources they need to ensure UD, including human and economic resources, as well as equipment for user testing such as available assistive technologies	1	2	3	4	5	6
7.	The project team is cross-disciplinary and co-located, open for discussions and cooperation. Roles are clearly defined and there is room for dialogue.	1	2	3	4	5	6

Sum: _____ **Number of responses:** _____ **Mean:** _____ ,_____

Figure 19. The first version of the self-assessment tool based on key factors and the PEVS scheme.

4.8.2 Universal Design (UD) Critical Success Factor (CSF) Evaluation Tool: Draft 2

The tool is then peer-reviewed and revised by the second researcher, based on the CSF analysis in 4.7. The revised tool increased question specificity related to the CSF content, and revises the scoring system. Ten questions were formulated by Researcher 2 based on Researcher 1's formulations, were seven main questions are scored 0, 1 or 2 points based on compliance, while three bonus questions each give an additional point if fulfilled.

4.8.3 Universal Design (UD) Critical Success Factor (CSF) Evaluation Tool: Draft 3

Upon review against the CSFs it was detected that in Draft 2 no main questions points to UD Quality Control CSFs. Thus, a third draft was created to better reflect CSFs. Seven main questions were formulated and four bonus questions, and the same scoring model as Draft 2 was applied.

In Draft 3, Question 1 of the main questions in is on Organizational level, and one of the bonus questions. The Organizational level main question is a motivator, spanning both UD Awareness & Vision CSF 1 and UD Priority & Focus CSF 2 in the category UD Anchoring. The extra-point a) is on UD Competence Development CSF 13, in the UD Strategy category.

Another of the main questions is on Individual level, and another of the bonus questions. The main Question 4 is the hygiene CSF 7 on UD Competence and DfA mindset in the category UD Competence, and also touches on the non-CSF Developer UD experience in the same category. The bonus question b) spans the motivators CSF 3 UD Motivation & Interest and the CSF 4 Enthusiasm for UD, both belonging to the Personal Qualities category.

The other five main questions and the last extra point are on Project level. Two main questions reflect project hygiene factors. CSF 5 Time & Budget Priority and CSF 6 Human Resources & Equipment are combined into Question 3 on Enough Resources. CSF 12 Cross-disciplinary Collaboration is the last key hygiene factor, in Question 7 on Process Qualities. The last extra point c) reflects the hygiene non-CSF factor Flexible Process Model, also in the category Process Qualities.

The final three main questions reflect Project level motivators. Question 5 is on CSF 9 UX & UD needs integration and CSF 8 Continuous Integrated UD Focus in the UD & UX Integrated Focus category. Question 6 spans CSF 10 Internal UD Evaluation and CSF 11 UD & User Testing with an emphasis on the CSF Real & Disabled Users, and the formulation also mention the non-CSF External UD Evaluation. Motivator CSF 14 UD Requirements is reflected in Question 2 along with its category Early UD focus. The formulation in Question 2 is also touching upon the CSF 2 UD Priority & Focus. Finally, bonus question d) is a non-CSF Project level motivator External UD Evaluation. The category UD Quality Control is quite extensive and encompasses many CSFs, but had previously not been given sufficient focus. Through adding both a main and a bonus question, its focus is strengthened.

Researcher 2 evaluated this third version of the UD-CSF evaluation tool (UD-CSF v3) against the codes from each interview transcript. This test was not a proper self-assessment test, because the test was performed by a researcher, and not the project participants themselves. Also, in several interviews the informants had participated in several successful projects, and referred to their combined experienced in these included projects. Thus, in the evaluation many projects could not be evaluated as single projects, but rather as combined projects. As such, it was merely meant as a preliminary investigation into the accuracy of the tool, as sort of a regression test. Table 22 displays the resulting test scores from assessing each projects based on the informants responses, where the projects referred to in the evaluation are visible on each row, and likewise the informant numbers are displayed.

Project	No	Q1	Q2	Q3	Q4	Q5	Q6	Q7	a	b	c	d	Sum:
1	8, 10	2	2	1	1	1	2	2	1	1	1	0	14
2	9, 21	2	2	2	2	2	1	1	0	1	1	1	15
3	11, 12	1	0	2	1	1	1	2	1	1	1	1	12
4, 8, 9, 21	3, 5, 7	1	1	1	2	2	1	2	0	1	1	1	13
5, 11	1, 2	1	2	1	2	1	2	2	0	1	1	1	14
6	20	1	0	0	2	1	2	1	0	1	1	0	9
6, 7	13	0	0	0	2	2	2	2	0	1	1	0	10
8	22, 23	1	1	2	1	1	2	1	0	1	1	0	11

Project	No	Q1	Q2	Q3	Q4	Q5	Q6	Q7	a	b	c	d	Sum:
10	4	1	2	0	1	2	2	1	0	1	1	1	12
1, 12	6	1	2	2	2	2	2	2	1	1	1	1	17
13	25, 26, 31	2	0	2	2	2	1	1	0	1	1	1	13
14	18, 24	2	1	2	2	2	2	1	1	1	1	1	16
15	14, 15	2	2	1	1	2	2	2	1	1	0	1	15
16	16, 17	2	0	2	1	2	2	2	0	1	1	1	14
17, 18	27	2	1	2	1	2	2	1	1	1	0	1	14
19	29, 30	1	2	1	2	2	1	2	1	1	0	1	14
20	19, 28	2	2	2	2	2	2	1	0	1	1	1	16
	Sum:	24	20	23	27	29	29	26	7	17	14	13	

Table 22. UD-CSF v3 evaluation by Researcher 2 based on coded interview transcripts

Looking into the included success project scores from the sample, Researcher 2 noted that bonus question a) containing CSF 13 UD Competence Development seemed less important than the other extra points. However, as this question is based on a CSF, the decision was made to keep it as a bonus question.

Further, based on the scores it was evaluated as positive to keep the d) non-CSF on external expert evaluations as an extra point question.

It was however decided to attempt changing the bonus question b) on CSFs 3 UD Motivation & Interest and 4 Enthusiasm for UD on Individual level to a main question, as this was the highest scoring extra point item.

Finally, Question 2 on the CSF 14 UD Requirements was switched from a main question to an extra point, as it is the main question giving the lowest points. This may be due to it being a very narrow and specific question, and it should thus fit as an extra point.

4.8.4 Universal Design (UD) Critical Success Factor (CSF) Evaluation Tool: Draft 4

Based on her expert evaluation, and in conference with Researcher 1, the second researcher drafted a fourth UD-CSF evaluation form. Here, Question 1 consists of the two motivational factors in the UD Anchoring category on organization level *CSF 1 UD Awareness and Vision* and *CSF 2 UD Priority and Focus.* Question 2 covers the Personal Qualities individual motivational factors *CSF 3 UD motivation and interest* and *CSF 4 Enthusiasm for UD (positive attitudes).* Question 3 in the evaluation form covers the two hygiene factor on Project level in the category Enough Resources, namely *CSF 5 Time and Budget Priority* and *CSF 6 Human Resources and Equipment.* Question 4, also a hygiene factor but on Individual level in the UD Competence category, covers *CSF 7 UD Competence and DfA mindset.* This question formulation is still overlapping some to the non-CSF Developer UD Experience in the same category.

Question 5 is on two motivational factors, *CSF 8 Continuous Integrated UD Focus* and *CSF 9 UX and UD Needs* Integration, both on Project level in the category UD & UX Integrated Focus. Question 6 also refers to two motivational factors on Project level in the category UD Quality Control, *CSF 10 Internal UD Evaluation* and *CSF 11 UD and User Testing.* Question 7 covers the hygiene *CSF 12 Cross-disciplinary Collaboration*, on Project level in the Process Quality category.

Bonus points can be added a) for the motivational factor *CSF 13 UD Competence development* in the category UD Strategy on Organizational level, b) the motivational *CSF 14 UD Requirements* in the category Early UD Focus on project level, c) the hygiene factor, but not CSF due to lack of mentions *Flexible Process Model* and d) the motivational factor, but not a CSF due to lack of mentions External *UD Evaluation.*

In order to verify that ICT projects affiliated with success received high scores using the self-assessment tool, the final prototype was re-evaluated against the interview transcripts the tool was based on. The re-evaluation against transcriptions results in a better score distribution in UD-CSF v4 compared to UD-CSF v3. The results are displayed in Table 23.

Project	No	1	2	3	4	5	6	7	a	b	c	d	Sum:
1	8, 10	2	2	1	1	1	2	2	1	1	1	0	14
2	9, 21	2	2	2	2	2	1	1	0	1	1	1	15
3	11, 12	1	2	2	1	1	1	2	1	0	1	1	13
4, 8, 9, 21	3, 5, 7	1	2	1	2	2	1	2	0	1	1	1	14
5, 11	1, 2	1	2	1	2	1	2	2	0	1	1	1	14
6, 7	13, 20	1	2	0	2	2	2	2	0	0	1	0	12
8	22, 23	1	2	2	1	1	2	1	0	1	1	0	12
10	4	1	2	0	1	2	2	1	0	1	1	1	12
1, 12	6	1	2	2	2	2	2	2	1	1	1	1	17
13	25, 26, 31	2	2	2	2	2	1	1	0	0	1	1	14
14	18, 24	2	2	2	2	2	2	1	1	1	1	1	17
15	14, 15	2	2	1	1	2	2	2	1	1	0	1	15
16	16, 17	2	2	2	1	2	2	2	0	0	1	1	15
17, 18	27	2	2	2	1	2	2	1	1	1	0	1	15
19	29, 30	1	2	1	2	2	1	2	1	1	0	1	14
20	19, 28	2	2	2	2	2	2	1	0	1	1	1	16
	Sum:	24	33	23	27	29	29	26	7	12	14	13	

Table 23. UD-CSF v4 evaluation by Researcher 2 based on coded interview transcripts

With UD-CSF v4, all included projects score more consistently across the questions and extra points (vertical sum column in Table 23) than in UD-CSF v3. Also, all main questions provide consistently high scores across the projects (horizontal sum row in Table 23). If the expert evaluation completed by Researcher 2 corresponds to how informants would self-assessment score the individual projects, the tool seem to be successful in measuring compliance to CSFs.

The minimum score through the self-assessment tool is 0 points, and the maximum possible score is 18 points. UD-CSF scores range from 12 to 17 in the sample of ICT-projects that have achieved UD successfully. Based on this, the following evaluation thresholds were suggested by Researcher 2: 0-5 points as indicative of UD unsuccessfulness, 6-11 points as indicative of unlikeliness to win UD awards and praise, but not necessarily indicating UD failure and 12-18 points as indicative of high UD quality.

The UD-CSF v4 evaluation form, shown in Figure 20, was thus handed over to Researcher 1 for testing.

UNIVERSAL DESIGN (UD) CRITICAL SUCCESS FACTOR (CSF) EVALUATION

Indicate if your project fulfills the UD critical success factors on the scale:

	Disagree		Agree
1. There is a common understanding of UD in the project team and at all management levels (including any costumer), and achieving UD is supported and viewed as positive.	0	1	2
2. The team has at least one person enthusiastic about UD, having a personal interest and motivation for ensuring universal usability.	0	1	2
3. The team has all the resources needed to ensure UD criteria; adequate time, budget and human resources; including access to assistive technologies, users and external competence.	0	1	2
4. The team has relevant UD competence and experience, e.g. UD principles in coding, IxD, content & visual design. Focus is on making design accessible and usable for everyone.	0	1	2
5. UD perspectives are integrated into all project activites; design, coding, UX/UCD & needs.	0	1	2
6. UD aspects are early and continously evaluated throughout the project, both through expert inspections and through user testing and real-user feedback including persons with disabilities.	0	1	2
7. The team embraces cross-disciplinary collaboration, open discussions and dialogue.	0	1	2

Bonus points:

A strategy for developing the UD competence in a team or organization. Add +1.
Requirement specification includes criteria for UD, ensuring early and continuous focus. Add +1.
An iterative or flexible process model, utilizing feedback from UD evaluations. Add +1.
Extending internal evaluations with external inspections adds to UD quality control. Add +1.

Sum: _____

0-5 points: Your project is not fulfilling critical success factors for universal design, and is likely to struggle to achieve universal design.
6-11 points: Your project mostly fulfills critical success factors for universal design, but is unlikely to win universal design awards.
12-18 points: Your project fulfills most or all critical success factors, and is expected to achieve excellent universal design quality!

Figure 20. Universal Design (UD) Critical Success Factor (CSF) Self-Assessment Tool (UD-CSFv4)

4.9 Testing the Self-Assessment Tool for UD CSFs

In order to explore the likelihood of the evaluation form's accuracy, the finalized prototype UD-CSF v4 is further tested by the thesis author in order to tentatively confirm or refute initial validity. The hypothesis is that projects affiliated with UD success will return higher test scores, and projects not affiliated with UD success will return lower test scores. The seven main questions in UD-CSF v4 can be awarded zero points by the assessor if they disagree and the factor is not fulfilled by the project, one point if the project is somewhere in between, or two points if they find that the project fulfills the UD critical success factor.

4.9.1 Assessment of UD Successful ICT Projects

The assumption made in this thesis is that the expert evaluation against transcribed interview data correctly indicates a high score for ICT-projects that have received success. Based on this assumption a natural next step is to check against projects that fulfill inclusion criteria for being unsuccessful with regards to achieving UD.

4.9.2 Assessment of ICT Projects not affiliated with UD Success

Part one of this study targets successful projects, so in order to acquire an initial impression of how projects *without* special consideration for UD might score using the self-assessment tool, a small sample of projects *not* affiliated with UD success are also recruited. A prerequisite for participation in this part of the study is having received negative press for efforts linked to UD, by a reputable source connected to UD quality.

Based on this, a large international company who has received a negative UD review by an expert in the field of UD with Funka Nu, is selected. Funka Nu is considered noticeable experts in the field of accessibility and UD, and is reported to have measured web accessibility status, on behalf of the European Commission, in Norway, USA, Canada, Australia and all EU member states ("About Funka," n.d.).

The included company from which the assessors are recruited is the private sector and has more than 3000 employees. It has a large range of ICT-projects in multiple international markets in addition to the Norwegian market. This company has, to this researcher's knowledge, not received an award, nomination or honorable mention specifically linked to UD or gotten a positive review or rating from DIFI.

Twenty assessors are picked randomly within the company and approached through e-mail. The assessors are shortly briefed on the purpose of the project, and asked to evaluate a completed ICT-project they have participated in, using the UD-CSF v4 evaluation tool. They are told the results will be completely anonymous. The assessed ICT-projects have not had special UD focus or achieved UD success as defined in this thesis, and the projects are all completed and not ongoing.

The assessors approached have similar disciplines as the informants in part one of the study; designers, developers, advisors and project managers. In the same way as the other large companies in this study, this company uses consultants, and some of the assessors are therefore external employees assessing projects within this company.

Table 24 provides an overview of the twenty randomly selected assessors approached to test the UD CSF evaluation tool. The company and the assessors are anonymized as the inclusion criteria directly targets negative press and has an unflattering perspective that the company is not likely to want to be affiliated with.

Assessor no.	Gender	Title/Discipline	Company
1	Female	Interaction Designer	Large International Company
2	Female	Interaction Designer	Consultant Agency 1
3	Male	Interaction Designer	Consultant Agency 1
4	Male	Interaction Designer	Consultant Agency 1
5	Male	Digital Designer	Consultant Agency 1
6	Male	Digital Designer	Large International Company
7	Female	Digital Designer	Large International Company
8	Female	Advisor / Editor	Large International Company
9	Male	Advisor / Editor	Large International Company
10	Female	Advisor / Content	Large International Company
11	Male	Project Manager	Large International Company
12	Male	Project Manager	Large International Company
13	Male	Project Manager	Large International Company
14	Female	Project Manager	Consultant Agency 2
15	Male	Project Manager	Consultant Agency 2
16	Female	System Architect/ Developer	Large International Company
17	Male	Developer	Large International Company
18	Male	Developer	Consultant Agency 2
19	Female	Developer	Consultant Agency 1
20	Male	Developer	Consultant Agency 1

Table 24. Overview of assessors asked to test the UD CSF Self-Assessment Tool

Out of the 20 approached assessors, 12 responded to the e-mail. All responses received were mirrored back to the assessors in order to disclose possible misunderstandings, and to ensure that the researcher's interpretation of their answers were correct. By doing this, it became clear that several assessors had overlooked the bonus question, due to the design of the tool. These assessors got the opportunity to add the extra bonus points if this was applicable to the project in question. It also cleared up one wrongly summarized total, and that one informant had misunderstood the summarizing line and read it as the total for the bonus questions only. Table 25 presents the final scores provided by assessors that answered the e-mail on behalf of a project not affiliated with UD success. Three projects received a total score in the 6-11 points group, and nine projects are in the 0-5 group. This confirm the hypothesis that non-successful cases should receive lower scores, and as such indicates that a successful tool.

UD Lacking Project	Assessor	1	2	3	4	5	6	7	a	b	c	d	Sum:
Project A	1	1	1	0	1	0	1	2	0	0	1	0	6
Project B	6	0	2	0	0	0	0	2	0	1	0	0	5
Project C	7	1	1	0	1	0	0	1	0	0	0	0	4
Project D	8	0	2	0	1	0	0	1	0	0	0	0	4
Project E	9	1	2	1	2	2	0	2	0	1	0	0	11
Project F	11	0	0	0	1	0	0	1	0	0	0	0	2
Project G	12	1	2	0	1	0	1	2	0	0	1	0	8
Project H	14	1	2	0	0	0	0	2	0	0	0	0	5
Project D	15	0	1	1	1	0	0	2	0	0	0	0	5
Project I	17	1	0	0	0	0	0	2	0	0	0	0	3
Project G	18	0	2	0	1	0	0	2	0	0	0	0	5
Project J	19	1	2	0	1	1	0	0	0	0	0	0	5
	Sum:	7	17	2	10	3	2	19	0	2	2	0	

Table 25. UD-CSF v4 Evaluation Results from Projects not affiliated with UD success

Assessor 14 specifies that her answers are limited to her knowledge of the situation, and that she might report things as lacking even though they are present – especially related to the bonus questions. Assessor 15 adds a comment about how the developers on project D were concerned with UD, but did not have time to work thoroughly on it: the first design sketch

was designed to meet UD requirements, but changes were made along the way by the stakeholders which were not tested or considered from a UD perspective.

4.9.3 Revised UD-CSF Evaluation Design

Based on the feedback received through testing the tool, the issues discovered, such as bonus questions being overlooked and the summarizing line being unclear, Researcher 1 revised the UD-CSF design slightly to further improve on these usability aspects.

By moving the line separating the main questions from the bonus questions to the bottom, and thus presenting the bonus questions as part of the total assessment form, they are hopefully less likely to be overlooked. The headings are placed in a hierarchy and include three steps, to be more consistent, and specify concrete user tasks; answering the main questions, answering the bonus questions and finally summarizing the total. The bonus points are now presented with the letters a) - d), to give them a place further down in the hierarchy, but still keeping them as part of the total assessment form. The headings are also made more active to encourage action from the assessor. By making the assessor answer all the questions in a more consistent way, the intention is to make it easier to scan the form in the end, to calculate the grand total. The explanation of the points is also clearer when it is separate from the form itself, and more resembling a footnote or explanation. Figure 21 presents Researcher 1's revised version UD-CSF v5.

Based on feedback of the question formulation and the scores from the unsuccessful sample in 4.9.2, the revised UD-CSF self-assessment tool (v5) presented in Figure 21, is considered as successful in measuring project success factors, and ready for further future testing.

Figure 21. UD CFS Self-assessment tool, revised by Researcher 1 (UD-CSF v5)

UNIVERSAL DESIGN (UD) CRITICAL SUCCESS FACTOR (CSF) EVALUATION

Step 1. Indicate if your project fulfills the UD critical success factors on the scale:	**Disagree**		**Agree**
1. There is a common understanding of UD in the project team and at all management levels (including any costumer), and achieving UD is supported and viewed as positive.	**0**	**1**	**2**
2. The team has at least one person enthusiastic about UD, having a personal interest and motivation for ensuring universal usability.	**0**	**1**	**2**
3. The team has all the resources needed to ensure UD criteria; adequate time, budget and human resources; including access to assistive technologies, users and external competence.	**0**	**1**	**2**
4. The team has relevant UD competence and experience, e.g. UD principles in coding, IxD, content & visual design. Focus is on making design accessible and usable for everyone.	**0**	**1**	**2**
5. UD perspectives are integrated into all project activites; design, coding, UX/UCD & needs.	**0**	**1**	**2**
6. UD aspects are early and continously evaluated throughout the project, both through expert inspections and through user testing and real-user feedback including persons with disabilities.	**0**	**1**	**2**
7. The team embraces cross-disciplinary collaboration, open discussions and dialogue.	**0**	**1**	**2**

Step 2. Recieve 1 bonus point for:

a) A strategy for developing the UD competence in a team or organization.	**0**	**1**
b) Requirement specification includes criteria for UD, ensuring early and continuous focus.	**0**	**1**
c) An iterative or flexible process model, utilizing feedback from UD evaluations.	**0**	**1**
d) Extending internal evaluations with external inspections adds to UD quality control.	**0**	**1**

Step 3. Summarize your total:_____ point(s)

0-5 points: Your project is not fulfilling critical success factors for universal design, and is likely to struggle to achieve universal design.
6-11 points: Your project mostly fulfills critical success factors for universal design, but is unlikely to win universal design awards.
12-18 points: Your project fulfills most or all critical success factors, and is expected to achieve excellent universal design quality!

5. Discussion

Through in-depth interviews with 31 informants, spanning 21 UD successful ICT-project, this study aims to gain insight into what factors affected their success by asking:

1) Which practices should be implemented in order to successfully achieve universally designed ICT-solutions?
    a. What are key promoting and obstructive factors for UD?
    b. What is the relationship between the factors?
    c. Which are the critical success factors?
2) How may ICT-project compliance to identified UD best practices be measured?
    a. Does the prototyped evaluation tool indicate likelihood of UD success?

Factors reported to have an effect on integration of UD are identified through thematic content analysis, where themes (codes) are categorized into categories and levels.

The findings identify 19 factors that are reported as positive or negative for UD integration. The 13 positive factors are interpreted as indicators of aspects that **promote** successful implementation of UD, while the six negative factors are seen as indicators of **obstructive** aspects. A tendency in the data is that several negative factors tend to be the opposite of a corresponding positive factor, e.g. the **lack of** anchoring, competence, resources or interdisciplinary cooperation. This inclination further supports the notion of the positive factors being important promoting practices.

The fact that there is high frequency counts for several of the identified factors, despite the informants being asked open-ended questions, suggest that there to a large degree is consensus among the informants, as well as across the selections. Only 3 of the 13 promoting categories are mentioned by less than 2/3 of the population, and only one out of six obstructing factors. It should be noted that there might be a higher overall frequency count for selection B as a consequence of the shift in coding approach from emergent to a priori coding in round two of coding. Having pre-defined categories, in a combination with the aggregated knowledge and impressions from the first 13 interviews, may have led to themes being identified and categorized more frequently.

5.1 Identified Promoting and Obstructing Factors in Light of Existing Literature

The data indicate that informants agree about the identified categories across the various disciplines, projects and organizations. This can be viewed as positive in regards to applying knowledge from this study onto other projects and companies. Implementation of UD appears to be a complex area with lots of dependencies at different levels; factors are in this study grouped as external, organizational, project/process or individual levels, which all seem to affect the degree of UD successfulness as well as the other levels. The levels may be seen as indicators that UD implementation is not something that can easily be "fixed", but an issue that needs to be addressed at various levels. Other researchers in this field have identified similar factors (Fuglerud and Sloan, 2013; Røssvoll and Fuglerud, 2013; Schulz et al. 2014; Scott, Spyridonis and Ghinea, 2015; Nordli, 2016) which further indicates that the identified factors are accurate. The next sections will compare and contrast the findings from part one of this study light existing literature.

5.1.1 Identified Key Factors for Inclusive Design

The key factors identified in this study coincided very well with the seven key principles for an inclusive design process identified in literature (Fuglerud and Sloan, 2013; Røssvoll and Fuglerud, 2013; Schulz et al. 2014; Scott, Spyridonis and Ghinea, 2015). The fact that findings correspond well with findings from non-Norwegian cases as well, may indicate that the identified themes are applicable in other countries as well.

1. The first principle **holistic and interdisciplinary teams and/or process**, correspond with the factor **cooperate** in this study, which was mentioned by 25 of 31 informants (81% of N), 68 times.
2. The second principle having a process based on **user-centered design principles** is mentioned 131 times by 30 of the 31 informants (97% of N), 131 times. The informants mentions early and frequent **User Focus** and is the second most mentioned category of them all.
3. The third principle, **adopting and applying accessibility standards and guidelines**, is mentioned by 29 informants (93.5% of N), 135 times**.** The need for requirements specifying UD is highlighted in the category **UD focus**. This principle is also tied to

UD competence mentioned 85 times by 26 informants (84% of N), and **Resources** mentioned 77 times by 27 informants (87% of N), as both are necessary in order to apply the standard.

4. The fourth principle suggests **using an iterative development**, which is mentioned 26 times by 14 informants (45% of N) in the **Agile** category. Informants mention that UD should be a continuous process.
5. The fifth principle; **focus on users with disabilities early, and throughout the entire design process** is mentioned by 29 informant (93.5% of N) in **UD Focus,** 135 times**.**
6. The sixth principle, the **use of empirical evaluations with various impairments represented**, is mentioned in the **Quality Assurance** category mentioned 86 times by 30 informants (97% of N) that covers internal and external QA for UD.
7. The seventh principle **focusing on the entire user experience** is covered under the category **UD Competence** mentioned 85 times by 26 informants (84% of N) where a 'proper understanding' of UD is described as the recognition of a link connecting UD and general usability. Several informants share a vision stating that UD is design that goes beyond disability, and is simply great design that is accessible to all.

5.1.2 Identified UD Barriers in a Norwegian Case

In order to make an even more direct comparison, a case study of The Norwegian Broadcasting Corporation (NRK), identifying barriers for UD considerations when publishing news, will be used (Nordli, 2016). Nordli (2016) suggests that there are three levels of barriers at NRK that inhibits change towards achieving UD in practice; UD Awareness Barriers, Organizational Barriers and Technological Barriers. He also suggests applying institutional change theory i.e. changing in the values, norms, and practices that make up NRK as an institution, so they can overcome the barriers that exist in the organization. This may change the institution towards promoting, ensuring and achieving UD in practice. Further Nordli suggests that results from his cast study may also apply to other institutions, e.g., businesses and organizations. The identified barriers and suggested recommendations will therefore be compared to the findings in this study to investigate if they can confirm each other's assumptions. As Nordli's study focus on UD practice barriers, while this study focuses on UD success factors, the findings may as such complement each other well.

The **Awareness** barriers identified by Nordli (2016) addresses the degree of knowledge and awareness for UD. The findings suggest that although there is to some extent **familiarity with the term** Universal Design, informants seem to be focused on accessibility, technical tools and legislation requirements over universal design principles. The study also indicates that informants, who reported not making any **UD considerations**, actually did so without reporting or understanding that they were in fact securing UD through their actions. One informant pointed out the need to get time allocated in order to secure UD considerations. Only two of the seven interviews informants in the case study reported to **familiarity with the national requirements** for UD of ICT, suggesting that employees of a large governmental institution are not even aware of the legislation at all. The lack of UD understanding and familiarity with the legislation may be viewed as a direct consequence of the reports given about not having received any **UD courses or training** through the organization. However two of seven informants mention other courses that had indirectly mentioned a couple of UD considerations regarding the visually impaired.

In contrast, one of the most prominent factors identified by 90 % the informants from the UD successful projects is having solid **UD Anchoring**. The factor emphasizes the importance of all the things Nordli (2016) identified as awareness barriers at NRK; namely having UD understanding, competence and awareness at all management levels and an internalized UD culture. A corresponding 90 % of the informants also specifically report a Lack of Anchoring, and the consequences that represents as an obstructive factor. Having **Top Level Focus** among stakeholders such as leaders is identified as factor leading to the insurance of UD competence by 84 % the informants. Anchoring and top-level focus lead to projects being allocated the right **Resources** they need to succeed; whether it is necessary **competence**, a UD department, human or economic resources as well as enough **time** to consider UD issues. Further 77% report **Lack of UD Competence** as obstructive, both lack of knowledge and understanding, as well as negativity and inexperience is mention as obstructive. In addition 84% of the informants identify **UD Competence** and having an understanding of the UD principles as obstructive. There are also several references to regarding UD as good design "beyond" disability. Further, 74% of informants in the successful projects report UD **legislation** is promoting and help give priority. It should therefore be considered obstructive when employees are not even aware of its existence.

Nordli's **recommendation** for **Awareness** barriers is to take measures to have formal UD training to increase awareness and knowledge among employees. This study identifies UD anchoring and Top level as factors linked to UD training and awareness distribution. As the informants at NRK report to not feeling that accessibility and universal design is their responsibility, but rather the responsibility of developers, Nordli (2016) also mentions that training should include a section on shared responsibility, and suggests having a UD representative in the organization, or to invite a UD advocate from e.g. Funka NU to educate and train the staff in UD. There are 23 positive mentions regarding the use of organizations like these for external **Quality Assurance**, and all the informants in the study mention or show signs of being a UD advocate within their project and/or organization, due to UD enthusiasm and empathy for users. Nordli's identified barriers and suggestions related to awareness align well with the identified promoting and obstructing factors in this study, and as such they reinforce each other.

The **Organizational** barriers identified at NRK addresses current UD practices and workflows. Findings suggest that employees are not familiar with any **internal or external guidelines** specific for general usability or UD, including the WCAG 2.0 standards (which are also identified as an awareness barrier). Another barrier is linked to the **physical location and poor communication** within the organization. These issues are also reported to affect efficiency. This issue also makes it difficult to utilize **teamwork and collaboration** in, as well as between, different departments. There are also reports of trouble with collaboration due to late involvement in the case. Issues regarding **hierarchy and high-level employees** are reported, saying that hierarchy leads to delays, frustration and demotivation, largely due to misunderstandings in the chain of command. These barriers are demoting collaboration and efficiency**.** Another barrier is the fact that the staff is **pressured by time,** which often results in quick solutions being prioritized over "good" and thorough solutions.

The **Organizational** barriers are correspondingly identified as obstructing by the successful projects. **Process issues,** including the lack of interdisciplinary cooperation and sequential processes with UD issues introduced at the very end, are mentioned by 74 % of the informants. In addition 81 % identify **Cooperation** with cross-disciplinary teams, discussions, established roles and co-location as promoting factors for UD implementation. The barrier limited time is identified among other aspects in the category **Constraints.** Also the issues

regarding **hierarchy** is mentioned in the category **Agile**, where having a flat structure is pointed to as promoting, however this was not mentioned by many informants.

Nordli's **recommendation** for **Organizational** barriers is to **c**reate and enforce internal policies. This corresponds well with the important promoting factor **UD Focus** mentioned by 93.5% of the informants. An important theme in this category is having UD requirement specifications in projects, and to make UD a requirement. Further, Nordli suggests communication tools (such as Facebook at work) and a task management system (as staff was not updated on tasks,) to deal with communication, collaboration and physical structure barriers. No such tools were mentioned specifically as promoting for collaboration by this study. Next he recommends assigning responsibility to a high-level employee or decision-maker, so that people will know where to go for final decisions regarding UD, as well as the creation of an accessibility/UD unit to help out when others are too pressed for time, and to have an overall UD responsibility and act as internal UD champions. Having **Top Level Understanding** and **UD Anchoring** is recognized a decisive factor in order for decision makers to prioritize a UD department, specialist group, or even person with UD responsibilities (depending on the size of the organization).

The **Technical** barriers identified in the case study is NRK specific software issues, such as button placements in the publishing software, auto save features, internal search results etc. This study will therefore not go further into the specifics of these barriers; however a comparison to the **Process Issues** category identified in this research can be drawn, as the technical barriers are listed as hindering for effective processes and interdisciplinary cooperation.

An interesting observation is that Nordli (2016) **Awareness Barriers** correspond with this study's **Organizational level,** while his **Organizational Barriers** correspond with this study's **Process/Project level.** His grouping was done to address the origin of barriers, and indicate a clear direction to resolve them, and revolving around the **organization.** The levels in this study are based on where the factor originates and how they affect the **project**. However the finding still reinforces each other, despite being grouped differently.

5.1.3 The Team's Role in Project Success

The category **Personal Qualities** is mentioned or linked in some way to every single informant in this study. This category indicates that personal qualities like enthusiasm and empathy may be linked to UD success. Findings also suggest that 74% of the informants report having a personal motivation for working with UD. Khang and More (2008) claim that several researchers have linked the competence of team members, as well as the project manager, to project success. Critical individual competence identified includes technical, administrative and interpersonal factors (Khang and Moe, 2008). They also argue that if the team and project management are not dedicated to project success, the competence level is insignificant, because motivational factors include a clear and common understanding of the project goals and objectives. Perhaps the commonality of describing UD as an **obvious** factor in any design, and showing signs of strong UD motivation and passion, may indicate to some extent that having at least one team member with UD motivation and drive is linked to achieving UD success.

Seven of the nine developers interviewed report a personal motivation for UD, eight out of ten when including the UD advisor with a developer background. Taking into account that the designers often point to their team developers as interested in UD, and acknowledging that the developers took UD seriously, the study indicates that **developers** with high **UD competence** and **motivation** may be an important promoting factor. There are also many mentions about allowing all parts of a team, developers especially, to witness usage difficulties. This finding also coincides with a study performed in Brazil by Freire, Russo and Fortes (2008) that stresses the necessity of spending more efforts on educating developers in UD, and how disabled users interact with assistive technologies. That study points out that when developers see a user struggle with what they themselves have developed it can have a strong effect on their UD motivation. This is something several informants in this study also mention, claiming that seeing users yourself creates empathy for the users, which again sparks a motivation for UD.

According to Khang and Moe (2008) project success in general is related to how well an organization works in respects to provide the team with good communication systems, effective planning and scheduling, lack of bureaucracy, team cooperation and lack of conflict. Literature has also identified top-level support and sufficient resources as key environmental

factors, along with technical conditions, facilities, economy and information. This coincide very well with the factors identified in this study, and may indicate that these findings are not entirely unique for UD project success. Perhaps these factors may contribute to a better project process regarding usability in general as well.

5.1.4 UD Requirements and Tools

The research indicates that current UD guidelines and legislation may be overly focused on technical aspects of accessibility and not enough on the surrounding variables identified; such as UD anchoring and awareness, including attitudes and training, interdisciplinary competence in development teams as well as cross-disciplinary cooperation and adequate allocated resources; human, economic, time and testing resources, which are all mentioned as important factors, or identified as obstructive if missing. The findings also indicate that because there is a higher focus on technical accessibility in the requirements, the technical requirements are also more specified for developers than for others disciplines, e.g. interaction designers, resulting in a gap which cases confusion about issues that goes beyond technical accessibility. This is corresponds with the identified shortcomings Lazar et al. (2015) point out, about how accessibility regulations in many countries are limited to technical guidelines, leaving out organizational aspects such as enforcing actual implementation and process guidelines. Several other researchers have also identified that standards and guidelines alone are not sufficient in order to ensure a universally designed ICT solution (Garrido et al. 2013; Røssvoll and Fuglerud, 2013; Schulz et al. 2014; Aizpurua, Arrue and Vigo, 2015; Jung et al. 2015; Abascal et al. 2015; Nordli, 2016). Some researchers therefore make a distinction between technical accessibility and universal usability, claiming both need to be in place in order for a solution to be truly accessible for disabled users (Røssvoll and Fuglerud, 2013).

An expressed desire to be able to show more discretion regarding the WCAG requirements in certain situations also emerged in the data, defined as frustration over the requirements being too strict and not always logical, e.g requirements do not always corresponding with what the actual disabled user says or does in user testing scenarios. The WCAG standards were referred to as being "*too black and white*" as well as overwhelming, indicating that the informants may be dissatisfied with the current formulation and degree of flexibility allowed for in the requirements. There were also a few mentions of imagined project tools for UD,

most often exemplified a couple of times with a checklist; this was however then expressed to be “in the lack of a better alternative”, suggesting that the informants miss a tool that they cannot quite envision. A couple also mentions a concrete tool suggestion in the form of a JIRA (project management software) plugin, suggesting that there is a desire for tools used for project management and control over compliance to WCAG standards during the project process. Several informants do indicate that they have had to simplify and use excel sheets within projects and/or organizations in order to make the WCAG requirements approachable for themselves and their team.

5.1.5 Universal Design as part of User-centered Design and General Usability

When the informants were asked if they considered UD to be a separate field/discipline or if they considered it to be an additional qualification linked to their main discipline, only one person reported viewing UD as their main discipline. The remaining 30 informants suggest that UD is not a separate field, and several mention UD as a natural part of good **functional** design. Informants also point out that user-testing does not necessarily have to be a separate process for UD every time, and that several usability issues align with UD issues and can therefore be tested in “regular” user testing. However, there is a general consensus that user testing on people with disabilities is crucial in order to understand **all** users and thus successfully achieve UD. These needs are not always present to the same degree in every project, and therefore the degree of QA may vary from project to project depending on what type of ICT-solution is being built and what target audience they have.

It is a recurring focus and emphasis among informants on UD as part of general usability, and how integrating UX and UD principles early and continuous in the design and development process, not at the very end, makes it easier to succeed with UD. As previously mentioned this study suggests that UD anchoring as well as general UD and UX awareness at all levels is considered key as it leads to UD being a priority. When UD is a priority it is more likely to be included early and continuously in the development process. Studies exploring implementation of **user-centered design in agile processes** also point to how anchoring of user-centered design at an organizational level may affect how well implementation will work in an agile process (Raison and Schmidt, 2013; Begnum and Thorkildsen, 2015; Silva da Silva et al. 2015). In other words, key factors found in this research may not necessarily be

unique for implementation of UD in an ICT-project, and may also apply to usability, user-centered design and work with user experience in general. Several informants in this study also mention how an early UD focus in an iterative process limits the need for extensive resources. This is a promising finding in regards to the assumption made by Bordin and De Angeli, (2017) about issues from agile UCD staying persistent when integrating UD perspectives into the UCD approaches in agile projects.

5.2 Measuring Project Success Factors

This second part of this study asks how ICT-project compliance to identified UD best practices might be measured, and suggests a prototyped self-assessment tool based on data from this study, aiming to reveal the degree of compliance to identified critical success factors for UD, thus predicting likelihood of UD success.

However, trying to measure success factors based on the findings from this study does bring up the issue of whether or not these projects can really be compared as success cases in the first place. Defining criteria to be able to measure and indicate project success is acknowledged as a challenge, (Khang and Moe, 2008) and success is not an easy thing to define as it will differ from project to project, opening up for various different interpretation of what constitutes as a successful UD solution. In this regard, it is natural to discuss how this study defines the term "success" e.g. what awards and/or honorable mentions should be regarded as valid for "success" inclusion. In retrospect, it might have been beneficial to have had stricter success criterion in order to make the projects UD success easier to evaluate and compare afterwards. Perhaps the study should have been limited to awards solely evaluating based on strict UD criteria, and perhaps it should have included a sample of un-successful projects to contrast and separate findings. On the other side, stricter success criteria would also results in a smaller sample, due to limitations in in awards purely dedicated to UD. In addition, the adolescence of the field leads to a corresponding lack of unlimited award winners to choose from. Such restrictions would therefore have been at the expense of broad insight in the practice field.

In order to investigate whether or not these cases are suitable for comparison, the award criteria are examined closer. **The Innovation Award for Universal Design** rewards

innovative projects and honors an inclusive and user-centered development process. The award highlights innovative, accessible and user-friendly solutions. This award is part of the government's commitment to universal design. Innovation and universal design beyond general legal requirements and minimum standards will be particularly emphasized here ("Kriterier og kategorier," 2017).

The Badge for Good Design award solutions that cover functional requirements and visualize user benefits compared to existing and/or competitive solutions. It states that a universally designed solution can be used by all people, without the need for customization. This award requires a description of how users have been involved in the innovation process and how the user insight has shaped the solution. The design should cover the user's need in both rational and emotional ways. They describe ease of use as a critical success factor for a digital solution. For the categories Interactive Design and Services specified keywords are; Usability, comprehensive experiences, principles of universal design, perception and intuitive qualities, navigation, infrastructure, technical solution ("Interaksjonsdesign," 2013).

The **Design for All Award** is won annually by a recipient of **The Badge for Good Design**, which has developed an excellent solution with particular focus on ease-of-use and good universal design. Design for all prizes is funded, judged and distributed by the Delta Center, the State Center for Participation and Availability. The Delta Center will contribute to increased accessibility and universal design in society so that people with disabilities also can participate ("Dette er Design for alle-prisen", n.d).

Digital Service of the Year – Online Quality award those who put a lot of effort into providing a good user experience regardless of whether the customer chooses to use desktop or mobile. The service should have a modern design with balanced icon usage and efficient use of animations. The winner goes through a thorough assessment. First, Difi has made an expert assessment of the service, along with other public digital services. Then the service is user tested before a jury narrows it down to one winner. The award highlights five aspects particularly 1) Website and service are easy to find, 2) Website and service are credible, 3) Website and service are safe to use, 4) Website and service work well, 5) Website and service are easy to use for all and 6) It's easy to find help ("Om kvalitet på nett-arbeidet," n.d).

The Public Website of the year – Online Quality evaluation by the Directorate for Administration and ICT (Difi) considers the quality of municipal and state websites. The criteria set consist of 33 different principles within the accessibility, customization and useful content. The criteria for this award are based on Difi's quality criteria for **Digital**

Service of the Year – Online Quality, but here the jury also considers elements that are not easy to measure objectively.

The Farmand Award for public services evaluates sites based on 1) A general quality review of the websites 2) Initial evaluation of the opening page; how well it "sells" and how transparent and user-friendly it is, 3) Content relevance; "Depth/Width" and a rating of "updated content" 4) Ease of use; overview, menus, structure, navigation, availability 5) Use of multimedia; visual communication, video, images, interactivity 6) Emotional properties; user's "experience" of the site 6) Adaptations and facilitation; does the site work for "all" types of users 7) Participants' use of social media - as well as the ability to effectively interact with the website 8) A summary with pros and cons and the sum of points the site achieved out of 100 possible points ("Om Beste nettsted", n.d).

There is not a perfect overlap in these criteria, and the award committees emphasize slightly different success criteria. It might therefore be argued that this study does not provide accurate evidence to base indications of success on, and that by using award winning projects as inclusion criteria, this study does not measure general UD success, but rather the likelihood of winning a UD award. However, when part of the basis for this research is that there is no common denominator or objective measure for what constitutes a universally designed web site or service, and these award criteria all have one thing in common; a specific mention of accessibility, usability (ease of use) and creating services that are usable to all. This study argues that these criteria are as good as any in order to start an investigation into what actually constitutes success when it comes to UD of ICT-solutions.

In regards to the identified Critical Success Factors CSFs that are explored in part two of the study and used in the evaluation form, it should be noted that when promoting factors are considered motivators if no opposite negative factors can be identified, and thus merely viewed as drivers, it could be argued that the factors left out using this logic, do in fact have opposites, although mentioned in a less direct matter. An example of this is external QA, which is defined as a motivator due to a lack of a concrete opposite factor. However, a lack of resources which includes human-, economic- and time resources as well as test lab, equipment or test users, could in fact be viewed as the opposite of having enough resources to perform external QA. In fact some informants specifically mentioned that a lack of funding may result in lacking quality assurance. Likewise the negative factors with no opposite

positive factors are regarded as limiting, and with so few negative aspects identified in this study it might be argued that the study should have withheld from drawing any conclusions based on the obstructive factors.

The study only asks specifically about obstructive factors once in the interview guide due to the overall focus being on successful practices and what the informants did to succeed with UD. It can therefore also be argued that with a main focus on success, naturally less information about negative aspects will appeared, and the study should as such should be careful in assuming too much regarding the scale from positive to negative at this stage. Any further research in this direction should therefore gather more data on obstructive aspects before landing any final CSFs. A possible way to do so could be to use factors identified in this research as the basis for a survey with multiple answer alternatives, this way the negative aspects would not have to be reliant on the informants being able to evoke memories.

5.2.1 Test results

Further the study asks if the prototyped evaluation tool indicate likelihood of UD success. The assumption made being that by evaluating the transcribed interview data against the questions in the evaluation form should indicate high scores as they are ICT-projects that have achieved UD success. Based on this assumption a natural next step was to have projects that fulfill inclusion criteria for being unsuccessful with regards to achieving UD evaluate themselves in order to verify that they would receive low test scores. Based on comparisons made between transcripts and the CSF-UD measuring tool, resulting in high scores, as well as the low scores received by the unsuccessful sample tested in 4.9.2, the UD-CSF self-assessment tool (v4) presented in Figure 21, is considered to tentatively confirm initial validity. Therefore the tool is also considered successful in predicting project success and as such ready for further future testing.

However, the findings presented in part two of this study, and specifically these test results, are not considered to be reliable at this point. First, the assessment on the successful sample was not actually performed as a self-assessment test, and can therefore not be said to provide a correct measure, there could have been aspects they did not remember in an open-ended questions that they would have answers when confronted with alternatives. Second, the test

was sent to a random sample selection for un-successful bases through e-mail and this study has little additional data on the assessors. Further, the sources may have interpreted the questions differently and filled out the form under varying circumstances. Lastly, the self-assessment evaluations performed on the non-successful cases was performed on a very small sample, and can as such not be seen as generalizable or valid. However, because the prototype did return low scores for the un-successful cases, it may be argued that the validity of the criteria as UD success indicators is strengthened.

This study will therefore be careful with drawing any concrete conclusions based on these results, but the research does give an intriguing indication of the possibility to measure compliance, as they did tentatively confirm the hypothesis. Further exploring and testing of this or similar tools are therefore encouraged in order to further validate measures of compliance to success factors.

5.3 Limitations of the Study

This study identifies several factors that are seemingly promoting or obstructing for UD integration based on a limited number of successful cases in companies represented in Oslo, Norway. The IT industry is very large and diverse with development practices that vary within each company and possibly in different regions of the country. The findings in the study are therefore not considered generalizable as the sample is too limited in both size and geographical range. Potentially the study could have identified more, or entirely different, factors had an even larger and population been represented from different companies and cities. Whether or not limiting the interview study to only including projects affiliated with success makes this a non-representative population can also be speculated. One could also speculate in whether or not including a non-successful sample would have resulted in more obstructive practices. Another aspect that makes it harder to compare the cases is that the data does not include specific project background information such as overall project size, duration and budgets. However, this study does provides solid indications as to what various project roles in the Norwegian IT industry regards promoting and obstructing for UD integration regardless of company types and sectors, and is as such still a solid contribution to the field, despite the lack of generalizability.

The validity of the study can be questioned due to the previously discussed issues with determining what constitutes **success**. However, the validity is supported by the fact that two researchers performed the analysis of the initial data, coding, categorizing, determining frequencies and interpreting the data, and came to similar conclusions. In addition, the results correspond with findings in existing literature. According to Weber the ultimate goal regarding reliability in qualitative research is ensuring different persons would code the same text in the same way (Lazar, Feng and Hochheiser, 2010), and this study has intra-coder reliability as described in section 3.6.1.

The findings from part one of the study are considered to have good reliability, as the data collection method was kept consistent. However by interviewing participants about previous experiences, and only asking open-ended questions, you do rely heavily on the informants' ability to conjure correct memories, and remember things accurately (Lazar, Feng and Hochheiser, 2010). Perhaps the findings would have suggested different factors if the participants were given examples or alternatives in the interview guide. However one of the aims in this study was to identify what the participants would choose to emphasize, and as such, the fact that both samples agree to such a large extent despite the open-ended questions, confirms a high degree of reliability.

6. Conclusion

This research provides insights about ensuring universal design in practice by looking into how universal design has been successfully achieved in 21 Norwegian ICT-projects with reported UD success. The study had two aims: One aim was to extend and confirm previous findings by Harder and Begnum (2016), thus concluding with a set of promoting and obstructing factors as well as proposing critical success factors (CSF) for UD implementation. The other aim was to explore the possibilities of predicting likelihood of achieving UD through a prototyped self-assessment evaluation tool, aiming to measure the compliance of ICT-projects to the study's identified critical success factors.

The findings indicates consensus among the study participants regarding promoting and obstructing factors for UD implementation. The interview study reveals a complex area that is affected by several factors at various levels; external, organizational, project process and individual. This study therefore provides insight into the relationship between factors, including the particularly important positive effect UD Anchoring and an internalized UD culture has on all the other promoting factors. The study also highlights the importance of human resources with UD competence and the presence of positive personal qualities and UD enthusiasm. The research indicates that current UD guidelines and legislation may be too focused on technical aspects of accessibility and not enough on the surrounding variables identified, such as anchoring and awareness, including attitudes and training, interdisciplinary competence in development teams as well as cross-disciplinary cooperation in general and adequate allocated resources; human, economic, time and test resources which are all mentioned as important factors, or identified as obstructive if missing.

This research contributes to the research field by suggesting what may be construed as a set of Best-Practices for achieving Universally Designed ICT-Solutions. The findings coincide well with existing literature, reinforcing both the findings in this study, as well as the existing ones. This research suggests that ICT projects will be more likely to succeed with UD implementation if they have at least one person who is passionate about UD, however, findings show that this is far from enough, and that a projects ability to succeed is also heavily reliant on solid **UD Anchoring** at all levels resulting in an internalized "UD culture" in the organization. Having UD anchoring and **Top-level Understanding** further affects the

process level because projects are allocated adequate **Resources,** allowing for an early and continuous **User and UD Focus** in addition to a general focus on usability. Using an **iterative** approach with **frequent** internal and external **Quality Assurance,** and having an established **Interdisciplinary Collaboration** is indicated as promoting practice. Individual **UD Competence and Motivation** are qualities of team members and stakeholders identified as highly influential factors if hoping to succeed with UD implementation in ICT development projects.

These practices are implied effective in a larger perspective related to general project success and the implementation of User-centered Design and general usability focus in agile processes.

Finally, the study suggests a set of interpreted critical success factors and prototypes a self-assessment tool based on these, aiming to measure if projects compliance to these critical success factors can predict likelihood of UD success. Although the tool did confirm a defined hypothesis, suggesting it was successful in predicting UD success, this study will not draw conclusions based on these findings, as the results are considered too unreliable.

6.1 Further Research

This study compares a wide range of projects, not distinguishing between web sites, apps and services, and representing both private and public sector. It may therefore be interesting to focus on more specific segments, or compare at project level, with similarities in project type, budget and duration, towards a more specific and reliable best practices. The findings in this study should also be strengthened with regards to generalizability, now that this in-depth study has identified a set of promoting and obstructing factors, a survey study could be used to gather data from a broader range of projects. Comparative case studies may also be considered, where factors identified as crucial for success in this study are either absent or present. Through further studies, new aspects may appear, and relationships and dependence between factors may become clearer.

In order to further verify that the prototyped self-assessment tool can predict successful outcomes, it should be systematically tested on projects presenting or lacking critical success factors. In future research it may be expedient to narrow the scope of the success criteria in

order to make the contribution more comparable in regards to what constitutes a UD successful project.

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Appendix A: Study information sheet (Norwegian)

Informasjon om deltakelse i forskningsprosjektet

”Universal Design in IT development - Identifying Practices for Integration of Universal Design in Norwegian IT development Projects”

Bakgrunn og formål

Universell utforming er et tema som stadig får mer fokus. Det er likevel et såpass nytt tema at det finnes få beskrivelser om praksisen rundt hvordan dette kan, og bør, håndteres i norske IKT-prosjekter. Denne intervjustudien ønsker å undersøke hvordan norske IKT-prosjekter jobber for å sikre universell utforming ved utvikling eller utbedringer av IKT-løsninger, og metodisk stil. Intervjustudien gjøres i forbindelse med en masteroppgave i Interaksjonsdesign på NTNU i Gjøvik. Deler av datagrunnlaget vil også brukes av min veileder fra NTNU i denne oppgaven i forbindelse med hennes PhD studier.

Hva innebærer deltakelse i denne studien?

Deltakelse i studien vil innebære gjennomføring av et personlig intervju på ca. èn time. Intervjuet er todelt, og første del vil handle om ditt arbeid med universell utforming, samt ditt arbeid knyttet til et spesifikt prosjekt. Del to spør om generell arbeidsmetodikk, og ber deg ta stilling til en del utsagn/påstander. Intervjuer vil notere underveis, og det vil bli gjort lydopptak av intervjuet *dersom* det gis tillatelse til dette av respondenten.

Hva skjer med informasjonen om deg?

Alle personopplysninger vil bli behandlet konfidensielt. Data fra intervjuet vil kun være tilgjengelig for intervjuer og studentens veileder ved NTNU Gjøvik. Eventuelle lydopptak blir lagret med passordbeskyttelse, og navn på deltakere holdes adskilt fra datagrunnlaget og lydopptak. Masteroppgave som inneholder aggregerte data fra intervjuene kan bli publisert og offentlig tilgjengelig. Informasjonen i denne oppgaven vil ikke kunne spores tilbake til deg eller andre enkeltpersoner dersom du ikke ønsker det, da ingen navn på enkeltpersoner vil være med i denne oppgaven uten at skriftlig samtykke er gitt. Navn på bedrifter som deltar i studien kan bli publisert dersom dette er ønskelig, og godkjennes av de aktuelle bedriftene. Denne intervjustudien skal etter planen avsluttes 01.06.2017. Alle notater, lydopptak og

deltakerlister slettes innen utgangen av 2017.

Frivillig deltakelse

Det er helt frivillig å delta i denne studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert og lydopptak slettet. Dersom du har spørsmål til studien, er du velkommen til å ta kontakt med intervjuer Susanne Harder, tlf. 930 95 638 eller susanne_harder@hotmail.com.

Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS.

Appendix B: Study Consent Form (Norwegian)

Samtykke til deltakelse i forskningsprosjektet

”Universal Design in IT development - Identifying Practices for Integration of Universal Design in Norwegian IT development Projects”

☐ Jeg har mottatt, lest og forstått informasjon om denne studien.

☐ Jeg samtykker til at data fra denne studien kan brukes i Susanne Harders masteroppgave høsten 2016-2017.

☐ Jeg samtykker til at det blir foretatt lydopptak av intervjuet.

☐ Jeg ønsker at all data om meg blir anonymisert.

Navn (Blokkbokstaver)

Signatur

Sted og dato

Appendix C: Interview guide (Norwegian)

Tittel: Universell utforming i praksis

Denne undersøkelsen retter seg mot deg som jobber med universell utforming av IKT-løsninger. (Informasjonsskriv presenteres, samtykkeerklæring signeres og, hvis opptak er godtatt starter opptak. Ønsker å takkes ved navn/arbeidssted i artikkel?)

Navn:

Prosjekt/Firma:

1. **Hvor lenge har du jobbet med universell utforming[1] av IKT? Rund opp antall år.**

2. **Hva gjorde at du begynte å jobbe med universell utforming?**

3. **Hvilke områder jobber du med innenfor universell utforming?**
   - ☐ Teknisk funksjonalitet/programmering
   - ☐ Visuelt design
   - ☐ Interaksjonsdesign
   - ☐ Innholdsproduksjon
   - ☐ Service design/kundereiser
   - ☐ Fysisk design/ergonomi
   - ☐ Rådgiving
   - ☐ Annet: _____

4. **Hva vil du si er ditt fagfelt?**

_____

[1] *Definisjon antas kjent i utvalg som består av personer vi vet jobber med uu; FN def og DTL def. Ved spm brukes FN definisjon:* "utforming av produkter, omgivelser, programmer og tjenester på en slik måte at de kan brukes av alle mennesker, i så stor utstrekning som mulig, uten behov for tilpassing og en spesiell utforming. Universell utforming skal ikke utelukke hjelpemidler for bestemte grupper av mennesker med nedsatt funksjonsevne når det er behov for det."

5. **Hvilket utsagn er du aller mest enig i?**
   - ☐ Jeg jobber med universell utforming, som jeg regner som et eget fagfelt.
   - ☐ Mitt fagfelt er innen (det som er krysset av i 3). Universell utforming er en av mine tilleggskompetanser tilknyttet dette.

6. **Hvordan vurderer du din egen kompetanse med hensyn til universell utforming av IKT?** På en skala fra 1-7, der 1 er mangelfull og 7 er fremragende.

Mangelfull						Fremragende
1	2	3	4	5	6	7

7. **I arbeidet med (vellykket prosjekt) hvordan jobbet dere med å ivareta universell utforming?**

Oppfølgingsspørsmål:

Hva gjorde dette prosjektet vellykket tror du?

Har du vært med på andre vellykkede eller mislykkede prosjekter?

Hva gjorde dette/disse prosjektet vellykket/mislykket tror du?

8. **Hadde dere en smidig prosjekt prosess i (vellykket prosjekt)?**

9. **Hvordan ville du jobbet i forhold til universell utforming dersom du sto helt fritt til å velge metoder og fremgangsmåte?**

10. Er det noe som særlig *fremmer* realisering av universell utforming?

11. Er det noe som særlig *hemmer* realisering av universell utforming?

Metodeliste til informanten:

Observasjoner
Intervjuer
Spørreundersøkelser
Markedsundersøkelser
Statistiske analyser
Personas
Scenarioer eller brukerhistorier (user stories)
Brukerreiser (user journeys)
Smidig metodikk
Storyboard
Workshops
Skissering
Prototyping
Brukere gir uformelle tilbakemeldinger
Formative og utforskende brukertester (fokus på å avdekke problemer)
Summative og vurderende brukertester (fokus på å måle måloppnåelse)
Brukertesting i laboratorie/testmiljø
Brukertesting i reell brukssituasjon/kontekst
Ekspertinspeksjoner (f.eks. heuristisk evaluering og tilgjengelighetssjekk)
Eye tracking
Tjenestedesign (service design)
Automatisk testing av kode
Annet, spesifiser:
Annet, spesifiser:
Annet, spesifiser:

12. **Hvilke 5 metoder *anser* du som aller *viktigst* i ditt arbeid med universell utforming?** Ranger fra 1-5, der 1 er den du mener er aller viktigst, ut fra ditt fagfelt og faglige ståsted:

1) _____
2) _____
3) _____
4) _____
5) _____

13. **Hvilke 5 metoder *bruker* du aller *hyppigst* i ditt arbeid med universell utforming?** Ranger fra 1-5, der 1 er den du benytter hyppigst, og som er de viktigste ut fra den praksis du møter:
    1) _____
    2) _____
    3) _____
    4) _____
    5) _____

De neste spørsmålene vil forsøke å måle din metodiske "stil". Velg de alternativene du umiddelbart føler at passer deg best.

14. Hvilke faktorer påvirker valg av metoder?

15. Hvordan passer disse utsagnene til din hverdag? På en skala fra 1-7, der 1 er helt enig og 7 er helt uenig.

	Helt enig 1	Ganske enig 2	Litt enig 3	Verken enig eller uenig 4	Litt uenig 5	Ganske uenig 6	Helt uenig 7
I mitt arbeid tar jeg utgangspunkt i kunnskap om brukerbehov, men har ikke direkte kontakt med sluttbrukere.							
I mitt arbeid involveres brukere i alle faser, og deres bidrag i diskusjoner og designarbeid er likestilte med innspill fra utviklere og designere. Jeg har svært mye kontakt med sluttbrukere.							

16. Hvilket utsagn er du *aller* mest enig i?

- ☐ Det finnes noe som er objektivt sant, og noe som ikke er sant. Fakta er fakta. Virkeligheten kan avdekkes gjennom flere undersøkelser, som sammen motvirker feilaktige perspektiver, slik at man finner ut hva som er det korrekte perspektivet.
- ☐ Hva som er sant, er egentlig subjektivt. Fakta er *noens* fakta. Virkeligheten fortolkes og konstrueres basert på inntrykk, og man må derfor bli enige om hva som skal være det felles perspektivet gjennom forhandlinger.
- ☐ Det finnes kanskje noe som er objektivt sant, men det er umulig å vite hva dette er. Fakta er ikke nødvendigvis fakta, og informasjon fra ulike undersøkelser må man stille seg kritisk til. Virkelighetsoppfatninger bør utfordres og diskuteres, slik at man kan finne et hensiktsmessige perspektiv å ta.

17. Dersom du kan velge flere, hvilke av disse utsagnene vil du si deg enig i?

- ☐ Det finnes noe som er objektivt sant, og noe som ikke er sant. Fakta er fakta. Virkeligheten kan avdekkes gjennom flere undersøkelser, som sammen motvirker feilaktige perspektiver, slik at man finner ut hva som er det korrekte perspektivet.
- ☐ Hva som er sant, er egentlig subjektivt. Fakta er noens fakta. Virkeligheten fortolkes og konstrueres basert på inntrykk, og man må derfor bli enige om hva som skal være det felles perspektivet gjennom forhandlinger.
- ☐ Det finnes kanskje noe som er objektivt sant, men det er umulig å vite hva dette er. Fakta er ikke nødvendigvis fakta, og informasjon fra ulike undersøkelser må man stille seg kritisk til. Virkelighetsoppfatninger bør utfordres og diskuteres, slik at man kan finne et hensiktsmessige perspektiv å ta.

18. Hvilket utsagn er du *aller* mest enig i?

- ☐ Jeg foretrekker kvalitative metoder, som gir meg nærhet til brukere, dybdekunnskap og rik innsikt.
- ☐ Jeg foretrekker kvantitative metoder, som gir meg generaliserbar oversiktskunnskap og representativ informasjon.

19. Hvilket utsagn er du *aller* mest enig i?

- ☐ I mitt arbeid er jeg en ekspert. Jeg sørger for at den korrekte teknologiske løsningen bygges.
- ☐ I mitt arbeid sørger jeg for dialog, slik at alle parter gjennom kommunikasjon og forhandlinger til slutt kan enes om en løsning som fungerer godt for alle.
- ☐ I mitt arbeid jobber jeg aktivt for å påvirke prioriteringer i en riktig retning, slik at løsninger for eksempel ikke påtvinges eller ekskluderer sluttbrukere.

20. Dersom du kan velge flere, hvilke av disse utsagnene vil du si deg enig i?
På en skala fra 1-7, der 1 er helt enig og 7 er helt uenig.

	Helt enig 1	Ganske enig 2	Litt enig 3	Verken enig eller uenig 4	Litt uenig 5	Ganske uenig 6	Helt uenig 7
I mitt arbeid er jeg en ekspert. Jeg sørger for at den korrekte teknologiske løsningen bygges.							
I mitt arbeid sørger jeg for dialog, slik at alle parter gjennom kommunikasjon og forhandlinger til slutt kan enes om en løsning som fungerer godt for alle.							
I mitt arbeid jobber jeg aktivt for å påvirke prioriteringer i en riktig retning, slik at løsninger for eksempel ikke påtvinges eller ekskluderer sluttbrukere.							

Til sist ønsker vi litt bakgrunnsinformasjon om deg:

21. Hva er din faglige bakgrunn?

- ☐ Informatikk/Teknologi
- ☐ Design/Interaksjonsdesign
- ☐ Markedsføring/Media
- ☐ Annet:

  _____

22. Hva er din alder?

- ☐ Under 30 år
- ☐ 30-39 år
- ☐ 40-49 år
- ☐ 50-59 år
- ☐ Over 60 år

Tusen takk for din deltakelse!

Appendix D: Codebook SPSS

1) Informants: Informant number (1-31)
2) Company: 1 = Consultant Agency
   2 = State Agency
   3 = Private Agency
3) Experience: Number of years
4) Motivation: 1 = Personal
   2 = Legislation
   3 = Both
5) Discipline: 1 = Designer
   2 = Developer
   3 = Manager
   4 = Advisor
6) Competence: Likert scale (1-7)
7) Agile: 1 = Yes
   2 = No
   3= Hybrid
8) Age: 1 = < 30
   2 = 30-39
   3 = 40-49
   4 = 50-59
   5 = > 60
9) Gender: 1 = Female
   2 = Male
10) Category mentions: 0 = Not mentioned
    1 = Mentioned

PRO_ORG:	10-13	NEG_EXT:	23
PRO_EXT:	14	NEG_ORG:	24
PRO_PRO:	15-20	NEG_PRO:	25-27
PRO_IND:	21-22	NEG_IND:	28

Appendix E: Article on the Pre-study, Published at NOKOBIT 2016

PROMOTING AND OBSTRUCTING FACTORS FOR SUCCESSFUL UNIVERSAL DESIGN

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ABSTRACT

The focus on Universal Design (UD) has increased steadily over the last decades. Web content accessibility standards and guidelines have been created, and specific legislation is in place in several countries to further UD. However, there are limited insights into the actual practices regarding successful implementation of UD in ICT-projects. This study aims to provide such insights through an interview study with 13 individuals affiliated with 12 ICT-projects that have been successful in ensuring UD. The data from the interviews is analyzed in-depth through a thematic analysis, in search for theoretical interpretations that may generate the basis for a proposed best practice for UD in ICT-projects. Our data identify 13 promoting and 6 obstructive factors related to the implementation of UD, spanning three levels - organizational, process and individual. Our findings both coincide and expand previous research findings. The study highlights the link between user-centered design, usability focus and universal design. On process level, early and continuously focus on UD and usability in iterative approaches with frequent quality assurance and user contact and interdisciplinary collaboration seems to be good practice. Our findings also emphasize the importance and influence of having a solid anchoring of UD at all levels (a "UD culture"), as well as the individual competence and personal qualities of team members and stakeholders. Main findings are summarized in 6 factors; "UD anchoring", "UD competence", "Focus", "Collaboration", "Iterative" and "QA". Future research aim to verify findings, contribute towards reliable best practices, model practice factors and design a tool indicating the UD maturity of a project.

1 INTRODUCTION

The necessity to ensure that the one billion individuals with various disabilities can use information and communication technology (ICT) in the same way as individuals without disabilities, is acknowledged by The International Telecommunication Union (ITU), (Msimang, 2014). Today, ICT-solutions are more frequently linked to civil rights, for instance voting. It is therefore vital to avoid discriminating against any part of a country's population when digitalizing such services. Legislation regarding UD is only present in certain countries, and may vary from one country to another. In some countries only certain providers, such as official public web sites, are effected by UD legislation. Therefore a synchronized international effort might be essential in order to create a common UD standard (Vanderheiden and Treviranus 2011; Abascal et al. 2015).

There are both ethical and commercial benefits of UD. To exclude disabled users from receiving the benefits of new technology is unfortunate. By doing so, there is also a risk of eliminating a considerable group of potential customers; for instance those with physical and cognitive limitations, ageing people, individuals with low socioeconomic status, low literacy skills, children and individuals

who do not speak the native language (Fuglerud and Sloan, 2013; Cremers et al. 2014; Scott, Spyridonis and Ghinea, 2015; Abascal, et al. 2015).

In Norway, the government initiated an ambitious aim for the country to be universally designed by 2025 (Anti-Discrimination and Accessibility Act 2009). A section of the Norwegian legislation for UD is dedicated specifically to ICT. However, despite this legislation, as few as five of Norway's 50 most visited websites met the minimum criteria for universal design in 2014 (Aune, 2014). According to Rygg and Brudvik (2015), a sample survey performed by DIFI to check web accessibility on 304 Norwegian websites, returned disappointing results regarding Norway's standards for UD. There were large variations amongst the sample web sites, and scores ranged from 18 to 79 percent of the possible obtainable points in their measuring system. The average was at 51 percent.

In order to provide more insight into possible best practices, this study investigates ICT-projects that have received awards or honorable mentions due to the quality of universal design in their projects. Through an interview study with 13 designers and developers affiliated with 12 successful projects, this article explores recommended practices for high-quality universal design in Norwegian ICT projects.

2 PREVIOUS WORK

The concept of Universal Design (UD) was introduced in the mid-eighties, and have been applied to several fields, where ICT is one of the more recent ones (Røssvoll and Fuglerud, 2013). There are various terms used to define UD; Universal Usability, Inclusive Design, Design for All, User-Sensitive Inclusive Design and Ability-Based Design to name a few. Petrie, Savva and Power (2015) performed an analysis of 50 different definitions of web accessibility. They searched for a better way of understanding what researchers and practitioners consider the core components of web accessibility. This demonstrates how open the field of universal design is, and why it is difficult to have *one* common understanding.

In the process of assuring accessible ICT-solutions the goal is to meet all the requirements specified by W3C Web Content Accessibility Guidelines (WCAG). Several researchers agree that accessibility standards and guidelines are necessary tools to ensure UD (Røssvoll and Fuglerud, 2013; Schulz et al. 2014; Scott, Spyridonis and Ghinea, 2015). However, there seems to be a growing consensus that compliance with these guidelines alone is not adequate for achieving universally designed ICT-solutions. For an ICT solution to be completely accessible, a distinction between technical and usable accessibility must both be in place (Røssvoll and Fuglerud, 2013; Garrido et al. 2013; Schulz et al. 2014; Abascal et al. 2015; Aizpurua, Arrue and Vigo, 2015; Jung et al. 2015). A gap is identified between the theory of inclusive design and the industry practices. According to Fuglerud and Sloan (2013) there is a heavy focus on standards in the requirements provided by the legislations, without any emphasis on the development process.

Seven key principles for an inclusive design process are identified in the literature *1)* holistic and interdisciplinary teams and/or process, *2)* based on user-centered design principles, *3)* adopting and applying accessibility standards and guidelines, *4)* using an iterative development, *5)* focus on users with disabilities, - early and throughout, the entire design process, *6)* use of empirical evaluations with various impairments represented and *7)* focusing on the entire user experience (Fuglerud and Sloan, 2013; Røssvoll and Fuglerud, 2013; Schulz et al. 2014; Scott, Spyridonis and Ghinea, 2015).

A cross-sector survey performed amongst web development projects in Brazil, reports a lack of consciousness regarding accessibility issues in the web development process (Freire, Russo, Fortes, 2008). The study had 613 participants and suggests educating web developers in how disabled individuals use assistive technologies. The study implies that by showing developers how a user struggles with a solution they have developed themselves can be very effectual.

Cremers et al. (2014) argue that the most suitable approach to UD is by enriching inclusive design methods with qualitative methods from anthropology, to enable personalized systems. Sachdeva et al. (2015) on the other hand, explore how to make technology affordable and socially accepted, using social and systemic innovation alongside already existing technical innovations.

3 RESEARCH APPROACH

Due to the nature of the study's research topic, it is deemed expedient to use an exploratory and qualitative approach for data collection. Semi-structured, in-depth personal interviews are selected in order to maintain a solid foundation and framework, exposing the respondents to the same questions and themes, while simultaneously allowing for flexibility and follow-up questions (Rogers, Sharp and Preece, 2011).

The interview guide is divided into two main sections. The first part concerns personal experiences related to practices for successfully achieving UD in Norwegian ICT projects, and consists of 5 questions. The second part concerns methodic style and epistemologies, and consists of 10 questions. In addition 6 questions map out background variables about the informants. The entire guide consists of 21 questions. This study, however, focuses on the first section of the interview guide and the questions concerning UD practices in Norwegian ICT projects[2]. Questions are formulated as neutrally as possible to avoid creating bias.

A prerequisite for participation is affiliation with an ICT project linked to success in regards to UD. 'Success' is defined as either having won an award or getting an honorable mention for efforts concerning UD. Based on this, 13 informants are recruited for the study over a total of 11 interviews: 9 individual interviews and 2 group interviews, where two informants are interviewed together. Several participants are involved in projects linked to the public sector and want data to be held anonymous due to confidentiality agreements in the respective projects. As a consequence, all data is kept anonymous. In order to increase readability all agencies and mentioned projects are numbered. Projects linked to UD successes are marked with an asterix (*).

All participants received written information about the study, and gave their written consent for participation and for recording of the interview. The averaged duration of an interview was 45 minutes. The recordings were transcribed verbatim. In addition to recordings, hand-written notes were made throughout the interviews. The study is reported to the Data Protection Official for Research (NSD) as part of a larger study.

3.1 Data Analysis

A thematic content analysis was selected for data analysis. There are few pre-defined codes in the existing literature, and emergent coding or ("open coding") was chosen. After completing the interviews, the 13 transcripts are reviewed in order to form an initial overview of and familiarization with the data. Questions giving overlapping answers are identified. These are regarding specific practices in successful projects (Q7), the preferred methodologies in an imagined project (Q8) and general practices that promote UD (Q9). Overlapping questions regarding negative practices are practices inhibiting UD (Q10), and factors affecting the choice of methods (Q13). As a consequence of

[2] Q7, Q8, Q9, Q10, Q13

the overlapping responses, the transcripts are analyzed as a continuous text, as opposed to questions consecutively. Two overarching categories are identified, one considering positive *promoting* aspects, and one considering the negative *obstructive* aspects. A second transcript review is conducted separately by the two authors with the goal of identifying unique codes in the text. For researcher 1 this results in 103 codes across the 13 transcripts, separated into 75 promoting and 28 obstructive. Researcher 2 identifies 104 codes; 75 promoting and 29 obstructive. The full list of codes is available upon request.

Weber states the ultimate goal of reliability control is to ensure that different people code the same text in the same way (Lazar, Feng and Hochheiser, 2010). Inter-coder reliability is thusly calculated between two coding researchers. 88 % of the 150 promoting codes have a perfect or nearly perfect overlap. A further 10 % are overlapping, but without an exact match. This is due to researcher 1 focusing more on detailing codes related to understanding the concept of UD, while researcher 2 focus more on organizational culture and resource prioritizing. Overall, there is a 98 % overlap between promoting codes. Only 3 codes clearly differ; researcher 1 has a code on innovative abilities while researcher 2 has one on access to ATs and another on the link between securing usability and UD.

For the 57 obstructive codes there is a 95 % overlap. Again there are 3 diverging codes; researcher 1 has a code on handling resistance, while researcher 2 has one related to lacking utilization of available UD resources and another on the challenge of frameworks and tools in violation of WAI. In order to quality control the categorization process, codes and code-categories were discussed, and codes cooperatively sorted and categorized. The result is 13 promoting and 6 obstructive categories.

3.1.1 Promoting Categories

Promoting, positive categories are divided into organization level, project process level and individual level practices; 5 categories on organization level, 6 on process level and 2 categories on individual level. The finalized categories from the thematic analysis of UD *promoting factors* are presented in Table 1, Table 2 and Table 3. Note that codes in the category *Resources* are relevant both for organizational aspects and for specific project processes, thus the category could also be placed on process level.

Category	**Description**	**Codes**
Top level Focus	UX/UD-department UD specialist group Ensuring UD competence Disabled co-workers Good-practice library	1, 18, 20, 28, 48, 49, 64, 76, 78, 86, 89, 109, 133, 143, 149
Resources	Available ATs, Human resources, Economic resources	19, 94, 95, 96, 115
Anchoring	Understanding, awareness and competence at all management levels Internalized UD culture UD strategy Usability strategy	2, 6, 10, 11, 41, 45, 69, 71, 77, 79, 80, 81, 82, 83, 84, 90, 91, 102, 138
Reputation	External recognition (awards, nominations...)	7, 70, 73, 74, 85, 87,

Category	Description	Codes
	Presentation, conferences Visibility (internal/external)	88, 144
Legislation	Legislation gives priority Feedback and support from supervisory authority	27, 145, 146, 147

Table 1: Organizational Level Promoting Factors

Category	Description	Codes
UD Focus	Early; from needs analysis Throughout project process Requirement specification Costumer/resource priorities In solution- and UI-design Across groups; design for all UD process maturity Agency collaboration	4, 12, 47, 54, 57, 59, 60, 92, 97, 98, 99, 100, 101, 108,148
User Focus	Personification of users (persona/user stories) Early testing – from sketch Frequent user feedback Frequent QA-inspections Test accessibility + usability Continuous low-cost formative (guerilla) testing High-quality user testing with disabled users User needs prioritized Real user feedback	5, 21, 33, 34, 35, 38, 39, 42, 43, 50, 51, 61, 62, 63, 67, 68, 93,107, 119, 120, 125, 126, 127, 128, 129, 130, 132, 150
Quality Assurance	Clear UD quality demands Test code, design, content Early code/unit quality check Milestone (planned) controls Automated validation Internal inspections (peer-inspections, basic needs, simple ATs, accessibility) External expert inspections (advanced ATs and needs)	9, 22, 23, 26, 52, 53, 56, 116, 117, 118, 121, 122, 123, 124, 134, 135, 136
Agile	Iterative development with continuous feedback Flat structure: distributed, personal responsibility	24, 25, 36, 46, 72, 103, 105, 106, 131
Cooperate	Cross-disciplinary teams Interdisciplinary design, QA, discussions and user testing	15, 29, 30, 58, 65, 110, 111, 112, 113,

Category	Description	Codes
	Established collaboration, roles and dialogue Co-location and full team-member positions	114
Simplicity	Simple/Mobile UI/code first Start with common minimum	37, 104

Table 2: Process Level Promoting Factors

Category	Description	Codes
UD Competence	Understand UD principles Across groups; universal Beyond "disability" Education/experience	8, 40, 55, 66, 142, 143
Personal Qualities	Enthusiasm Empathy Innovative Collaborative	3, 13, 14, 16 17, 31, 32, 44, 75, 137, 139, 140

Table 3: Individual Level Promoting Factors

3.1.2 Obstructive Categories

Codes associated with obstructive practices are sorted into 6 categories, and then into sub-levels organization, process or individual. This results in 1 category at organization level, 4 categories on a process level and 1 category on individual level. The finalized categories for thematic analysis of *obstructive practices* are presented in Table 4, Table 5 and Table 6.

Category	Description	Codes
Lack of Anchoring	Lack of UD understanding Lack of usability culture Resistance to UD	6, 8, 10, 11, 18, 20, 24, 28, 29, 31, 42

Table 4: Organizational Level Obstructive Factors

Category	Description	Codes
Focus	Lack of UD focus and priority Lack of user focus Lack of UD QA	2, 17, 30, 32, 40, 44, 45, 48
Process Issues	Lack of interdisciplinary cooperation in design & tests Sequential process model with testing and UD at end	9, 15, 20, 23, 25, 26, 27, 33, 36, 37, 38, 39, 40, 43, 46, 52, 53,

Category	Description	Codes
		54
Technical Challenges	Frameworks & trends not supporting accessibility	12, 21, 56, 57
Constraints	Time, Economy, Resources Lacking competence Lacking test equipment User unavailability	1, 13, 16, 19, 22, 34, 35, 41, 50, 51, 55

Table 5: Process Level Obstructive Factors

Category	Description	Codes
Lack of Competence	Lack of knowledge and understanding Lack of interest Negativity Inexperience	3, 4, 5, 7, 14, 47, 49, 50

Table 6: Individual Level Obstructive Factors

4 Findings

Table 7 presents an overview of the informants, which of five are women and eight are male. They include five developers; both front-end and back-end is represented. Further, four are interaction designers, one a functional designer and one a graphic designer. Finally, two are UD advisors. One of the advisors has a background as developer. Seven of the informants represent consulting agencies, three represent state agencies and three represent private firms.

Consultants are associated with projects from both public and private sector. The study investigates a total of 12 successful ICT projects. Five of the informants are affiliated with more than one successful project and several of the informants are affiliated with the same projects.

No	Experience	Competence	Project	Motivation
1	9 years	5	#7* #14*	Personal
2	4 years	5	#7* #14*	Personal
3	5 years	6	#5* #15	Personal+ Legislation
4	4 years	5	#6* #13	Personal
5	5 years	5	#5* #4* #12*	Legislation
6	10 years	6	#1* #16*	Personal

7	13 years	7	#5* #12* #11 #10	Personal+ Legislation
8	1 year	4	#1*	Legislation
9	15 years	5	#2*	Legislation
10	13 years	6	#1*	Personal
11	2 years	5	#3*	Personal + Legislation
12	8 years	6	#3*	Personal
13	16 years	7	#8* #9*	Personal

Table 7: Informant Profiles

Table 8 displays the informants' years of experiences (rounded up), numbers of projects mentioned during the interview (with asterix (*) on proven UD successful projects), self-rated competence (informants have evaluated their competence level on a scale from 1-7, where 1 is inadequate and 7 is excellent) and motivations for working with UD. Motivation is categorized as either *personal* or connected to *legislation*, where 'personal' reflects a personal interest in UD, while 'legislation' represents an interest that arose after the Norwegian legislation on UD went into effect.

No	**Age**	**Gender**	**Title/Discipline**	**Company**
1	30-39	Female	Functional Designer	Consultant Agency #1
2	> 30	Female	Interaction Designer	Consultant Agency #1
3	40-49	Male	Interaction Designer	Consultant Agency #2
4	30-39	Male	Interaction Designer	Consultant Agency #3
5	40-49	Female	Visual/Graphic Designer	Consultant Agency #2
6	30-39	Male	Developer	Consultant Agency #4
7	50-59	Male	Developer	Consultant Agency #2
8	> 30	Female	Developer	State Agency #1
9	40-49	Male	(Web) Advisor	State Agency #2
10	40-49	Male	Senior UD Advisor	State Agency #1
11	30-39	Female	Developer	Private Agency #1
12	40-49	Male	Developer	Private Agency #1
13	30-39	Male	Interaction Designer	Private Agency #2

Table 8: UD expertise and motivation

Through iterative transcript reviews by the two researchers, frequencies are mapped out for 1) how many informants mention codes associated with each category, and 2) how many times in total codes associated with each category are mentioned. A total of ten transcripts reviews are completed as part of the analysis; four for coding and categorization and six for frequency mapping.

The tables in the following sections present the counted sums of mentions for each specific category across all the transcripts. They also present which informants that mentions each category. A category can include several codes, and the frequency-of-mention per category embraces all included codes in the category. Informants who answer together in a group interview, on behalf of *one* project, are still counted as two individual informants.

4.1 Factors Promoting UD

Tables 9, 10 and 11 summarize frequencies for UD promoting practices mentioned in the interviews. Table 9 display frequencies on organization level. The importance of an established internalized UD culture, including ensuring available human resources with UD competences, is recognized. Many of the informants mention legislation as a useful tool for getting UD prioritized.

Category	**Mentions**	**Informants**
Top-level understanding	18	8 (No. 1,4,6,8,9,10,11,12)
Resources	28	11 (No. 1,2,3,4,5,6,7,9,10,11,12)
Anchoring	17	10 (No. 1,2,3,4,6,7,8,10,11,12)
Reputation	12	3 (No. 6,11,12)
Legislation	18	9 (No. 1,2,4,5,7,10,11,12,13)

Table 9: Organization Level Promoting Frequencies

Category	**Mentions**	**Informants**
UD focus	59	12 (No. 1,2,3,4,6,7,8,9,10,11,12,13)
User focus	53	12 (No. 1,2,3,4,6,7,8,9,10,11,12,13)
Quality Assurance	37	12 (No. 1,2,3,4,6,7,8,9,10,11,12,13)
Agile	10	5

		(No. 1,4,6,10,13)
Cooperate	37	11 (No. 1,2,4,5,6,8,9,10,11,12,13)
Simplification	6	5 (No. 1,3,4,12,13)

Table 10: Process Level Promoting Frequencies

Table 10 shows promoting practices on process level. UD and user focuses are recognized as the most important factors on ICT projects process levels; *"...UD must be present from the very beginning of development, and permeate all aspects of the project delivery"*. Early and continuous focus on UD in is mentioned by 12 of the 13 informants, as is having a strong user focus. Codes linked to both categories are frequently mentioned in the interviews. 10 informants emphasize early and frequent user testing as well as high-quality user testing with disabled users. On the link between user focus and UD focus, one informant states *"Focus on usability in general furthers universal design, because the two walk hand in hand. It is often easier to take usability to heart, and the though of making it usable for all. That is a good gateway to the theme of UD"*.

Continuous quality assurance and interdisciplinary cooperation are also highlighted frequently and by most. These aspects are also tied to user and UD focuses. Several specify the importance of including UD quality demands and requirements criteria. 12 informants express the value of quality assurance (QA), seven of which focus on external quality control in the form of specialized expert UD evaluation, while five mention automated tools and internal technical code reviews. One informant explains: *"we chose two solutions; firstly we hired a specialist at UD in front-end development who would participate in the development team to our supplier. Secondly, we used specialists in UD as external quality advisors in the development of requirements, design, UX, etc. These specialists participated either in meetings with our supplier when different solutions were discussed, or were contacted directly to check whether a proposed solution was good according to UD."*

11 informants promote cross-disciplinary dialogue, collaboration connecting visual design, technical code, content and usability and interdisciplinary problem solving. Involving developers in user testing is highlighted; increasing UD engagement and providing first hand evidence of hardships experienced by disabled users. Informants aim to integrate UD in all phases and all design and development work. A little less than half of the informants mention how iterative and/or agile processes promote UD.

Category	**Mentions**	**Informants**
UD Competence	34	11 (No. 1,2,3,4,6,7,8,9,10,11,12)
Personal qualities	25	13 (No. 1,2,3,4,5,6,7,8,9,10,11,12,13)

Table 11: Individual Level Promoting Frequencies

Table 11 shows promoting factors on individual level. Here, informants mention how important it is to have sufficient UD competence attached to a project. Key persons such as project owner, designers

and developers need to have a holistic understanding of UD rather than only focusing on legislated WCAG criteria. Many mention overlapping needs and how UD benefits individuals without impairments e.g. using mobile technologies or experiencing challenging contexts of use, and highlight the necessity of motivations to ensure usability for all. One says: "*In my experience, it is effective to compare UD to usability in general, and to look at it from an elevated perspective where UD is not simply about having 'visually impaired or blind people also able to use a website'. UD is the other side of usability, and when you focus on UD, you also focus on usability – that way the solution becomes better for everyone.*"

Several informants say at least one person with a strong professional UD enthusiasm is needed for increasing UD competence and engagement in team members and stakeholders. Some personal qualities in people working on projects linked to UD successes are also pointed out; user empathy, a positive interest in UD and an openness to learn and evolve. Many of the informants show signs of possessing these qualities themselves during the interview.

4.2 Factors Obstructing UD

Tables 12, 13 and 14 summarize the frequencies for practices obstructing UD mentioned in the interviews. Table 12 presents the frequencies on organization level.

Category	**Mentions**	**Informants**
Lack of Anchoring	26	13 (No. 1,2,3,4,5,6,7,8,9,10,11,12,13)

Table 12: Organizational Level Obstructive Frequencies

Category	**Mentions**	**Informants**
Focus	18	8 (No. 1,2,3,4,6,7,8,10)
Process Issues	20	8 (No. 1,2,3,4,6,7,8,10)
Technical Challenges	5	4 (No. 10,11,12,13)
Constraints	23	11 (No. 1,2,3,4,6,7,8,9,10,11,12)

Table 13: Process Level Obstructive Frequencies

Category	**Mentions**	**Informants**
Lack of Competence	23	9 (No. 1,2,4,6,8,9,10,11,12)

Table 14: Individual Level Obstructive Frequencies

All informants point out lack of anchoring of UD on top levels as obstructive. The interviews indicate that if a UD-culture is not anchored in the organization, UD is likely not to be prioritized in processes. Thus, constraints may become an issue. Also, all informants mention that resource constraints affect the process, and most mention at least once during the interviews that tight constraints limit the capability to succeed. Time constraints are quite frequently mentioned as an important factor, as is available competent human resources and available test resources – including user unavailability. Further, lack of anchoring and focus is tied to lack of individual UD competence, as the priority and time resources to ensure employees have the needed knowledge and skills are not allocated. More than half of the informants mention that a lack of knowledge and experience regarding UD will damage the team's ability to implement UD.

The informants exemplify how lack of knowledge and UD culture is manifested in resistance and counterarguments such as "why do we have to spend time on this, it only applies to 1% of the users" and "there are only 1000-1200 blind people in the country, why on earth are you doing this?". Process model issues are also quite often mentioned. Informants especially warn against sequential processes with a late UD focus, and no or little early testing and quality assurance. Most informants mention interdisciplinary collaboration and cross-disciplinary communication is an important promoting factor for UD, and about half of the informants specifically point out that cooperation can be an issue. A few mention technical challenges such as frameworks or trends that do not support UD principles.

5 DISCUSSION

The study identifies a set of positive and negative factors affecting the implementation of UD in Norwegian ICT projects. The positive factors may be seen as indicators as to what may *promote* successful implementation of UD, while the negative factors on the other hand may be seen as indicators of *obstructive* elements. An interesting tendency in the data is almost all the negative factors identified are merely *opposites* of a corresponding positive factor, such as *the lack of* anchoring, competence, resources or interdisciplinary cooperation. This inclination further supports the notion of the positive factors being important promoting practices.

There are two factors that all the informants mention in some manner: 1) an understanding and *anchoring* of UD and usability culture at all levels, and 2) *UD competence*; stakeholders holding necessary understanding and skill sets, including personal qualities and enthusiasm. The need for a proper *understanding* of what UD actually is and proper *anchoring* are mentioned by 11 informants as *promoting* factors a total of 35 times, and by all 13 informants a total of 26 times as an *obstructive* factor.

Further, there are some factors *almost* all the informants mention; 3) UD and usability *focus* in the projects, including prioritizing time to do user-centered and QA activities, 4) interdisciplinary team *collaboration* – both related to process level cooperation and personal qualities of colleagues, and 5) an *iterative* process model with 6) early and frequent *QA* and user testing. These six factors are interpreted as *particularly important* for ensuring UD. They are all related, and could be divided into more or fewer factors depending on the desired level of detail. It is worth noting that even through resources are mentioned by all informants as an element in relation to method selection, it is not necessarily mentioned as a promoting or obstructive factor, but rather as a consequence of and requirement for other factors.

Most informants do not primarily call for more resources to do UD activities beyond ensuring the necessary competence; time to learn new skills if needed during the process and considering external QA control. The informants mention *human resources* as vital for UD, pointing to *UD competence*. The need to give QA and testing priority is also emphasized; tying *time resources* to obstructive/promoting practices. As such, increased costs related to UD seem to be mostly tied to time, pointing to the necessity of UD *focus* in requirements and processes. Several mention how an early UD-positive "usability for all" focus in an iterative process limits the need for extensive resources.

The lack of funding and/or time may as such be viewed as a consequence of missing anchoring, thus further implying that without proper anchoring, UD practices will be obstructed.

The important factors identified in this study coincide well with seven key principles identified for an inclusive design process in the literature (Fuglerud and Sloan, 2013; Røssvoll and Fuglerud, 2013; Schulz et al. 2014; Scott, Spyridonis and Ghinea, 2015). First, having a *holistic and interdisciplinary team and/or process (principle 1)* was mentioned by 11 of 13 informants in this study and grouped in the code category *cooperate* which was mentioned 37 times. The fact that this was brought up more than once per informant, suggests that it is of great importance for successful implementation, and that the team plays an important part. Several of the informants mention the term "interdisciplinary" and there were also several mentions of how important good communication and co-location is. Not being able to talk directly to the other team members is identified as obstructive, and a root cause for misunderstandings and difficulties. *Basing the process on user-centered design principles (principle 2)* is also strongly supported in our findings. Early and frequent *user focus* is mentioned as many as 53 times by 12 of the 13 informants. A quite intriguing finding is how several of the informants describes a 'proper understanding' of UD as the recognition of *a link connecting UD and general usability*; and how making a solution universally designed, also makes it more usable for *all users.* Several informants share this vision, and agree that it is important for management, costumers and team members to see this link in order to fully understand *why* UD is important. This is consistent with the literature key factor; *focusing on the entire user experience (principle 7).*

Further, the informants also support *using an iterative approach (principle 4)* to development, and specify how separating UD from the design and development process is adverce, as is delaying UD focus until towards the end of a project and treating UD as one step in a sequential process. 12 informants mention having an early and continuous focus on users with disabilities early, and throughout the entire design process (*principle 5*), in this study coded as UD focus and mentioned the most frequently – 59 times. Out of the 13 informants, 12 mention various degrees of internal and external *quality assurance* such as the *use of empirical evaluations with various impairments represented (principle 6)*. QA is mentioned as a promoting factor 37 times and is the third most frequently mentioned code category. Allowing all parts of the team, including developers, to witness usage difficulties is mentioned several times, and coded both under the promoting categories *Cooperate* and *UD Competence* and the obstructive category *Process Issues.*

Linked to the ability to *adopt and apply accessibility standards and guidelines (principle 3)* all informants mention the importance of having the right *resources* and the right *competence*, and 9 informants specifically mentioned *legislation.* The need for requirements specifying UD is highlighted in the category *UD focus*. This principle is also tied to UD competence and personal qualities, which are highlighted in the interviews. Four of the five developers interviewed report a personal motivation for UD, five out of six if the UD advisor with a developer background is included. Taking into account that *all* the designers interviewed also specifically mentions how "their" team developers are interested in, and takes UD seriously the study suggests that having a *developer* with high *UD competence* may be an important promoting factor. This finding also coincides with the study performed in Brazil by Freire, Russo and Fortes (2008).

Finally, the results from this study are aligned with studies exploring implementation of a user-centered design in agile processes (Raison and Schmidt, 2013; Begnum and Thorkildsen, 2015; Silva da Silva et al. 2015). These studies also points out that anchoring of user-centered design at a business level may affect how well implementation will work in an agile process. The identified key factors in this study are thus not necessarily unique for the implementation of UD in an ICT-project, but may also be true for user centeredness, usability and user experience work in general.

The findings in this study are reinforced by previous findings in the literature, and vice versa. It can however be argued that this study to a larger degree emphasize having some form of top-level *anchoring* of UD as necessary in order for other promoting practices to fall into place. Without an understanding of what UD is among stakeholders such as leaders and costumers, projects will not be granted the right resources they need to succeed; whether it is necessary competence or authority to

prioritize focus on users and QA, thus maintaining an early and continuous focus throughout the process.

5.1 Limitations of the Study

This study identifies a set of promoting and obstructing factors based on a limited number of successful projects; therefore there is a potential that the study could have identified more, or entirely different, factors had a larger population been represented. It may also be speculated in whether or not interviewing only "successful" projects makes this a non-representative population. Finally, the definition of "successful" could be discussed – e.g. what awards and/or honorable mentions should be regarded as valid for "success" inclusion. The validity of the findings are supported by the fact that two researchers performed the analysis; coding, categorizing, determining frequencies and interpreting the data, and came to similar conclusions. In addition, the results correspond with findings in other literature.

6 CONCLUSION

This study explores successful practices for the implementation of UD in Norwegian ICT projects. The data is based on an in-depth interview study of 13 informants across 12 UD-successful projects. A thematic analysis identifies a set of positive and negative factors that are interpreted as *promoting* and *obstructive* practices for ensuring UD in ICT solutions. Six important promoting factors are identified: 1) *UD anchoring*, 2) *UD competence*, 3) *focus* (on UD, users and usability), 4) *collaboration* (in interdisciplinary teams), 5) *iterative* approaches and 6) early and frequent *QA* and user testing. Identified negative and obstructive factors are mainly absence of a corresponding positive factor, and may as such be seen as a confirmation that the positive factors identified are in fact "success factors".

Findings coincide well with related literature. The factors emerging from the transcripts in this study are categorized on three levels; organizational, project process and individual. This study therefore provides insight into the relationship between factors, including the positive effect of an anchored UD culture on organizational top-level to promoting process practices outlined, as well as ensuring competence and understanding on an individual level. The study also highlights the importance of human resources with UD competence and the presence of positive personal qualities and UD enthusiasm.

6.1 Future Research

Future research will firstly focus on confirming the insights by increasing the number of informants as well as the number of successful projects. The findings in this study should be strengthened with regards to generalizability. Comparative case studies may also be considered, where factors identified as crucial for success in this study are absent or present. Through further studies, new aspects may appear, and relationships and dependence between factors may become clearer. Next, the aim is to model the identified practice factors, and based on this design a measuring tool suitable for providing an indication of how prepared a project is to implement UD ("UD maturity").

Best practices may also be viewed in a larger perspective related to user and usability focus in general. Several informants link user focus, usability focus and UD focus. Iterative and interdisciplinary user-centered processes with early and continuous UD focus and UD QA seems to be best-practice approaches. Having user contact is further regarded as important when designing for disabled users, including allowing developers and non-designer team members to witness usage difficulties. Future research will thus also focus on the integration of both UD and UX work into the agile approaches commonly used in Norway ICT project processes.

The overall goal is to be able to make contributions towards more reliable best practices based on verified success factors, as well as attempt to create a measuring tool for ICT-projects related to UD that can be used to indicate to what degree a project is likely to achieve UD based on organizational, individual and process properties.

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Appendix F: Cross tabulations in SPSS per category by Discipline and Company

PRO_ORG_TopLevelFocus * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_ORG_TopLevelFocus	Not mentioned	4	1	0	0	5
	Mentioned	11	8	4	3	26
Total		15	9	4	3	31

PRO_ORG_TopLevelFocus * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_ORG_TopLevelFocus	Not mentioned	4	0	1	5
	Mentioned	10	7	9	26
Total		14	7	10	31

PRO_ORG_Resources * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_ORG_Resources	Not mentioned	1	2	1	0	4
	Mentioned	14	7	3	3	27
Total		15	9	4	3	31

PRO_ORG_Resources * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_ORG_Resources	Not mentioned	0	1	3	4
	Mentioned	14	6	7	27
Total		14	7	10	31

POR_ORG_Anchoring * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
POR_ORG_Anchoring	Not mentioned	2	0	0	1	3
	Mentioned	13	9	4	2	28
Total		15	9	4	3	31

POR_ORG_Anchoring * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
POR_ORG_Anchoring	Not mentioned	1	1	1	3
	Mentioned	13	6	9	28
Total		14	7	10	31

PRO_ORG_Reputation * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_ORG_Reputation	Not mentioned	11	5	4	2	22
	Mentioned	4	4	0	1	9
Total		15	9	4	3	31

PRO_ORG_Reputation * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_ORG_Reputation	Not mentioned	10	5	7	22
	Mentioned	4	2	3	9
Total		14	7	10	31

PRO_PRO_UDfocus * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_PRO_UDfocus	Not mentioned	1	1	0	0	2
	Mentioned	14	8	4	3	29
Total		15	9	4	3	31

PRO_PRO_UDfocus * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_PRO_UDfocus	Not mentioned	1	0	1	2
	Mentioned	13	7	9	29
Total		14	7	10	31

PRO_PRO_UserFocus * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_PRO_UserFocus	Not mentioned	1	0	0	0	1
	Mentioned	14	9	4	3	30
Total		15	9	4	3	31

PRO_PRO_UserFocus * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_PRO_UserFocus	Not mentioned	1	0	0	1
	Mentioned	13	7	10	30
Total		14	7	10	31

PRO_PRO_QA * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_PRO_QA	Not mentioned	1	0	0	0	1
	Mentioned	14	9	4	3	30
Total		15	9	4	3	31

PRO_PRO_QA * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_PRO_QA	Not mentioned	1	0	0	1
	Mentioned	13	7	10	30
Total		14	7	10	31

PRO_PRO_Agile * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_PRO_Agile	Not mentioned	7	5	3	2	17
	Mentioned	8	4	1	1	14
Total		15	9	4	3	31

PRO_PRO_Agile * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_PRO_Agile	Not mentioned	8	6	3	17
	Mentioned	6	1	7	14
Total		14	7	10	31

PRO_PRO_Cooperate * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_PRO_Cooperate	Not mentioned	1	2	3	0	6
	Mentioned	14	7	1	3	25
Total		15	9	4	3	31

PRO_PRO_Cooperate * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_PRO_Cooperate	Not mentioned	4	1	1	6
	Mentioned	10	6	9	25
Total		14	7	10	31

PRO_PRO_Simplicity * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_PRO_Simplicity	Not mentioned	7	6	2	2	17
	Mentioned	8	3	2	1	14
Total		15	9	4	3	31

PRO_PRO_Simplicity * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_PRO_Simplicity	Not mentioned	8	5	4	17
	Mentioned	6	2	6	14
Total		14	7	10	31

PRO_IND_PersonalQualities * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_IND_PersonalQualities	Mentioned	14	7	10	31
Total		14	7	10	31

PRO_IND_UDcompetence * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_IND_UDcompetence	Not mentioned	3	1	0	1	5
	Mentioned	12	8	4	2	26
Total		15	9	4	3	31

PRO_IND_UDcompetence * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_IND_UDcompetence	Not mentioned	2	2	1	5
	Mentioned	12	5	9	26
Total		14	7	10	31

PRO_IND_PersonalQualities * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_IND_PersonalQualities	Mentioned	15	9	4	3	31
Total		15	9	4	3	31

NEG_EXT_TechnicalChallenges * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
NEG_EXT_TechnicalChallenges	Not mentioned	9	5	3	1	18
	Mentioned	6	4	1	2	13
Total		15	9	4	3	31

NEG_EXT_TechnicalChallenges * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
NEG_EXT_TechnicalChallenges	Not mentioned	8	4	6	18
	Mentioned	6	3	4	13
Total		14	7	10	31

NEG_ORG_LackOfAnchoring * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
NEG_ORG_LackOfAnchoring	Not mentioned	2	1	0	0	3
	Mentioned	13	8	4	3	28
Total		15	9	4	3	31

NEG_ORG_LackOfAnchoring * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
NEG_ORG_LackOfAnchoring	Not mentioned	1	0	2	3
	Mentioned	13	7	8	28
Total		14	7	10	31

NEG_PRO_Focus * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
NEG_PRO_Focus	Not mentioned	3	3	2	1	9
	Mentioned	12	6	2	2	22
Total		15	9	4	3	31

NEG_PRO_Focus * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
NEG_PRO_Focus	Not mentioned	2	1	6	9
	Mentioned	12	6	4	22
Total		14	7	10	31

NEG_PRO_ProcessIssues * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
NEG_PRO_ProcessIssues	Not mentioned	5	2	0	1	8
	Mentioned	10	7	4	2	23
Total		15	9	4	3	31

NEG_PRO_ProcessIssues * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
NEG_PRO_ProcessIssues	Not mentioned	1	1	6	8
	Mentioned	13	6	4	23
Total		14	7	10	31

NEG_PRO_Constraints * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
NEG_PRO_Constraints	Not mentioned	2	0	0	0	2
	Mentioned	13	9	4	3	29
Total		15	9	4	3	31

NEG_PRO_Constraints * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
NEG_PRO_Constraints	Not mentioned	1	0	1	2
	Mentioned	13	7	9	29
Total		14	7	10	31

NEG_IND_LackOfCompetence * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
NEG_IND_LackOfCompetence	Not mentioned	5	2	0	0	7
	Mentioned	10	7	4	3	24
Total		15	9	4	3	31

NEG_IND_LackOfCompetence * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
NEG_IND_LackOfCompetence	Not mentioned	4	0	3	7
	Mentioned	10	7	7	24
Total		14	7	10	31

PRO_EXT_Legislation * Discipline Crosstabulation

		Discipline				
		Designer	Developer	Manager	Advisor	Total
PRO_EXT_Legislation	Not mentioned	4	3	0	1	8
	Mentioned	11	6	4	2	23
Total		15	9	4	3	31

PRO_EXT_Legislation * Company Crosstabulation

		Company			
		Consultant Agency	State Agency	Private Agency	Total
PRO_EXT_Legislation	Not mentioned	3	2	3	8
	Mentioned	11	5	7	23
Total		14	7	10	31