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Universal Design of ICT

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Driving factors of universal design of ICT in Norwegian businesses

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Abstract

This study aims to discover promoting and hindering factors for universal design of ICT within Norwegian businesses with a special focus on ICT businesses. This is done through an extensive literature review examining the state of universal design within corporations and how practices can be used and data collected through interviews from Norwegian businesses.

The results of this thesis build on data gathered from semi-structured interviews conducted at six anonymous Norwegian companies with interview participants including designers, developers, project leaders and content creators. Interview participants were divided into two categories after transcription, those displaying positive attitudes towards universal design of ICT and those displaying negative attitudes towards universal design of ICT. This thesis tries to find common themes among the two groups, in identifying these themes this thesis aims to be able to provide advice that can help Norwegian businesses achieve higher levels of accessibility within their products.

This thesis only uses qualitative methods and tries to draw generalizable results from interview data, the thesis does however have a rather small sample size and some businesses with above average accessibility ratings. It could prove useful expand on the research presented in this paper with data from more companies closer to the median accessibility conformance level as measured by the Norwegian Agency for Public Management and eGovernment reports.

Results from this thesis indicate that accessibility work is dependent on communication and respect within teams and organizations. This thesis has also found accessibility enthusiasts to be important for accessibility within an organization, if allowed. These enthusiasts have an ability to spread awareness and accessibility skills throughout an organization.

Through interview data this thesis has further found that it is important to both allow for and require training for lean teams. As lean teams often deliver products or features autonomously they are dependent on having all the required knowledge to deliver a product without the help of other parts of an organization. Without team members with pre-existing knowledge of accessibility it can be hard for lean teams to know the importance of and how to do accessibility. Through research presented in this paper we also find arguments for why team

leaders should maintain a close relationship to their teams, strive to understand team jargon and attend daily stand ups.

1.1 Introduction

Universal design aims to make a product accessible by as many users as possible. How inclusive design is being done varies from following the minimum requirements set by legislation in some countries to using inclusive design in all parts of development in order to make a better product with inclusive design as a design framework. There is little shortage of incentives to use inclusive design including an aging population, ease of learning to use a product, usability and using a product on multiple screen sizes and with multiple input methods. Yet, inclusive design within ICT adoption among western businesses remain low according to Putman (Putnam et al., 2012).

1.2 Problem statement

Universal design is not a new concept, but legislation requiring its use in ICT products is relatively new in Norway. Businesses had good reason to strive towards universal design before the legislation. Using universal design, a business could reach a broader audience, gain customer loyalty, use universal design to make the product better for everyone and the moral reason of not excluding certain groups of people.

Now any ICT solution in Norway that is facing the general public and most ICT solutions targeting other businesses must adhere to WCAG 2.0 A and AA requirements, greatly increasing accessibility and universal design awareness. Yet just the adoption of WCAG 2.0 is nowhere near the standard on customer-facing solutions, with adoption being even lower on solutions in the business to business marked where such adoption is optional. Personal observations indicate that universal design is of little priority in many business-to-business solutions, even going so far as to instead of designing solutions that are easy to use and learn rather requiring users to spend significant time learning to use the solution. With the Norwegian government seeming to become increasingly aware of the social and economic benefits of universal design as shown by strengthened and new legislation it seems peculiar that many Norwegian enterprises exempt from the universal design law show slow adoption or no change in their products.

In this research the thesis author wishes to the driving and hindering factors for universal design within Norwegian corporation. This research aims to provide general findings usable for businesses selling both business to business products, business to costumer products and businesses catering both to business to business and the business to customer market.

After investigating hindering and driving factors for universal design of ICT this research aims to present proposals on how Norwegian businesses can improve accessibility within their organizations and products. These aim to be usable by developers, designer, business analysts and decision makers.

2.0 Literature review

Norway is somewhat uniquely positioned to use inclusive design within ICT services, Norwegian law mandates a minimum compliance with most of WCAG 2.0 A and AA guidelines for all ICT solutions targeted towards the public. Further the Norwegian public has a high adoption of newer models of smartphones and laptops and often have many options when selecting software. The Fletcher School at Tufts University rated Norway as to top-ranking nation in their 2017 Digital Evolution Index ("Digital Planet," n.d.), the report outlines that Norway has one of the highest digital adoption rates and best digital trust among the population in the world. Tufts University is not alone in giving good marks regarding digital adoption; the EU publishes an annual Digital Economy and Society Index (DESI). The index measured connectivity, human capital, use of internet services, integrations of digital technology and digital public services. In 2018 the index rated Norway as the 5th best nation in the index, down from second place in 2017 but still considerably above the average in the EU (moderniseringsdepartementet, 2018; "The Digital Economy and Society Index (DESI)," n.d.). The index states that 90% of users in Norway use digital public services in contrast to the 50% average for the EU, Norway also scored high on business digitization and eCommerce compared to fellow EU/EEA countries. This high adoption rate, multiple options and competence enable users to set higher demands to their software; they can simply choose something else if a product or service is hard to use. Other driving factors include an aging population ("Færre fødte og flere eldre gir sterkere aldring," n.d.) and relatively high focus on public inclusivity. The same Digital Planet report that rates Norway as top-ranking nation in the digital evolution index also points out some potential problems for the top-ranking nations, noting that Norway finds itself in the "Stall out zone". Fletcher states that countries in the stall out-category may have problems sustaining growth and have a need to consciously reinvent themselves and push for innovation ("Digital Planet," n.d.). Despite having some of the best digital adoption rates in the world Statistics Norway report that only 43% of the part of the population identified by Statistics Norway as disabled between the age of 15-66 years currently have employment ("Funksjonshemmede, arbeidskraftundersøkelsen," n.d.)

If we assume that using inclusive design to create and modify ICT solutions makes better products, then we should see inclusive design as high priority within Norwegian IT companies. However there seems to be a divide between the academic view on the benefits of inclusive design and industry standard in Norway and elsewhere. In this thesis I aim to map these differences, look at perception, use of and the importance of inclusive design on ICT products.

2.1 Legislation and demographic

In 2010 an EU report by the Academic Network of European Disability Experts stated that 28% of all women and 23% of men aged above 16 in the EU have on or more disabilities (Academic Network of European Disability Experts (ANED), Centre for European Social and Economic Policy (CESEP ASBL), & Grammenos, 2013). In Norway a survey by the Norwegian Agency for Public Management and eGovernment found that 20% of the population self-reported having one or more disabilities, Staistics Norway found that between 15 and 18 percent had one or more disabilities, they used different metrics from the Norwegian Agency for Public Management and eGovernment ("Antall med nedsatt funksjonsevne," n.d.). Norway and the EU can be said to have reasonably similar statistics, but within the EU/EEA Norway is the only country requiring the use of WCAG 2.0 in private corporations that do not sell to government or official offices. Many EU countries have however implemented laws requiring ICT solutions by the government to adhere to the WCAG 2.0 guidelines. Implementation of universal design legislation can be said to have become easier for countries after WCAG 2.0 was published and the EU ratified the WCAG 2.0 guidelines as the framework to be used in order to standardize universal design for all EU citizens (Easton, 2013). Apart from being EU law the united nations have ratified universal design to be a human right, giving moral reasoning for all who wish to follow human rights to incorporate universal design ("United Nations Treaty Collection," n.d.). Industries self-regulate but have proven to be resilient and difficult to change even with significant external factors. However businesses are shown to have an ability to adapt and change, but this change happens incrementally and over a longer period (Mahoney & Thelen, 2009).

2.2 Internal factors

Internal factors in businesses can present organizational barriers that significantly hinder or slow down change. Organizational barriers may include norms, tradition, existing project

evaluation systems and a drive to get quick to market. These barriers can run deep within an organization and staff are used to following them for many years, change can disturb the workflow giving relatively direct negative financial consequences for the business. While change is necessary to stay competitive change can also create a range of problems and slowness within an organization, to alleviate this organizations tend to adopt change slowly over time instead of rapid major changes (Boos, Grote, & Guenter, 2013).

DePaul University surveyed to map the perception of accessibility among user experience and human-computer interaction experts. The survey included multiple job titles and made efforts to also include multiple nationalities. The survey found that participants who self-reported to be highly interested in universal design when directly asked gave indications of not being nearly as interested when asked indirectly. Many also reported feeling a moral obligation to implement accessibility measures but that the decision to do so was out of their hands (Putnam et al., 2012). The survey found that several other factors influence accessibility perception. One major factor was age with one participant quoted stating that when doing usability tests with 50-years-old women the co-workers would not care as they felt the woman constituted only a small part of the marked. The interview participant went on the express that this could lead to conflicts and that the interview participant saw this group as a market majority instead of the minority. Putnam et al. further cited external factors as having a major impact. Clients would neglect to allocate resources toward accessibility or universal design when hiring consultants. This could be due to budget restraints, lack of knowledge on the added benefits of accessibility or universal design, priority or lack of interest (Putnam et al., 2012)

An effective way corporations can implement change is by the use of coercion; however this does not necessarily alleviate all the problems outlined regarding the rapid change in organizations. By implementing coercion businesses can force rapid change and endure the temporary negative consequences, but such actions also require appropriate training and support in business processes used within the organization.

2.3 Compliance

Universal design is somewhat special in that its advocates promote its use to the greatest extend possible, but full universal design has so far proven to be very hard to implement. As detailed in this research universal design has many definitions, some broad and others especially allowing for elements such as assistive devices. If we look at the definition by the universal design advocates it states that 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.' ("The Center for Universal Design - Universal Design Principles," n.d.). Here the 'to the greatest extent possible' can offer business great headache, it is not clearly defined what the greatest extent possible is and as a result businesses may find them hard to test. The same page then lists the seven universal design principles, many of which are also impossible to test but some that have higher testability. Guideline 2a states 'Provide choice in methods of use', this is an easily testable statement. But statement 1d states 'make the design appealing to all users'. This is impossible to test as you cannot test on all users, and different demographics have different taste; catering to every user's design preference may well prove to be impossible. By being hard or impossible to test the definition and guideline can be hard to justify use of in a profit driven organization. While a project can stretch as close as they can to the seven universal design principles the project will never reach full compliance. Therefore a business may find it difficult to include the principles as part of their corporate processes.

The seven principles can be used as a framework to make products better for all, but other more testable ways of increasing universal design in ICT have been implemented. The WCAG 2.0 guidelines now enjoy broad acceptance by nation states, several major technology corporations and the EU. The guidelines help businesses evaluate and plan their ICT solutions, but there are concerns regarding their testability. A paper published in ACM by Alonso et al. did experiments on WCAG 2.0 beginners, of which there can be many in business IT projects, in this study the participants were students. The study found a significant error margin with the students failing to reach an 80% agreement rate on the majority of success criteria (Alonso, Fuertes, González, & Martínez, 2010). The study identified three possible sources of the

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reliability problem, these were comprehension, knowledge and effort. Difficulty comprehending the success criteria may be due to difficult wording and lack of knowledge on how to apply the principles was suggested could be alleviated by providing different and possible better training. The students were only given a one-week intensive course before the experiment began so it could be beneficial to look at more experienced users as well. A later study evaluated how well both expert and non-expert users evaluated WCAG 2.0. The study used 22 accessibility experts and 27 non-experts. The experts were either working professionally with universal design or accessibility or were a researcher within a relevant field. Like in the previous study the non-expert users had limited to no accessibility or universal design training. The study found that experts produce 20% false positives and miss 32% of all true problems (Brajnik, Yesilada, & Harper, 2010), well below the 80% agreement threshold specified by the WCAG guidelines. The non-expert testers were also evaluated; they produced 42% false positives and 49% false negatives. Both these studies had a limited number of participants and state that with the right training the participants may have achieved better results. For Norwegian corporations this presents a problem, the corporations that must follow WCAG cannot seem to be able to ensure doing so even when employing domain experts. The businesses that legally do not have to follow WCAG but want to seem to have little hope achieving the requirements, especially if they do so by using their existing staff that is not universal design or accessibility experts.

2.4 Universal design

There are several definitions of universal design, but they generally share the same aim, to make design easier to use for all people; including those with permanent or temporary disabilities to use any object, service or infrastructure. The advocates of universal design define the term as '*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.*' ("The Center for Universal Design - Universal Design Principles," n.d.). The authors explain that this definition is applicable to a wide variety of uses and can be used both by the designer and consumers. While the definition is not specifically made for ICT it has had a widespread impact on the design and implementation of modern ICT, including but not limited to web pages. The same group of

authors also created the seven principles of universal design ("The Center for Universal Design - Universal Design Principles," n.d.), combined they are believed to be impossible to archive fully. While being impossible to fully archive some of the guidelines are more testable than others, we can use these to make ICT as easy and pleasant to use, efficient and appealing as possible. In order follow these guidelines it is important to adopt an approach where all users are considered at an as early as possible phase of development.

The United Nations uses a definition of universal design that slightly differs from the ones used by the advocates of universal design, they state '"*Universal design" means the design of products, environments, programmes 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.*' ("Article 2 - Definitions | United Nations Enable," n.d., p. 2). The UN definition differs in that it states that universal design should not exclude assistive devices. This is significant in that the original definition states that there should be no need for adaptation or specialization, while the UN definition can be interpreted as allowing for some specialization and customization while also specifying that the definition applies to ICT products. There are more definitions of universal design, some more broad but they seem to share the same goal of making products, services and infrastructure available to everyone

2.5 Web accessibility

The term accessibility is occasionally used to represent the same thing as the term universal design, but they mean different things. Scientists from the Perie et al. defined web accessibility as '*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, & Power, 2015), there are several more definitions but they share a common goal of increasing accessibility and allowing for assistive devices. Here is where accessibility and universal design differ, universal design aims to include everyone without the need for assistive devices; except the UN definition. While accessibility allows for separation where disabled users can have customized content.

2.6 Web accessibility or universal design

Universal design requires there to be made one product that fits all, while as discussed accessibility can allow for multiple versions tailored to meet specific user groups. When creating with universal design instead of accessible design businesses will get fewer parts of products to maintain, instead of multiple versions tailored towards different devices or disabilities. Since universal design only requires one product to be maintained many argue that universal design is a cheaper solution, even though initial development costs may be higher. Following either solutions businesses can expand their potential user base and many institutional customers have accessibility or universal design requirements (Lazar, Goldstein, & Taylor, 2015a) (Harder, 2017) . All universal design is accessible, but not all accessible design is universal design, the two terms are often used to describe on another without distinguishing them, but it is important to know that there is a difference.

2.7 Technical debt and design debt

Technical debt refers to the concept of cutting corners or taking shortcuts to reach time to market quicker (Yli-Huumo, Maglyas, Smolander, Haller, & Törnroos, 2016). Cutting corners can be necessary to reach project deadlines and a certain degree of technical debt is often acceptable within a project. As technical debt is a somewhat abstract concept it has been shown to be hard to measure, getting rid of technical debt has also been shown to be hard to justify to project leaders as the direct value is hard to measure (Kazman et al., 2015). Historically technical debt has referred to architectural and code specific debt; in this paper I try to present technical debt from a universal design point of view. It can save time to cut corners in code, making implementing a specific feature faster. The same can be said for universal design, it can be quicker to implement a feature visible to the user that has not been tested or developed with accessibility and universal design in mind. End-user reported errors in software are often caused by lacking dependencies and the way the development work is organized, these errors often stem from both technical and organizational errors and can accumulate up as technical debt (Cataldo, Mockus, Roberts, & Herbsleb, 2009). Interviews with Norwegian participants who identified with having one or more impairments showed frustration over lack of accessibility features in several

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solutions, one of the legally blind participant expressed frustration over not being able to use the DNB online banking solution at all (Fardal & Hauge, 2005). As previously stated in this thesis Norway has a legal requirement for all business to customer solutions to follow most of WCAG level A and AA ("Act relating to equality and a prohibition against discrimination (Equality and Anti-Discrimination Act) - Lovdata," n.d.). With this in mind it could be possible to characterise any lack of WCAG A and AA requirements in costumer facing solutions released as technical or design debt. Measuring this debt would require accessibility audits and testing, accessibility faults found outside the WCAG requirement could be presented with the rest of the project`s technical debt. Direct violations of WCAG should hold higher priority as they are mandated by law and it could thus make sense to present these by themselves.

2.8 Promoting factors of universal design

The competence of team members in a project plays a crucial role in how a project is conducted and completed. This competence is somewhat domain specific but must be present especially in the project leaders and developers. The competence should be paired with a motivation to achieve the project goals, including universal design and accessibility (Harder, 2017). A master thesis by Harder et al. from 2017 conducted serval in-depth interviews aiming to identify promoting factors for universal design, the thesis divided driving factors into external factors, organizational factors, process and individual practices (Harder, 2017). The thesis found legislation in Norway to be an important driving factor for following WCAG; interview participants stated that frameworks making accessibility easier or requiring accessibility made universal design easier. Interview participants also reported reputation as being an important driving factor, awards and conferences give accessibility and universal design higher reputation and increase the drive to both learn and use both WCAG and further universal design. Quality assurance and inter cross-disciplinary collaboration bridging code, design, an agile workflow with feedback and content work were identified as especially important factors, apart from the importance of seeing universal design as for more than just the disabled it seems from this study that the promoting factors for good universal design draws parallels to factors involved in running a successful IT project (Daojin Fan, 2010). As a higher degree of universal design in projects require competence within accessibility and or universal design an argument for

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requiring all employees who work on creating solutions with a graphical interface should be required to partake on mandatory usability training (Poore-Pariseau, 2010), such training would increase accessibility and universal design awareness allowing employees to push for more accessibility work even towards project leaders that have not participated in usability training. A survey of human-computer interaction and user experience professional found that even though many of the participants did work directly related to accessibility they reported feeling a lack competence of universal design even though the participants reported accessibility being a part of their daily workflow. The participants also reported a feeling of lack of control on decision-making processes, so even thought they had accessibility knowledge they could not make the project allocate resources towards accessibility work (Putnam et al., 2012). Organizations often perform compliance monitoring, compliance monitoring deals with procedures used to insure compliance with laws, policies, regulations and standards (Lazar et al., 2015a). Compliance monitoring can trigger actions to be taken when faults are found either in testing, development or as a response from end users of a product. Using this system an organization has a framework of actions to take if accessibility issues are found either during development or in production. This process can also help an organization develop a proactive approach to usability issues, this in turn requires the organization to know how to detect usability errors. Thus, a good compliance monitoring policy can force project leaders to allocate resources towards accessibility (Lazar et al., 2015a). Accessibility and or universal design monitoring requires an organization to conduct continues accessibility evolution, both during development and for products that change like websites regular evaluations. These can be expensive and can be done using serval methods, such as automated tests, expert inspection and user testing. Yet they are still likely to prove cost saving compared to fixing issues after they have been discovered by end user and can help an organization in not alienating costumers or potential customers with disabilities (Lazar, Goldstein, & Taylor, 2015b). In order to perform these evaluations usability competence is of vital importance, several modern tools now perform automated accessibility tests. These tools are now so advanced that they can be integrated into an IT project automated build pipeline and automatically fail a build if certain accessibility demands are not met. However, these systems have been found not to be able to

detect all WCAG errors. A 2017 audit performed by the British Civil Services found that automated tools found a max of 29% of all barriers identified by expert auditors from the Civil Service ("What we found when we tested tools on the world's least-accessible webpage - Accessibility in government," n.d.)

2.9 Universal design as an innovation driver

While I in this thesis see universal design as created better solutions for all it can be especially useful for elderly persons who more commonly develop different disabilities. Across Europe and Norway the percentage of elderly is projected to rise steadily ("Færre fødte og flere eldre gir sterkere aldring," n.d.). The Norwegian statistical burau projected in 2018 that Norway within 15 years would have more people above 65 than under 19 (Even & NTB, n.d.). Meanwhile the Norwegian mean life expectancy is by the Norwegian statistical bureau projected to keep rising. Keeping these numbers in mind it could be hard to defend excluding seniors and elderly persons from products. Accessibility advocates and governments can argue that inclusively designed tools can help seniors and the elderly live richer and more independent lives, and that access to ICT solutions is of paramount importance in order to be able to partake in society. How ever in order to encourage for-profit organizations to join in on this initiative showing that inclusive design leads to higher potential earnings could be effective. Currently organizations in Norway as previously discussed in this paper are required to follow WCAG level A and AA. However WCAG alone cannot find all usability problems. A 2012 study asked 32 blind users to test 16 websites, only 50.4% of the problems found by the users were covered by the WCAG 2.0 success criteria (Power, Freire, Petrie, & Swallow, 2012). Another issue that arises from using only WCAG to do inclusive design is the testability of WCAG. If WCAG is tested by human evaluators there needs to be agreement among these evaluators on what meets and what fails to meet WCAG 2.0 requirements. Studies have how ever shown this not to be true, a 2010 study measured the testability of WCAG using expert evaluators with a goal of at least 80 percent agreement among evaluators for a WCAG requirement to be met. The study found that expert evaluators failed to reach the 80 percent agreement threshold. In the study experts produced an average of 20 percent false positives and missed 32 percent of real-world problems giving them a combined validity of 72 percent (Brajnik et al., 2010).

Nonexpert evaluators made an average of 42 percent false positives and missed 49 percent of the real world problems , making their average validity just 51 percent (Brajnik et al., 2010). So even with full WCAG coverage a solution may not be usable for people with disabilities and the full coverage cannot be guaranteed as experts cannot agree on how full coverage looks. One way organizations can alleviate these problems would be to use user-centered design, involving users identifying with not having any disabilities and users identifying with having disabilities in all design and testing stages of a project. A 2013 conference proceedings by Fuglerud et al. book recommends using the ISO 9241-210:2010 Ergnomics of human-system interaction standard (Fuglerud & Sloan, 2013). Fuglerud & Sloan draws some principles from the standard, the principles compiled by Fulgerud & Sloan states: The design must be based upon an explicit understanding of users, tasks and environments, users are involved throughout the design and development process, the design is driven and defined by user-centered evaluation, the process is iterative, the design addresses the whole user experience and the design team includes multidisciplinary skills and perspectives. Fuglerud et al. also emphasizes thinking of "users" as "human" instead of a specific target group, widening the scope of users to be used in the user-centered design process. The users also need to represent a broad range of accessibility needs and usage context; these users should be present from as early as possible in the project. Using this method projects can draw from a wider range of perspectives, potentially resulting in new functionality, ways to solve problems or user groups that the original team would not have thought of. A 2007 paper by Dong et al. conducted tests to see if an inclusive template would be effective, in these tests for profit organizations cooperated with designers and design students to create more inclusive products. During this work several new products were made, some of these were made into products born from user cantered design now offered by companies. One of the products made was quoted as being the companies best seller for several years since launch (Dong, Cassim, & Coleman, 2007). During the workshops the designers worked closely with people identifying with having one or more disabilities, giving them unique user knowledge and allowing for rapid feedback to drive innovation. Serval studies have identified user involvement as a key source of innovation (Gales & Mansour-Cole, 1995; Shum & Lin, 2007). Innovation, especially radical innovation plays a key role in keeping

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businesses growing and providing a platform for long term growth (Chayutsahakij & Poggenpohl, 2002). Chayutsahakij et. Al found that traditional market research, while widely used, put limits on the innovation it could produce. This due to market research building upon existing experiences and technologies instead of new potential technologies. The study finds using tests from real design companies that user-centered design using inter-disciplinary teams from an early point increased to probability of the company making redical innovations outside the firm's current strategic context (Chayutsahakij & Poggenpohl, 2002) allowing organizations to reach new an unfamiliar markets with user design feedback as a foothold. The Chayutsahakij et. Al study also found that using user-centered design companies were more likely to radically redefine products within their existing markets, strengthening the firm's position within a familiar market by increasing understanding of potential users, uncovering unmet needs, restructuring the product to meet the newly uncovered needs and adding features to meet user expectations. While the user-centered design approach seems to bear with it many benefits and has been shown to help an organization with innovation it bears with it additional work and cost. Just finding the right users can be challenging, then defending the extra costs to project managers can stop user-centered design in many projects. As with universal design user-centered design is dependent on the organization and team seeing the long term benefits of this approach, within in depth knowledge about these benefits it can be hard to measure and defend the added value user-centered design can give a project. A concious effort to increase both universal design and user-centered competence is needed both at a manager and project worker level. When finding users for user-centered design is can be highly benefitial to find users identifying with having disabilities. These users are often accustomed to solving problems in creative and unusual ways. Their experience can reveal new and more effective uses of technoligies and help design products so that fewer senses are needed to use the product. These insights from users identifying with having disabilites can overlap with use cases that are benefitial for users without disabilites (Fuglerud & Sloan, 2013). There are sevral products designed specifically for disabled users that are now mainstream products such as automatically opening doors, remote control, text TV and website keyboard navigation

Compliance monitoring can save an organization resources a proactively finding accessibility errors and correcting them as development is happening is both easier and less expensive than making a fix after the initial design and implementation phases are completed can incur significantly higher costs (Harder, 2017). As of 2018 Norway has mandate WCAG requirements in law but has not mandated any internal compliance monitoring policies for organizations. Thus it is up to the individual organizations to both use and see the value in compliance monitoring.

3.0 Methods and procedures

In this thesis several methods and procedures were planned. They were chosen because businesses would cooperate and willingly provide data to the author of this thesis. Planned data collection methods included in-depth interviews, document analysis, observations from the work place and tools/software analysis. Three businesses had agreed to participate in this thesis before data collection started. However, when data collection was due to start all three businesses that had agreed to participate in this thesis backed out and declined to provide any data for use within this thesis. This was part in due to the thesis authors contact persons changing jobs and, speculatively, a lack of written contracts although one of the businesses that pulled out also had a written contract with the author. Getting new participants for this thesis proved difficult; over 50 Norwegian businesses were contacted via emails and phone calls. Some said no, most never replied and six businesses said agreed to participate in this thesis. Due to time limitations and in an effort to speed up the approval process for businesses participation in this all the businesses are kept anonymous. Some classification is how ever given to allow the reader to roughly understand where these businesses position themselves in the Norwegian market. All of the six participating businesses only allowed interview data collection. While the author of this thesis would like more data, especially documents and observations from day to day work, the interview questions were designed to alleviate some of these issues. To further strengthen the findings in this thesis the author tries to draw data from other papers where the author was more successful in gathering data. This paper only has one author; this author holds strong pre-existing views on what is driving and holding universal design of ICT back in Norway. The methods used in this thesis try to alleviate this bias. The same interview guide was used for all interviews but the interviews were semi-structured allowing both the interviewer and the interview participant to deviate from the structure. The semi-structured approach was chosen for serval reasons, most notably to facilitate a relaxed atmosphere between the interview participant and the interviewer. This approach also had the added benefit of allowing the interviewer to ask follow up questions, the interview participants would also on several occasions provide additional data related to universal design not covered

by the original questions. You can read more about the interview technique under section 4.1. After the interviews had been conducted they were manually transcribed, information that could potentially identify the interview participant were removed during transcriptions. After transcription each interview was added to the qualitative research analysis program NVivo 12. Within NVivo data was coded to match one of 11 categories, with all sub-categories the total number of categories used in this thesis was 43. Out of the 43 total categories created only three ended up without any data. Each category was chosen based on expected answers from interviews and later modified after having transcribed interview data. The use of sub-categories was employed as NVivo allows for all sub-category data to easily be aggregated into the main category, allowing the user to see individual sub-category data and all the data within a given category without much effort. Coding data in NVivo allows the author of this thesis to see all gathered interview data on given subject. Along with data being easier to find it also allows the author of this paper to more efficiently compare different responses within a given subject. NVivo also allows the user to see how many extracts fit within a given coding category, for example how many participants answered that their professional environment is good at their work place. In this thesis, the author has chosen to mostly ignore those numbers, they can give indications while doing data analysis but the author found that some excerpts held more weight than others. Counting them would be a more quantitative approach and would ignore the weight of each quote and how quotes can say different things yet still find themselves in the same category. This could lead to misrepresentation of data (Lewis, 2015). For analysis of the gathered data I employed a multi-model approach, the original intention of this thesis was a nomothetic approach where the author looks for generalizations and themes. During data analysis a need for an idiographic approach also presented itself, some groups of participants even from the same business had great variety in what they said. The author of this thesis found some information conveyed by individuals to be highly beneficial for this thesis and is was thus decided to not only focus on groups of people, but also on individuals. From gathered data this thesis aims to examine processes and interactions by using grounded theory and cultural themes, while the latter borrows form ethnography this thesis does not have a

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sufficient data basis to perform a systematic study of the universal design culture among ICT professionals.

3.1 Interviews

In-depth interviews are the primary and only direct source of data used in this thesis. Interview data is how ever compared to findings from a variety of papers and to a minor extent findings from accessibility reports produced by the Norwegian Agency for Public Management and eGovernment (Difi), see section 4.2 for more information regarding data gathered from Difi. A semi-structured interview approach was employed in an effort to extract additional insight, ideas, and opinions that the researcher had not previously considered or focued on (Lazar, Feng Heidi, & Hochheiser, 2017). With interviews as the only direct source of information in this thesis some methods borrowed from action research was considered in order to maximize the results gained from interview data. These methods were to record facial and body language in order to contextualize further and understand participants answers. This approach was however scrapped for several reasons. Primary among them we find the interviewers limited experience, this was the first interviews the interviewer conducted. All interviews were done by the thesis author. With only one author who has a strong pre-convinced bias the risk of misinterpreting body language seemed unreasonably high, a study done with experienced action researchers could lead to additional valuable insight supporting this thesis's findings.

To further allow for a relaxed atmosphere and conversation flow during the interviews a recorder was used for all the interviews. See section 4.3 for more information on how recordings and privacy were handled.

All companies that agreed to participate in this thesis were contacted via their official contact email addresses. The emails specified what the purpose of this thesis is, how data would be collected and stored, information regarding privacy and what kinds of employees this thesis aims to interview. Each company was informed that the company name would be confidential in the final thesis. The thesis author asked to speak to any person working on ICT projects that had a front end and from there had a dialog about potential participants for the interviews with each company. This was done to get data from a wide range of people working with ICT project

showing several viewpoints, the interviews revealed this to be a good idea as many of the people working with universal design did not work as developers. The semi-structured interview approach also aimed to let people in different positions express views that may not be held or understood by other positions (A. Adams & Cox, 2008). Since the interview is semi-structured participants can answer questions the researcher has without question first being asked, the researcher can also ask a series of questions to get the answer to one question. As such an interview template was written with twenty-five concrete questions divided into four categories. The interviewer had as a goal to complete all questions within a given category before moving on to the next. This was done to give more structure to the semi-structured interview and help the researcher keep track of which questions had been answered. Further this was done to keep a good flow in the interview and allow the interview participant to relax. During the interviews the interviewer checked off each question that had been answered and tried to either steer the conversation towards another question within the category or if necessary asked another question from the category directly. The researcher is free to choose whatever questions is natural to answer at that time and does not need to follow a chronological order except trying to stay within each given category. All participants were given a consent contract before each interview, they were given time to read the document in its entirety before each interview and asked if they had any questions regarding the content of the consent contract and had to sign before the interview began. The consent contract was based on a template and approved by the Norwegian Centre for Research Data (NSD). Each participant was also given the option to opt out of audio recording should they choose so, none of the participants chose to opt out of audio recording. The interview questions had to go through serval revisions before passing NSD inspection, the questions that failed NSD inspections failed due to asking for potentially medically sensitive information like if the participant identified with having any disabilities. The categories selected for the interview question template were based on a template suggested in "Research Methods for Human-Computer Interaction" by Adams at al. published in Cambridge University Press (A. Adams & Cox, 2008).

The attached table shows all the interview category names and the intended purpose of each category

Category	Reasoning
Background	The particpant gets informed about the general purpose of this thesis is. The researcher should try and find the participants self-perceived universal design competence level, self-perceived IT-competence level and general work tasks within the organization the individual works in. The interview participant is also offered to talk about themselves, both to gather data and to build trust and comfort with the researcher.
Letting off steam	This chapter is intended to further build trust and comfort between the interview participant and researcher. Here the interview participant can talk about anything, such as how their day has been, their pets or anything they may want to talk about. This chapter contains broader more vague questions that can be answered in many ways.
Addressing issues	In this chapter the researcher will address any universal design issues noted as goals that has not naturally come up in conversation yet. Here the researcher will try a greater degree ask questions that try to steer the conversation into the right direction and may give example scenarios. Here more direct questions are asked, this both to ensure that the necessary data is gathered and to hinder the interviewer from asking potentially leading questions.
Debriefing	During the debrief the researcher will try to sum up the data gathered and allow to participant to make corrections or additions to what has been said. During this time the researcher will also have the ability to ask follow-up questions that could be up interest to this thesis. The participant will be informed about what specifically the interview is trying to achieve and the interview participant will have the option to ask any final questions they may have. Finally, the researcher will repeat how the information is to be processed, the participants privacy and how confidentiality will be handled. The participant is given to option to withdraw anything they have said from being transcribed,

	this is done to alleviate concerns of giving away confidential information to the interviewer.

During the interview the researcher will used a student-tutor approach (A. Adams & Cox, 2008), in this approach the researcher takes a role similar to how a student may ask a tutor questions. Using this approach may aid in letting the interview subject feel in control and at ease, helping participants feel at ease is done in order to allow the participant to feel like the participant can expresses views beyond what is being asked.

To preserve privacy all interviews will be conducted in a private room either on the premises of the business the participant works in or in another location of the interview participants choosing. While it is the researcher's goal to have an as easing and comforting environment as possible it can prove hard to conduct the interviews outside of the business due to time and logistical restrains. The most important part of the interview environment is that the participant can be sure that no one else is listening in on the conversation. During the interview the researcher has a goal of doing maximum 15 % of the talking while letting the interview subject talk for the rest of the time, this is to further the participants feeling of being in control and is consistent with the student-tutor mentality.

3.2 Grouping

This thesis has opted to use both a nomothetic and an idiographic approach, the nomothetic approach used in this thesis tries to creates create generalized groups and find common themes within these groups. Traditionally nomothetic often has at least in part quantitative data, this thesis has however only gathered qualitative data. As such it can be said that this thesis borrows from the nomothetic approach but fails to meet the full requirements of the method and instead uses an ideographic method with some elements of the nomothetic approach. The borrowed parts from the nomothetic approach are to try and establish themes and see what the participants both within the groups and across the groups share. It is important to note that there is a difference between the grouping done on coding within NVivo

and the grouping selected to be used within the thesis. In the grouping approach used in this thesis interview participants are always present in at least two groups. The chosen groups are technical, administrators, educators, content creators, high universal design competence, medium universal design competence and low universal design competence. Universal design competence is assessed based on the individual's self-assessed universal design competence and the thesis authors individual conclusions from reading transcripts. This thesis also shows the interview participants self-assessed universal design competence without corrections by the thesis author. All interview participants completed the same interview questions. The groups for analysis were deliberately made after all data had been transcribed and coded in NVivo, the NVivo coding groups were used to help in designing the grouping for use within this thesis.

3.3 Ethics and privacy

All research that involves living participants must adhere to high moral and ethical standards. This research aims to follow ethics and privacy principles that not only adheres to required guidelines but also builds trust between the researchers and participants.

During any data collection from individuals, clear information is given on their rights, how the data is to be used, stored and when the data that can be used to identify a person will get destroyed. During interviews both verbal and written consent must be given, and all participants were be informed that they at any time can choose to cancel the interview and have the data deleted. Participants were also be informed about an option to have the data deleted even after the interview before the scheduled time if they should feel the need and who will have access to and will transcribe the data. By doing this researchers aim to help participants feel at ease and comfortable enough to answer whatever they may want to answer, if the participant has privacy concern they may not give full or give different answers(A. L. Adams, 2001). If data is gathered from participants that have a close personal connection with the researcher a clearly stated not will be given in this report where the data may be represented if the data stands out or is used on its own.

This paper will present in its findings the opinions of interview participants, as such it is a moral obligation for the researcher to not ask leading questions or criticize opinions participants may have so as to allow the participants to express themselves freely. Further this research adheres to the Ethical Guidelines for Research at Oslo Metropolitan University availed at tilstatt.hioa.no.

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4.0 Results

4.1 Attitude

Attitudes were measured both via questions directly asking how a participant feels about the importance of universal design and via coding of any data that conveyed a certain attitude via NVivo. This data has been used to group participants into two groups, participants displaying negative attitudes towards universal design of ICT and participants displaying positive attitudes towards universal design of ICT. After transcription it became apparent that participants from companies would share either negative or positive attitudes with other interview participants from the same company.

4.2 Negative attitudes

Several participants self-reported positive attitudes towards universal design of ICT but presented negative attitude towards universal design later in the interview. Common among the persons presenting negative attitudes towards universal design of ICT was that they belonged in the group's administration or content creators. All participants who displayed negative attitudes towards universal design of ICT self-reported high universal design competence, a total of four interview participants reported these negative attitudes towards universal design. As described in section 4.2 universal design competence grouping is adjusted by the author making self-reported competence only part how the participants are grouped.

4.2.1 Compliance and requirements

All participants with negative attitudes towards universal design of ICT were aware that there are legal requirements for universal design of ICT in Norwegian digital products. Three of the four participants showing negative attitudes were also familiar with the WCAG name, the guidelines mandated by the Norwegian state. Participants with negative attitudes cited legal requirements as having raised awareness, three of the participants were also allowed to attend a course on universal design held by Difi as a result of the legal requirements. Three out of four participants with negative attitudes expressed that while the law may be strict, the way that it is being upheld is not. The participants were aware of the fact that in writing time of this thesis Difi had tried to give out fines for lack of WCAG compliance but never successfully managed to give a fine. One participant with leadership responsibilities stated that since no one had recived

a fine yet they did not need to conform to WCAG before the company was threatened with fines. The participant expressed further stated that from looking at how previous cases have been handled by Difi the company could start work to more fully comply with WCAG when errors had been found by Difi, by starting to work on improving the companies WCAG compliance Difi would drop a potential fine against the company. The participant acknowledged that due to the size and impact the company had it was seen as likely that Difi would evaluate the company at some point. Parts of this view was found in a different company, but with a different angle. Three financial and organizational reasons were put forth as the primary reasons as to why universal design was down prioritized. Assigning developer time to accessibility issues would take away time that could be spent on other parts of a product. The participant from this company expressed a view that it would be hard to justify the cost and time investment required to conform with WCAG unless there was a higher probability of being fined, the participant in this company also stated that if Difi threatened with fines they would start focusing on WCAG, thus avoiding the fines.

4.2.2 Technical

None of the participants displaying negative attitudes towards universal design of ICT were in the group developers. They were however working closely with developers as either content creators or in leadership positions. Content creators within this category were graphic designers and employees adding text and images to web pages through a CMS system. Two of the participants with negative views were directly involved in acquisition of software to be used within a product and the choice of frameworks. These participants stated that choosing solutions that conform to the WCAG standard was hard to do, they had little trust in vendors claim of WCAG conformance. This view on external software was shared among all participants in all groups. Responders from two companies stated that the frameworks they used did not support WCAG, for both companies the frameworks had also been recommended by external consultants. Follow up questions by the interviewer revealed that the respondents had received this information from external developers used within the organization. This information led to some of the participants expressing WCAG compliance could not be achieved in the product before the frameworks were updated to support WCAG.

The participants were asked to list some of the frameworks that made it impossible to comply with WCAG, these were the frameworks listed

- React
- React Native
- Flutter
- Angular
- JSF

Efforts were made after transcription to verify the claims of these frameworks not supporting WCAG, no credible sources were found. The most commonly used framework found in all the interviews was React, there is a debate as to whether React can be called a framework or a library but for the sake of simplicity React is referred to as a framework in this thesis. Searching for react and accessibility on Google revealed several dedicated accessibility documentation sites for the React framework ("Accessibility – React," n.d.). Further probing reveled that React supports everything standard HTML and JavaScript supports, so any accessibility work that can be done in HTML and JavaScript is also possible to do using React. In the introduction to the main accessibility documentation page for React we find this line "React fully supports building accessible websites, often by using standard HTML techniques." ("Accessibility – React," n.d.). Participants stated that both the frameworks chosen and components the companies had bought for these frameworks failed to meet WCAG requirements, while React fully supports WCAG it is probable that the React components chosen to be used may not have been fully compliant with WCAG. Further probing during the interview revealed that the companies where employees had negative attitudes towards universal design of ICT tried to use as many pre-made front end components as possible. Reasons were cited as these components having been tested by other people and updates from both the open source community maintaining open source components and vendors selling proprietary components. This could drive down development and update costs and came with the added benefit of most of these components having already been documented. Common among all the frameworks were that while they seemed to have full support for WCAG actual implementation required specialized knowledge

of the framework. Examples of this include how the React framework handles the HTML <div>
tag. React requires all code to be wrapped in at least one HTML element, breaking up different
<div> elements in the code into their own snippets. This could break semantic navigation in
HTML, instead React recommends that related elements such as HTML lists should be wrapped
in the React specific <Fragment> tag.

Examples of this can be seen in the React documentation, consider these two React snippets
being called in the following React class, examples taken from React Fragments documentation
("Fragments – React," n.d.). Each snippet renders the <Columns /> element in the React Table
class.

```
class Table extends React.Component {
  render() {
    return (
      <table>
        <tr>
          <Columns />
        </tr>
      </table>
    );
  }
}
```

Snippet 1, React code.

```
class Columns extends React.Component {
  render() {
    return (
      <div>
        <td>Hello</td>
        <td>World</td>
      </div>
```

```
    );
  }
}
```

Snippet 1, React code compiled to HTML.

```html
<table>
  <tr>
    <div>
      <td>Hello</td>
      <td>World</td>
    </div>
  </tr>
</table>
```

Since all react code must be wrapped in a parent element the resulting HTML code returns a <div> inside the HTML table. Without specific React knowledge on how to produce semantic HTML or knowledge of the importance of semantic HTML this could prove hard to fix, in plain HTML you do not need to wrap everything in parent tags and as such this would not be a problem. Consider snippet two presenting the solution from the React documentation page on React fragments ("Fragments – React," n.d.)

Snippet 2, React code.

```jsx
class Columns extends React.Component {
  render() {
    return (
      <>
        <td>Hello</td>
        <td>World</td>
      </>
    );
  }
```

```
}
```

Snippet 2, React code compiled to HTML.

```
<table>
  <tr>
    <td>Hello</td>
    <td>World</td>
  </tr>
</table>
```

In snippet 2 semantically correct HTML is produced without an additional <div> tag. Similar examples can be found in the other frameworks mentioned in the interviews, with especially strong cases found in frameworks that compile to multiple smartphone application platforms. The code compiles and runs without any apparent issue when wrapped in the <div> tag, however WCAG technique G115 relating to WCAG success criterion 1.3.1 tells us that all elements should use semantic mark up ("G115: Using semantic elements to mark up structure | Techniques for WCAG 2.0," n.d.). Noticing these errors requires the developer to be aware of the WCAG success criterium and how the specifics of a given frameworks handle different situations, it can be thought from interview data that while frameworks can provide great benefits to productivity the specialized knowledge they require in order to follow WCAG is greater than with plain HTML and JavaScript, possibly heightening the barrier to full WCAG compliance.

Three of the participants expressed frustration in lack of control over external vendors they were forced to use. These vendors included payment solutions and external resources required for mobile apps. Two participants stated that they had received complaints about accessibility issues from end users who found themselves unable to complete an action due to lack of WCAG comforance in vendor software, upon contacting the vendor they got replies that WCAG conformance was not a prioritized issue. The issue in question concerned payment, the interview participants stated that they instead tried to offer different payment solutions that could work for people with disabilities. In so doing they create products where people with disabilities lose access to the full product, instead of making the product accessible throughout

a compromise was made in order to ensure that it was at least possible for people with disabilities to complete purchases through the organization's customer facing app.

4.2.3 Testing

All the participants with negative attitudes and some of the participants with positive attitudes also expressed frustration towards how hard WCAG 2.0 and WCAG 2.1 could be to interpret. Especially designed for users with vision impairments were cited as both difficult and limiting for UX design for users without vision impairments. In the literature review of this thesis several papers examining how difficult WCAG 2.0 can be to interpret found that neither accessibility experts, students or general developers could reliably interpret WCAG to the required 80% agreement rate. In these papers examining the testability of WCAG both experts non-experts produced a significant number of false positives and missed several success criteria. These papers examined WCAG 2.0, the participants with negative attitudes were all aware what WCAG 2.1 had been completed and saw it is likely to be introduced as a requirement in Norwegian law at some point but currently saw WCAG 2.0 as the guideline they should work towards conforming with.

The interview participants with negative attitudes from the business that had conducted users testing on blind participants cited there being a large divide in what information different groups of users with visual impairments wanted to be read by screen reading software. What the interview participants described as power users wanted fast navigation with keywords and as short as possible sentences for navigation. A different group of visually impaired users described by interview participants as having low ICT competence wanted longer and more descriptive sentences. Some of the same issues was found when testing was done on users without the need for screen reading software. As a solution the company opted to have a mix of quick to read tables and some longer sentences that could be skipped by users to accommodate power users based on testing feedback from users without visual impairments. For blind readers the company opted to only accommodate power users by having the screen reader only read short sentences and descriptive words. The reasoning behind this approach by the business was that longer sentences would mean slower navigation for all power users who used blind readers, while this information could more easily be skipped by users not needing

blind reading software. The interview participants stated that they felt visually impaired users could learn to use the application. This led to there effectively being two versions of information, one displayed as tables and sentences in the app and a different version with different words being read up by blind reading software. The interview participants cited that this approach had presented a problem in that they now needed to maintain two versions of text and continuously check if new features also had custom made text for blind reading software. The candidates from the two other companies displaying negative attitudes towards universal design of ICT did no user testing. Instead they opted to do inn-house testing by using their own products, they also stated that costumer feedback through complains and reviews in app stores were taken seriously. In considering the views from end-user feedback it can be said that while the companies did no direct user testing they still employ some user-centered design methods. In all companies with participants displaying negative attitudes towards universal design of ICT participants stated that specific problems reported by end users had higher priority than other issues found during inn-house testing. Interview participants further stated that while user reported issues have higher priority, they did not have the time or resources to address all user reported issues.

Participants also cited a clash between how they had traditionally tested software and modern development cycles. This clash was also present in businesses where participants only displayed positive or mixed attitudes towards universal design of ICT with the only exception being a consulting firm. Participants cited that they traditionally had tested for WCAG errors by going through a checklist manually after a product had been made ready for release. However the change to a DevOps development cycle with agile methodologies meant that now products often had several releases a day instead of fewer but larger releases. While DevOps can be disconnected from the continuous delivery methods all businesses interviewed in this thesis using DevOps also used continuous delivery methods.

The definition of DevOps varies from business to business and even person to person. The original intent of DevOps can be described as bridging the divide between developers and operations, thus the name DevOps. In practice DevOps with an agile approach often aims to create as autonomous teams as possible, this would allow teams to push new features and fixes

for a system without interference from other parts of an organization. This constitutes and organizational shift aimed at delivering value and fixes faster than an approach with waterfall methodology and a team depended on resources outside the team to complete features1. In order for teams to achieve this goal they need to have all the knowledge required for pushing new features, including how to push updates to server, programming, design, testing and compliance. One external dependency could significantly slow a team down. As such DevOps now often has a broader reach than just developers and operations, sometimes this broader reach is described as things such as DesignOps with more terms being used. In this thesis I group all the *Ops terms together under the umbrella term DevOps for simplicity sake. Included in the new responsibilities for the teams are quality assurance, testing and a fundamental change in how design is done. One interview participant who primarily worked as a designer described having a professional identity crisis after the shift to DevOps in the team the designer worked at. The participant described that previously their job had been to create what the participant described as documentation, completing designs and handing it over to developers as documentation on how something should be made. This allowed the designer to spend what the designer described as weeks working on a new design, testing the design using paper prototypes and as the participant described as the most important stage; time to reflect and tweak the design. After the shift to DevOps the designer had to shift over from producing documentation to creating designs live with developers. The designer stated that this method of working was faster and often produced what was described as visually pleasing results, but without the time to reflect on user needs and time to consider how the design fits with the overall app experience the designer felt less confident in accessibility needs being met. Inn a follow-up question on how these processes may be improved the designer stated that involving users and user feedback in every lean cycle could greatly improve the user experience. However with the rapid releases the designer could not find time to complete these tasks and no extra resources for user testing or other user-centered design were allocated in the designer's team.

Looking into answers from other participants in lean teams revealed that teams were expected to have enough knowledge to safely operate autonomously but were given little to no extra

training and time. This resulted in team members becoming more proficient in their given domain, but without any accessibility specialists on the team no team members became accessibility specialists. One exception of this was found in the consulting firm interviewed, however this firm stated that accessibility expertise within a lean team was expected by one person in the team and this person would need to acquire accessibility expertise while focusing on becoming an expert within a more specific skill set such as front end development or rapid design.

All of the developers interviewed in this thesis except one worked on agile projects using DevOps methodology, no interview participant had dedicated quality assurance persons within the teams, one company had one employee periodically checking for universal design quality assurance across teams . The participant checking across team was not a member of a specific team, but held a special position made specifically to promote accessibility within the organization and in the organization's products. The shift to DevOps has allowed organizations to rapidly improve their products continuously and lowered the barrier for creating new features. DevOps can be seen as more of an organizational and mindset shift than a technical one, but trough data collected in interviews seem to be treated as a more technical change for many teams. Ensuring accessibility within products on a lean DevOps cycle without dedicated quality assurance personal or accessibility experts within each team proved difficult according to several interview participants. A front end developer described the change to DevOps as needing a "*New breed of developers and leaders*". While DevOps and lean methods have introduced new and yet un-solved challenges for some participating business the methods have been a contributing part in improving accessibility for other participating businesses.

Within software development and testing methodology requirements are often divided into functional and non-functional requirements. Non-functional requirements are aimed at parts of a system such as security, accuracy, efficiency, how data is transferred etc. Functional requirements target parts of a system the end users directly interact with. The modeling techniques for functional requirements are more developed than those for non-functional requirements, functional requirements often receive more attention and are seen as more important than non-functional requirements by businesses according to Gnaho et al. (Gnaho,

Semmak, & Laleau, 2014). Participants were asked if they were familiar with the concept of functional and non-functional requirements, two participants displaying negative attitudes towards universal design of ICT asked to be reminded what functional and non-functional requirements were and received a brief explanation and follow up questions asking if they understood the explanation.

Participants were then asked if they saw accessibility issues as functional, non-functional requirements or a mix of both. All participants displaying negative attitudes towards universal design of ICT stated that they saw accessibility issues as a mix of functional and non-functional requirements. Participants were then asked if they saw functional or non-functional requirements as most important to solve within a project. All participants displaying negative attitudes towards universal design of ICT stated that they saw functional requirements as the most important requirements. Follow up questions on what parts of accessibility fall under non-functional and what parts fall under functional requirements were asked. Three participants displaying negative attitudes towards universal design of ICT answered that they saw alternative text and code for use by blind reading software as non-functional requirements. One participant further elaborated that this was due to changes made for blind reading software would never be visible for most users.

As software grows in complexity so does technical debt, most software systems allow for some degree of technical debt. It is not feasible to maintain a completely bug-free system. Technical debt is a loose term and is measured differently in different businesses, some do not have any metrics or documentation on technical debt issues.

Interview participants in this thesis were asked if they were familiar with the concept of technical debt; some required additional explanation into the concept of technical debt. All participants were asked if they lack of universal design or lack of accessibility testing as part of technical debt. All participants displaying negative attitudes towards universal design of ICT answered that they saw lack of universal design as technical debt, how ever all participants displaying negative attitudes towards universal design also stated that they did not know of any methods for measuring technical debt within their organizations. No team members displaying

negative attitudes towards universal design of ICT interviewed stated that they did any technical debt documentation or measurement within their projects.

4.2.4 Impact

Within the universal design of ICT scientific community, the notion of universal design being beneficial for all people, not just those with certain disabilities are often put forth. To test this notion interview participants were asked a number of follow up questions based on conversation relating to who benefits from universal design of ICT, all participants were also asked directly who they felt benefited from universal design. All participants agreed that parts of universal design could benefit all users but some participants stated that accessibility work within their products led to the product being worse for other users without disabilities. These participants employed countermeasures against this problem such as maintaining different text for screen readers and providing alternative more accessible paths to achieve a goal within a product. 4 participants stated that the group of people with disabilities they spent most time on accommodating were those with disabilities relating to sight. All of these 4 participants stated that teams within their organization tailor made code specifically for blind users. In doing so they break with the universal design notion that one design should fit all users instead of creating custom designs for certain disabilities. Some participants further stated that they felt WCAG 2.0 limiting, stopping potential designs or ideas participants stated could improve the look and feel of a product. Since participants displaying negative attitudes towards universal design of ICT mainly focused on creating products accessible in at least some way for blind readers and saying the mainly focused on accessibility for blind users it can be said that the self-perceived main impact group for accessibility work was blind users for these interview participants. There can be many reasons for this focus, including people with vision impairments having strong advocacy groups behind them and blindness being a disability that is easy to understand compared to many other types of disabilities such as cognitive disabilities. Participants were also asked if they accounted for temporary or short-term disabilities. All but one of the participants displaying negative attitudes towards universal design of ICT were not aware of the concept of temporary or short-term disabilities, they got a short explanation with examples from the interviewer during the interview. The explanations given included sunshine

on displays, broken arms, how stairs can impair a person with a child stroller and using a product while moving. Participants who asked for more examples received more examples. None of the participants displaying negative attitudes towards universal design of ICT stated that they did any specific testing or did considerations for temporary disabilities. However all participants with negative attitudes towards universal design of ICT stated that they also used their companies applications themselves, both at work and outside of work. Further probing into which situations they used their applications revealed that the participants used the applications while on public transport and when outside in the sunshine. In doing so some testing for temporary disabilities were done even though this the participants did not call this form of testing as testing for temporary disabilities. One participant stated that the participant never thought of sunshine on a screen as a temporary disability, three other participants expressed similar views.

When asked directly whom the participants thought benefit from universal design of ICT work on a business product all participants with negative views stated that blind users and especially users of screen reading software benefited from universal design work. All participants with displaying negative views towards universal design of ICT but one also stated that they felt users without disabilities benefited from the accessibility work with the notable exception of text being tailor-made for screen reading software. While stating this stating this three participant expressed that accessibility work, while mostly beneficial, also acted as a barrier barring them from creating the best product possible. The participants had made similar statements earlier in the interviews.

Participants stating that the main goal for their accessibility work was to accommodate blind and hard of sight users were asked if they did any testing or had any routines towards users with cognitive disabilities. None of the participants answered that they had any testing or routines aimed at finding issues for users with cognitive disabilities. The same users reported that they tried to follow parts of WCAG 2.0 when possible or not too expensive, in doing so it can be said that they did some accommodations towards people with cognitive disabilities.

4.3 Positive attitudes

Participants displaying positive attitudes towards universal design of ICT had different answers for many of the questions given, as such participants with general positive attitudes towards universal design of ICT are grouped together. While participants are individually grouped analysis of transcription data revealed that if one interview participant had positive attitudes towards universal design of ICT all other participants from the same business also displayed positive attitudes towards universal design of ICT. A total of 11 interview participants from 4 companies were categorized as having positive attitudes towards universal design of ICT.

4.3.1 Legal and compliance

All but one of the participants displaying positive attitudes towards universal design of ICT were aware that Norwegian law requires websites to follow most of the WCAG level A and AA requirements. Two of the eleven participants displaying positive attitudes towards universal design of ICT further stated that they actively used the WCAG guidelines in their work. The remaining nine participants stated that they worked towards accessibility within their products without using WCAG checklists, four participants stated that although they did not actively use WCAG 2.0 in their work periodic unstructured tests were done to ensure WCAG compliance. All eleven participants were aware of the fact that the Norwegian Agency for Public Management and eGovernment (Difi) conducts evaluations of WCAG 2.0 compliance on Norwegian websites, publishes reports on these evaluations and can issue fines for lack of WCAG 2.0 compliance. None of the eleven participants displaying positive attitudes towards universal design of ICT expressed concerns regarding their respective companies products failing Difi evaluations.

Three of the eleven participants displaying positive attitudes towards universal design of ICT stated that they were directly involved with software acquisition. Follow up questions regarding WCAG compliance within software brought in from external vendors reveled similar answers to those given by participants displaying negative attitudes towards universal design of ICT. The three participants directly involved in software acquisition all came from different companies but expressed similar views. Software vendors had claimed WCAG 2.0 A and AA compliance however use and testing of software bought from external vendors often revealed several WCAG errors. All three participants directly involved with software acquisition expressed

frustration over contract terms that did not allow for a refund or the ability to demand a fix for WCAG errors. The participants stated that software bought from external vendors that were not WCAG compliant were still in active use within all three companies.

4.3.2 Technical

All interview participants were asked if they used any frameworks in their work. All programmer participants interviewed in this master stated that they used one or more frameworks, individuals working in a non-technical role within a project were aware of the frameworks used. Participants displaying positive attitudes towards universal design of ICT used many of the same frameworks as individuals displaying negative attitudes towards universal design of ICT. The most used frameworks among users displaying positive attitudes towards universal design of ICT were

- React
- Flutter
- Grails
- Angular
- JSF
- Spring

Participants were asked if they thought the frameworks used enhanced accessibility within their applications. The participants answered that some frameworks did not either enhance nor decrease accessibility within their application. Notably React and Anguler were mentioned as frameworks that could give warnings about some common WCAG errors and thus enchance accesibility. Serval participants stated that they had increased their general technical accessibility knowledge by reading framework specific documentation, one participant cited as having started to care about accessibility due to the React accessibility documentation. One interview participant stated that while frameworks allow for WCAG compatibility some frameworks require additional work and make common WCAG mistakes easier to do, when asked to give an example the interview participant stated that they had had problems using the

Mustache markdown framework. Three participants emphasized that since many teams can choose their own frameworks the interview participants did not know if any one used frameworks that did not allow for WCAG compliance.

None of the companies where employees displayed positive attitudes towards universal design of ICT used any organization-wide testing tools for accessibility. Individual teams instead chose if they wanted to use testing tools and what testing tools they wanted to use. Some of the testing tools listed as used within the businesses except for manual testing and in workshops were

- Axe Core
- Axe Chrome plugin
- WAVE
- Chrome Lighthouse
- Pa11y with or without Pa11y dashboard
- Tota11y

One participant stated that if a project used accessibility testing tools a tool was chosen via a vote in the team.

4.3.3 Testing

The nine participants not using WCAG to check for compliance in their work were asked what they used instead. A mix of methods were used, the ones all companies displaying positive attitudes towards universal design of ICT had in common were workshops, ready-made user interface components, testing with tools simulating disabilities and testing using people with dishabilles. All nine participants either conducted or participated in accessibility workshops. Common among all the workshops were that they were initiated by employees in technical positions and allowed time for by leadership instead of mandated or recommended by leadership. Participants described the initiative takers of these workers as accessibility enthusiasts trying to spread a positive message about accessibility within the organization.

Workshops focused on product testing rather than WCAG training, although participants said that WCAG and resources for reading about WCAG were conveyed during workshops. Workshop participants tested products while simulating disabilities either using software tools or manual tools. Some of the manual testing methods cited used by participants were looking at a display through a straw, only allowing the use of one hand, glasses blurring or giving tunnel vision and trying to use a system while manually being shaken by another participant. Some of the software tools cited were browser extensions and apps simulating disabilities such as blurred vision, text constantly changing letter ordering and screen blurring.

One of the four companies where participants displayed positive attitudes towards universal design of ICT had a dedicated quality assurance tester, the three other companies cited having no personnel or consultants working fulltime on quality assurance with the notable exception of technical security quality assurance personnel. DevOps and lean methodologies were used within all companies interviewed for this thesis, of all the interviews conducted one person stated that their position primary involved quality assurance testing with a special focus on accessibility testing. Follow up questions into how this person worked revealed this quality assurance position to have been created by the company to better developers understanding and respect for universal design. The quality assurance tester described the testers work day as having little structure and a great deal of personal freedom to focus on any project that the tester thought needed focus. The organization the tester worked for had over 30 teams each working on their own projects and the quality assurance tester stated that they themselves choose projects to evaluate and answered emails regarding universal design. Since each project worked on a lean cycle the goal of the tester was to fix a certain amount of issues within a given project but as the owners were low, this was common for all businesses conducting workshops.

Participants were asked if they had conducted any testing with people who had disabilities. Two out of four companies displaying positive attitudes towards universal design of ICT did testing with users who had disabilities. Participants from two other companies displaying positive attitudes towards universal design stated that they had not done any testing on users with disabilities but had tried to but failed to recruit participants for such tests. All the businesses with participants showing positive attitudes said they took feedback from end users seriously

and treated the feedback like an important quality assurance source. The two businesses who had tested with disabilities both tested with external users who had disabilities but had also employed users with disabilities who participated in testing software, some of the users with disabilities used in testing held positions where they did not do software development or were part of a software development team.

When then participants who displayed positive attitudes towards universal design of ICT were asked if they saw accessibility as a functional, non-functional requirement or mix of both they gave similar answers to those given by participants displaying negative attitudes towards universal design of ICT. With the exception of one participant all participants stated that they saw accessibility as falling within both functional and non-functional requirements, one participant stated that the participant saw accessibility as only falling within the realm of functional requirements. When asked if functional or non-functional requirements generally the highest priority within projects had all participants displaying positive attitudes towards universal design of ICT stated that they saw functional requirements as the most important for a project. Several participants also stated that issues found in functional requirements often had a higher priority to be fixed compared to non-functional requirements.

Participants were further asked if they were familiar with the concept of technical debt, some participants asked to be reminded of what technical debt was. When asked if lack of universal design or universal design testing could fall under technical debt all participants displaying positive attitudes towards universal design of ICT answered that they though lack of universal design of universal design testing could fall under technical debt. When asked how participants measure technical debt no participants stated that they measured technical debt and no participants knew of any parts of their organization measuring technical debt. However some participants stated that when issues were found they would put the issues into a work backlog, in doing so it can be said that they documented some technical debt.

4.3.4 Impact

When asked who benefitted from universal design work all participants from the four companies where participants displayed positive attitudes towards universal answered that

they felt everyone benefitted from universal design work. Three interview participants stated that while universal design benefitted everyone they thought that it had additional benefits for users with disabilities. Two participants from two different companies described some of the benefits gathered from universal design work in saying that by making products usable and functional for the edge cases the product would also be more usable for median users. Three participants stated that doing universal design was more effective than specialized accessibility features, when the participants were asked why they saw universal design as more efficient than accessibility the reasons given were less code to maintain, allowing more users access to the accessibility features and easier testing.

Some participants stated that while they felt universal design to be beneficial for all they had doubts about their leaders feeling the same way. This view was shared among several interview participants. One interview participant described the participants view on leaders and universal design in this quote, the quote was originally in Norwegian and has been translated by the thesis author

"*I wish leaders understood that universal design is not limited to the small group of people with disabilities. We clearly see this when we user test with users who have disabilities. They see things that make the application harder for them to use, things others don't notice or see. When we fix these issues the app usually becomes easier to use for everyone else as well, the whole system just feels more user-friendly*"

Two developers stated that they had their views of universal design being good for everyone formed after starting to focus on universal design within their own products. The developers stated that when they see things that annoy them on websites the issue could usually have been fixed using universal design and WCAG. One of the developers stated that the developer had always found these issues to be annoying but after learning about accessibility and universal design the developer found them more annoying than before, the reasons given were that the developer knew how easy these issues could be to fix and knew that some of the issues excluded users with certain impairments from using the website. Several interview participants stated that testing had revealed language issues that no automated accessibility testing tool

currently available would have been able to identify. These language issues had to do with users not understanding the text on an app or website, this was usually due to the text using words that can be hard to understand and long sentences. Several participants stated that an increased focus on universal design had also increased the focus on writing text that could be understood by as many people as possible, potentially making the learning curve for a new user lower.

Several interview participant stated that since beginning to focus on universal design within their product their products has also become easier to use while on the move for the interview participants, the participant thought that this added usability when on the move that they had experienced also could be felt by other end users not involved in the development of the product.

4.4 Organizational

In this thesis several businesses, in this chapter referred to as organizations, have been interviewed. Within this chapter this thesis tries to find common ground among organizations that can contribute to more accessible products, this thesis also tries to look at some organizational boundaries to universal design of ICT.

All interview participants in this thesis stated that they worked within lean projects, the interviewer did not ask if there were any waterfall projects within the organizations. As such this thesis assumes that all participating organizations work using lean methods in their projects, but this thesis has no reliable sources saying the organizations does not do any waterfall development. As previously discussed in this thesis DevOps and lean methodologies are loosely defined and often done in a different way between different teams and organizations, observations made from interview transcript data in this thesis affirm this statement for organizations participating in this thesis.

Common among all organizations were that technical and designer employees expressed difficult in communication with leadership both on an organizational level and team level. This difficulty in communication was explained by several participants as technical employees and designers speaking with what was described as a different language than leadership,

participants also stated that they saw themselves has often having different goals than leaders. Four participants stated that they had seen leaders within their organization emphasizing the importance of universal design but had not followed this emphasis up with more time allocated time for testing or accessibility work. While trouble communicating the importance of accessibility to leaders was found in all organizations participants from some organizations stated greater difficulty in communication with leaders than others. Common among the organizations where this communication difficulty was the greatest were that they had employees expressing negative attitudes towards universal design of ICT.

Follow up questions on how project leaders and organization leaders interacted with teams were asked. Participants stated that the proximity a project leader and a leader had to a project was important to the leader understanding requirements project developers and designers wished to complete. Project leaders with multiple projects and project leaders who did not sit with the project were pointed out by several interview participants as being difficult to communicate with. Participants further stated that they had difficulty in convincing project leaders to attend daily stand ups within their projects, the same participants described daily stand-ups as an important arena to express concerns and share knowledge within a team. Within these stand-ups the product requirements were discussed, however several interview participants stated that new requirements came from project leadership. Without project leadership approval new requirements were not added, this observation was found in some but not all teams. Some participants stated that detecting tangible accessibility errors early in development was important in order to persuade leaders to approve accessibility work. One participant stated in Norwegian, translated to English by the thesis author

"Product owners and project leaders know what universal design is, and if you ask them if they think its important they'll tell you that yes they think it is important. But if you find universal design errors and the project is already well on it's way they won't take away from the remaining project time to fix these issues. Especially if they have also begun on another project"

When participants were asked if they thought their views and opinions were taken seriously by leadership most said yes. However, several participants further stated that even though they

thought leadership would listen to them this did not mean that leadership would change anything, several participants also stated that they had not tried to communicate the importance of universal design to leadership because they were afraid that leadership might not understand what they were trying to explain. Participants from organizations that stated that they held accessibility workshops were asked if leadership was invited to these workshops. In all the organizations holding workshops all participants stated that leadership was invited to the accessibility workshops, but seldom actually attended the workshops. Follow up questions regarding why participants thought leaders refrained from attending accessibility workshops revealed that participants thought leadership may not see accessibility as within the domain of knowledge they needed for their job and that leadership could see other tasks as more important than attending workshops. Several participants in organizations that had been evaluated for WCAG compliance by the Norwegian Agency for Public Management and eGovernment (Difi) stated that they used the Difi reports to encourage leadership to increase focus on universal design. Participants from one of the organizations who had attained a high score from a Difi evaluation stated that they feared the high score would mean less focus on universal design but instead found leadership applauding the evaluation score and having an increased focus on universal design of ICT.

Several participants stated during the interviews that lack of universal design competence within each team in the organization led to challenges. As previously discussed in this thesis the change to a DevOps and lean organizational culture has increased the knowledge demands on individual teams. Yet not all businesses held workshops or had other methods of increasing accessibility awareness and competence within teams. Participants elaborated on this issue by stating that teams without accessibility knowledge could ship products and features, but if accessibility issues were found in code that had already been shipped the likelihood of these issues being fixed decreased. Within organizations that held accessibility workshops this issue was not mentioned. Participants from organizations holding accessibility workshops stated that these workshops produced individuals with what was described as a passion for accessibility. Within these organizations individuals with a passion for accessibility were used as a source for advice and feature testing across teams, even though the individual worked in a specific team

they were allowed to spend time assisting and training other teams. Participants from organizations displaying positive attitudes towards universal design emphasized mutual respect as important for both accessibility and general development. When asked to elaborate on what participants meant by mutual respect participants explained that within lean teams developers, content creators and designer had to work close. Participants further elaborated that within this closeness any one had to be able to make improvement suggestions to other team members even if the improvement suggestion was not within the person who suggested the improvements expertise area. One participant stated that without respecting fellow team members and spending time talking the participant thought that DevOps could not function as intended.

4.5 Competence

All interview participants were asked to self-identified universal design competence first by stating how good they thought they were by asking how they saw their own universal design competence than by asking how they would rate their own universal design competence on a Likert scale from 1-9. For each participant this thesis author adjusted the self-reported Likert competence to a level the author felt the participant were based on other answers given to questions during the interviews. The thesis author found little correlation between self-reported accessibility competence and thesis author evaluated competence. The interview participants the thesis author found the most competent self-reported a Likert scale rating between five and seven. The participants the thesis author found to be on the lower end of the Likert scale self-reported a competence level between 7-9. Only one participant stated that they thought their own accessibility knowledge was at point 9 on the Likert scale, this participant was unable to name WCAG and did not know of any accessibility guidelines. Work was done to categorize interview participants inn to competence groups, how ever as the work was evolving it became apparent that this data added little value to this thesis. Instead the indicator of showing positive attitudes toward universal design of ICT was chosen. Data about Likert scale and thesis author correct Likert scale data is collected but not actively used within this thesis.

4.6 Business

In the early stages if this thesis the thesis author had made arrangements with three Norwegian companies that would participate in this master thesis. The companies were carefully selected to represent three groups of the Norwegian market, namely a general IT consulting firm, a business to business software company and a business to consumer company. All three originally selected companies opted to withdraw from this master thesis after the thesis had begun. The companies opted to withdraw relatively late in this the work period of this master thesis and barred the thesis author from using any data collected about the companies. The thesis author opted to try and find new companies, to make this process easier all companies contacted were given the option to stay anonymous in this thesis. All participating companies opted to stay anonymous. As the companies opted to stay anonymous the names of these companies or directly identifiable information cannot be used, but the thesis author can give a rough estimate on where they place within the Norwegian market.

Six companies provided one too many interview participants for this thesis. Three of the six companies have at writing date more than 200 employees. Two of the companies had at writing date more than 1000 employees. One of the companies had less than 50 employees. All of the companies had primarily Norwegian owners and primarily Norwegian employees. All of the companies delivered ICT solutions used in Norway. One of the companies is a consulting firm, one of the companies only delivers business to business solutions, the remaining four companies all deliver a mix of business to business and business to client solutions and are not consulting firms.

5.0 Conclusion

5.1 Conclusions from research

Through research done in this thesis the notion of universal design of ICT requiring specialized knowledge and experience is strengthened. We see clear indications that Norwegian law requiring WCAG 2.0 compliance within all ICT products have increased awareness of accessibility within Norwegian organizations. However businesses have approached accessibility conformance in different ways. A divide in attitudes and working methods have been observed through this thesis between businesses trying to achieve WCAG and businesses more generally working towards universally designed products. This divide can be seen as two different ways to achieve the requirements mandated by law. One from a more traditional compliance perspective where an organizations try to adhere to strict set of rules or guidelines, the other a more human cantered approach where instead of focusing on rules or guidelines the organization focuses on what they think is good universal design.

The author of this thesis thinks this is related to some organizations having employees with passion for universal design. If allowed these passionate employees spread information about universal design and the potential benefits it may bring within an organization. It is unclear exactly how organizations can create these individuals with passion for universal design, but the thesis author has seen some indications of only adhering to the WCAG 2.0 standard having the opposite effect of creating individuals with a passion for universal design. Instead of seeing accessibility as something creating better products some participants from organizations only using WCAG 2.0 for accessibility saw accessibility as a legal requirement generating extra work and limiting design.

Several organizations in this thesis created content for their websites and applications exclusively for screen reading software. It can be argued that this practice breaks with universal design principles in that the organizations design custom solutions to be only used by screen reading software instead of just creating one solution that can be used by all. Some of the applications created by organizations participating in this thesis have high complexity and display allot of data on a small screen, it is this thesis authors opinion that allowing a screen reader to read everything present on a screen would make the app less usable for users with

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visual impairments. However the choice of what to exclude and include for screen readers should be an informed choice grounded in feedback from end users with visual impairments. This is especially important given how WCAG does not provide detailed instructions regarding what screen reading software should and should not read, such advice would be hard to create given the variety of potential information presented in different applications and websites. Creating different versions of content for screen reading software would require teams to have the accessibility knowledge to test that new features also work well with screen reading software, this would require all teams to have at least one team member with this competence. If a project changes teams it is important that the new team is both aware of this content specifically created for screen readers and receive the necessary training to continue the work.

Employees with a passion for universal design has been shown within the organizations participating in this master thesis to bring positive accessibility change to organizations they work for. Allowing these individuals with a passion for universal design time to educate other users can help in the spread of accessibility knowledge within an organization.

It is the thesis authors opinion that businesses employing lean and DevOps methodologies should both enforce and encourage team members to participate in training and other knowledge building exercises. While this practice can be said to already be common among several Norwegian ICT businesses the organization must ensure that team members train within the domains needed to maintain an autonomous team, this would include at least one team member acquiring an understanding of accessibility, WCAG and the concept of universal design of ICT. Participants from organizations utilizing ready-made accessible software components reported a belief in that these components helped enhance accessibility within the organization, there was also a correlation between organizations utilizing ready made components and organizations where participants displayed positive attitudes towards universal design of ICT.

Research from this thesis shows that workshops and training are effective at increasing accessibility awareness within organizations, not only because they train participants in the methods to completing accessibility requirements but also as a way to convey how accessibility

work can be beneficial for all end users while also having the potential to increase participants empathy for the situations end users with disabilities find themselves in.

Common among all organizations interviewed in this thesis was a difficulty in communication between technical employees and leaders. This difficulty in communication with leaders was also observed from content creators and designers, it is the opinion of the thesis author that this difficulty in communication is related to the attitudes and work loads of leaders. Some of the project leaders interviewed for this thesis managed more than five lean projects at the time, it is the thesis authors opinion that it would be difficult for project leaders with such heavy workloads would have a hard time finding time to learn the details of law requirements projects have to follow. With such a work load it is this thesis authors opinion that project leaders could be pushed to finish projects within deadlines and be ready to move on to different projects. Some of the effects of this can be observed from interview participants in either technical, designer or content creator positions expressing frustration over accessibility issues found late in a project had a decreased likelihood of being remedied.

Organizations conducting testing with users with disabilities had in common that the organization's employees displayed positive attitudes towards universal design of ICT. Recruiting participants with disabilities for user testing can however prove difficult as described by three businesses in this thesis. The organizations usually try to conduct user testing during normal business hours, but during these hours potential users with disabilities for user testing are also at work. Two organizations had employees with vision impairments willing to perform testing, giving the organizations a valuable resource. The two organizations utilizing their own vision impaired testers both reported that the testers provided them with valuable results while at the same time holding a different position within the organization.

It is the opinion of the thesis author that all of the organization participating in this thesis had their main accessibility work focus towards end users with vision impairments. While some organizations stated that they wished to test with users who had cognitive disabilities no organizations in this thesis reported having been able to recruit any such test participants.

WCAG 2.1 has a greater focus on cognitive disabilities than WCAG 2.0, if WCAG 2.1 becomes law in Norway this may have a positive effect on end users with cognitive disabilities.

Frameworks used within an organization can help increase accessibility conformance within an organization, several frameworks support relatively easy methods of creating standardized components and some also give warnings for some common WCAG issues. Some participants from organizations participating in this thesis reported framework specific accessibility documentation to have enhanced their understanding of accessibility. It is this thesis authors opinion that when working with frameworks developers tend to use the frameworks documentation extensively, documentation for accessibility and best practices are often part of framework documentation. However some participants in this thesis found commonly used frameworks to be an obstacle to WCAG compliance. The thesis author has not found the exact reason for this opinion existing within some organizations and while an effort to confirm these statements was made this effort yielded no results confirming that the framework in question, React, barred users from complying with WCAG 2.0. It is the thesis authors opinion that the belief that React does not allow for WCAG conformance is related to how lean project teams are forced to quickly and independently acquire knowledge within all domains required for the team to deliver a product. Teams under tight deadlines may struggle to attain the required competence to fill all the needs of the team. To further compound this problem frameworks, while often fully compatible with WCAG 2.0, often requires specialized knowledge of the framework to produce accessible code. Something that is accessible in HTML may not be accessible in React or Angular, these frameworks may require specialized methods to achieve the same accessibility as pure HTML would have. It is the thesis authors opinion that both allocating time for and requiring training within different domains should be a priority within Norwegian ICT businesses. Team knowledge of accessibility may also alleviate the issue of accessibility issues being down prioritized when discovered late in a project or after a product has shipped to production.

5.2 Recommendations for Norwegian businesses

Recommendations for Norwegian businesses are based upon this thesis authors personal views with a focus on the views having grounds in results found in this thesis. They are aimed at providing value for Norwegian businesses built from the results of this thesis.

The job of a project leader can be a difficult one, data gathered in this thesis suggests that project leaders often are not ICT professionals yet face responsibilities in approving and formulating new requirements for systems. Interview participants in this thesis have expressed frustration over the difficulty communicating with leaders can entail. It is the opinion of the thesis author that project leaders and projects could benefit from project leaders actively seeking to communicate with team members and learn their jargon, while doing so also trying to teach team members their own jargon. This could help decrease the gap between project leaders and team members while lowering the barrier to communication between team members and project leadership. It is also this thesis authors opinion that it is of great importance that project leaders attend daily stand ups and discussions had during daily stand ups. In order to achieve this it may be required to assign fewer projects to project leaders so that they have time to attend daily stand ups and other discussions.

All lean teams should have at least one team member with an understanding of WCAG and general accessibility, this team member should be encouraged to share their knowledge both within and across teams. Time for such knowledge sharing should be allocated and encouraged.

While WCAG is mandated by Norwegian law it is the opinion of this thesis author that WCAG should only serve as a base for an organizations accessibility work. In order to foster accessibility that benefits all users and a positive accessibility environment within an organization accessibility workshops should be help. These workshops should instead of focusing on just explaining WCAG allows participants to test the organization's products simulating different disabilities. If the organization has no individuals with a passion for accessibility to start these workshops and organization can try to create this passion by hiring accessibility specialist consultants and asking them to train and convey the importance of accessibility to employees.

It is this thesis authors opinion that results from user testing with users who have disabilities should hold greater weight than WCAG requirements, although it is important to verify such results with multiple testers.

Data gathered from interviews in this thesis suggests that ready-made accessible components could prove beneficial to accessibility within an organization. It is important that these components are made in such a way that they are easy to incorporate into different designs and well documented, allowing a team with accessibility competence time to produce and maintain such components could provide value, time-saving and increased accessibility knowledge to other teams within the organization.

Organizations participants in this thesis who had employees with disabilities willing to participate in user testing had the added benefit of having access to valuable testing resources other organizations struggled to get a hold of. It is the opinion of the thesis author that hiring employees with disabilities can allow organizations to gain a competitive advantage in having access to hard to reach test resources, it is also the opinion of the thesis author that employing people with disabilities can help in spreading accessibility awareness, accessibility acceptance and respect for people with disabilities throughout an organization.

6.0 Discussion

Research cited in the literature review of this thesis has concluded that WCAG 2.0 is hard to achieve (Alonso et al., 2010; Brajnik et al., 2010), the guidelines themselves can be hard to understand and agreement on what is correct WCAG and what is not is not always met within teams. Some of the effects of this has been observed in this thesis in that teams trying to strictly adhere to the WCAG 2.0 guidelines often displayed negative attitudes towards universal design of ICT. Teams that instead of just focusing on adhering to WCAG but instead saw accessibility as a driving factor for potential new customers and better design to a greater degree displayed positive attitudes towards universal design of ICT. Common among the teams not focusing on WCAG was a general universal design focus, mutual respect and accessibility training offered to all team members.

The research in this thesis is based on interviews written, conducted, transcribed and analyzed by a single in experienced researcher. The thesis author lacks experience in qualitative work, interview design, conducting interviews and analyzing data from interviews. While the thesis author has made an effort at grounding the research in established methods to try an alleviate issues stemming from this inexperience further research by more experience researchers into the findings of this thesis would aid in confirming or finding errors in the results of this thesis. This research has a relatively small sample size, in order to strengthen the findings in this thesis it is the opinion of the thesis author that further research using different organizations should be done, the results of this further research should then be compared to the findings in this thesis.

This research had several participating organizations achieving a high score in accessibility evaluations conducted by Difi, however the majority of evaluated organizations achieve medium to low scores in Difi evaluations. By interviewing participants from organizations already achieving high scores in Difi evaluations the conclusions and results in this thesis may have an overly positive view of the current situation in Norway. A 2018 accessibility evaluation performed by Difi found that form a sample size of 278 websites Difi found only a 60% compliance rate with the WCAG requirements mandated by Norwegian law.

The research conducted in this thesis lacked a focus on authoring tools but at the same time recommends that content creators and all other team members should have an understanding of accessibility. Further research examining how authoring tools and CMS systems can help enhance accessibility and measurements on how much such tools help could prove valuable for Norwegian businesses. The thesis author also failed to examine if organizations set specific requirements for external consultants to have accessibility knowledge but through data gathered from the open-ended interviews observed a frustration held by team leaders towards a lack of accessibility knowledge from hired consultants. Further studies into what demands should be set by organizations for the consultants they hire may prove beneficial for Norwegian businesses.

6.1 Competitive advantage

There are indications of the business value of a product laying in what the product can do, how is it is to do certain tasks come second to capabilities. A competitive advantage could be drawn from serving products employees can learn to use quickly, allowing costumers to rent workers or supplement workers from other divisions under heavy load without having to spend significant resources training these workers. This could also alienate some of the troubles an aging work force brings, and thus provide even more business value. Given employees access to software that lets them perform their job in a comfortable manner may lead to increased loyalty ("Corporate Social Responsibility," n.d.). Many organizations now also cite human rights as part of their corporate social responsibility, equal access to ICT is now a human right mandated by the united nations ("Convention on the Rights of Persons with Disabilities - Articles | United Nations Enable," n.d.). Not providing accessible products, while not mandated by law in B2B situations, may break the companies own corporate social responsibilities. While businesses are exempt from universal design requirements in most B2B situation unless requested by the costumer ICT products and services sold to the Norwegian state or to Norwegian public education has to conform with WCAG ("Universell utforming – krav i offentlege anskaffingar | Anskaffelser.no - Difi," n.d.). Having a disability can be viewed by some as being permanent, but unless there is something obstructing your ability to perform an operation you are not disabled. Light hitting your cell phone screen may render you temporarily unable to see the screen and a system designed for desktop use used on a touch screen device may hinder your ability to efficiently use the system. We can call this situational disabilities, a 2006 conference paper defines this term as 'ordinary users operating in extraordinary emoluments' (Lin & Seepersad, 2007). With increasing use of mobile devices, touchscreens and portable computers in the workplace situational disabilities may become more common in the Norwegian work place. Providers of business and customer facing solutions can may great benefits from allowing more situational use, organizations may see relative quick gains by having a larger potential market. By accounting for possible situational disabilities products can also become more user-friendly for users with more permanent disabilities. When accounting

for the temporary effects of things such as minor injuries or pregnancies universal and inclusive design can provide a significant market and brand advantage (John Clarkson & Coleman, 2015).

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8.0 Appendices

Interview questions were written in Norwegian as interview participants were likely to be Norwegian.

| Hva spør vil jeg vite?	Hva spør jeg om
Oppvarming	
Hva er dine hovedoppgaver hos {bedrift}	Hva jobber personen med? Har denne stillingen noe å gjøre med front end arbeid? Gjør personen andre oppgaver som ikke har direkte med front end utvikling å gjøre
Hva tenker du universell utforming er?	Om personen har noe erfaring rundt UU og personens syn på U
Kjenner du til hvordan myndighetene oppmuntrer til universell utforming?	Vet de at DIFI kan gi bøter om WCAG ikke følges?
Kan du beskrive din universell utformingskompetanser	Ser personen på seg selv som flink innen UU
Har du erfaring med noe form for nedsatt funksjonsevne?	Kjenner personen noen med nedsatt funksjonevne eller identifiserer personen med å selv ha nedsatt funksjonsevne
På en skala fra 1-9 hvordan vil du rangere din universell utfromingskompetanse	Likert skala svar, 1-9 så det ikke skal være lett å velge midtpunktet.
Avslaping	
Har du jobbet med {arbeidsoppgave} lenge?	Har personen mye erfaring innenfor det personen jobber med
Syntes dere verktøyene og/eller metodologiene dere bruker for testing hjelper på universell utforming	Har bedriften noe testverktøy eller metode for å teste UU, liker de ansatte disse?
Føler du at dine syn iog tanker blir att på alvor i {bedrift}	Føler deltaker seg hørt og at deltaker kan ha mulighet til å forbedre bedriften
Føler du at det er ett godt faglig miljø i {bedrift}	Har bedriften ett godt faglig miljø, for dette kreves at tanker kan deles og at de holder seg oppdaterte
Problemet	
Har bedriften noen orgaisatoriske eller tekniske krav om å følge UU	Finne ut om det er krav om UU i prosjekter før de kan gå videre
Hva tenker du om universell utformingsdokumentasjonen og kravene i {bedrift}	er det i det heletatt noe dokumentasjon? OOm den er der, vet personen om den og/eller forstår den
Viser testverktøyene dere bruker universell utformingsfeil	Hvis ja, følg opp med spørsmålet under
Hvis ja, stoler du på at dette resultatet er komplett?	Mener deltakeren at automatiserte tester kan finne alle WCAG feil?
Er det mange i prosjektet ditt som jobber med universell utforming i en kapasitet?	Hvem mener deltakeren at jobber med UU
Føler du at produkteier ser på universell utforming som viktig for prosjektet?	Finne deltakerens syn på prosjekteiers syn på Universell Utforming, om deltaker mener dette er viktig for prosjekteier er det nok viktig for prosjektet og
Hva føler du om viktigheten av universell utforming	Ser deltakeren på UU som viktig eller bare en til barriære i prosjektekt
Hvem føler tjener på universell utforming av sluttbrukeren	mener personen at UU bare er for de med nedsatt funksjonsevne?
Involverer dere brukere i testing?	Gjør de noen form for user centered design
Involverer dere brukere eller ansatte med nedsatt funksjonevne i utviklingsfasen?	Er brukersentrert design med i utviklingsfasen, får menensker med nedsatt funksjonsevne komme med inspill?
Blir universell utformingsfeil sett på som teknisk gjeld?	Teller universell utformingsfeil som teknisk feil i bedriften eller prosjektet?
Debrief	
Føler du noe kunne blitt bedre med hensys til universell utforming i {bedrift}	La personen snakke om egne syn om UU og UU mangler
Føler du at du vil ha mer opplæring innen universell utforming i bedrift	Bør skrives om til å bli mindre bolsk
Hva ville du forbedred med hensyn til universell utforming i {bedrift} om du fikk bestemme	Forsøke å la personen snakke mer om sine egne tanker rundt UU
Er det noe jeg har glemt å spørre om?	La personen snakke om eventuelle andre følelser/tanker personen har som ikke ble spurt i intervjuet

Figure 1 Interview questions

Feltkode endret

8.1 Project plan

Task	Start date	Duration	End date
MP1	01/04/2018	68	08/06/2018
Defining problem statement	01/04/2018	68	08/06/2018
Observations	12/04/2018	19	01/05/2018
Initial literaturere review	15/03/2018	56	10/05/2018
Contract signature	15/04/2018	40	25/05/2018
Write paper	15/04/2018	16	01/05/2018
MP1 presentation	07/06/2018	1	08/06/2018
MP2	05/07/2018	80	23/09/2018
Ask for more companies to be sources	05/07/2018	6	11/07/2018
Identify interview goals	10/07/2018	7	17/07/2018
Identify other data sources	20/07/2018	12	01/08/2018
Identify interview participants and departments	15/07/2018	14	29/07/2018
Conduct interviews	01/08/2018	14	15/08/2018
Document retrieval	01/08/2018	14	15/08/2018
Analyze software and tools	15/08/2018	2	17/08/2018
Analysis of interview and document analysis results	17/08/2018	3	20/08/2018
Write paper	05/07/2018	80	23/09/2018
MP3	05/01/2019	135	20/05/2019
Evaluate MP2 results	05/01/2019	25	30/01/2019
Epand literature review	30/01/2019	19	18/02/2019
Write paper	05/01/2019	135	20/05/2019

Project plan gant diagram
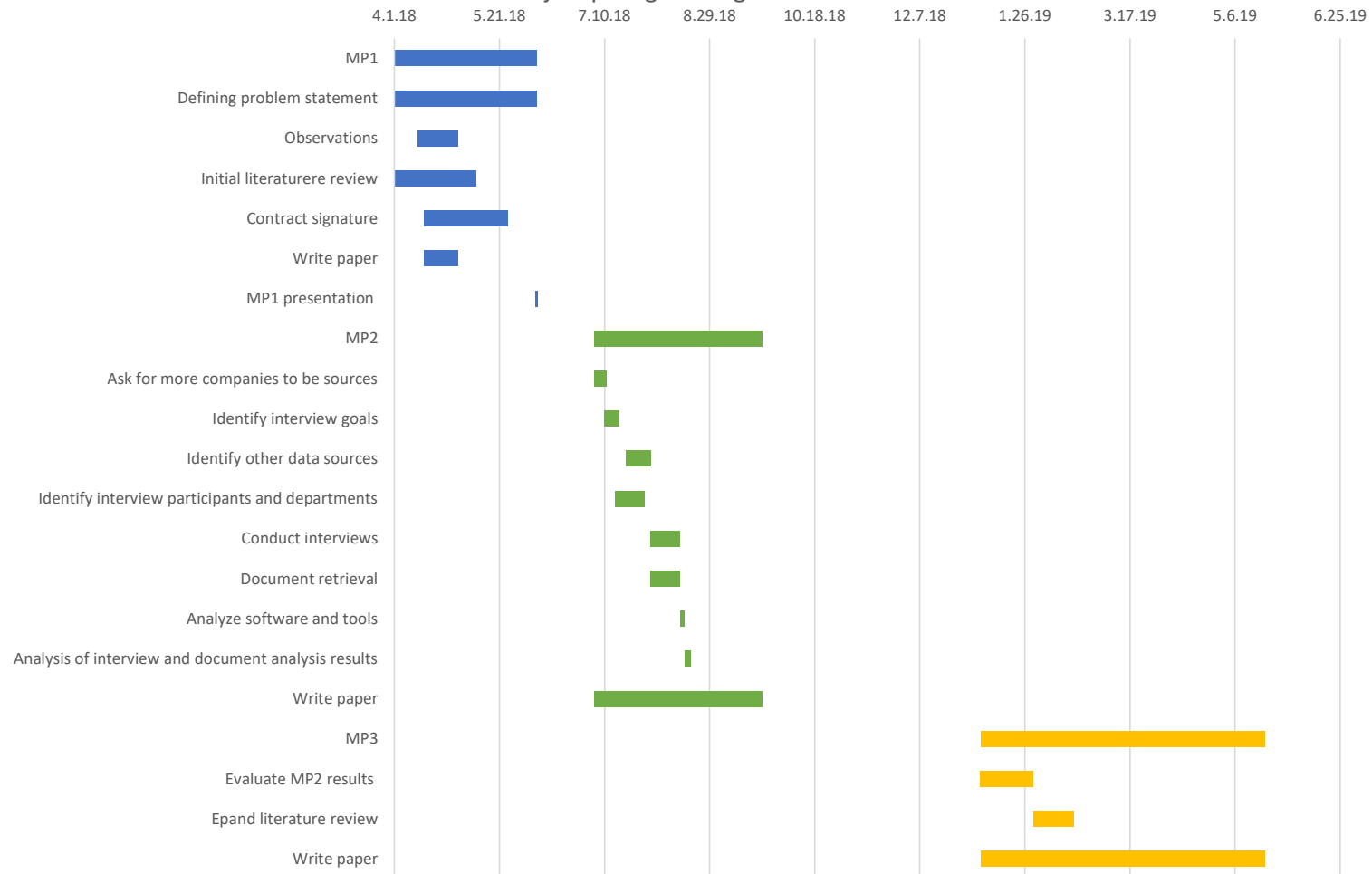
8.2 Risk

This project is reliant on information from several external sources to succeed and only has one writer, as such I see at is necessary to evaluate risk and possible actions to alleviate risk. Scale is evaluated on two scales, likelihood and impact. These risks are represented in a risk matrix table and given a risk rating from low (L), medium (M) to high (H).

Risk	Reason	Impact	Probability	Risk rating
R1 - Denied access or use of universal design process documentation	Companies may see this documentation as secret. Verbal indications from the companies have been given to that I can gain access to these documents and processes.	Medium	Medium	Medium
R2 – Not enough willing interview participants or businesses refuse to provide enough persons.	Interviewing would take time from other work tasks, interview candidates may divulge sensitive information or interview candidates may not want to participate.	High	Low	Medium
R3 – Ethical issues regarding what	Businesses may not want information that can put them in a bad light to be published. Alleviating measures include openness, including decision makers in	Medium	Medium	Medium

can be published	processes and being clear on the goals. The report will focus on processes and views by employees, and will not focus on pointing out errors on the corporations costumer facing solutions.			
R4 – Finding and reaching high level decision takers	Reaching employees in deciding positions that mandate universal design policy, and can make changes to that policy. To alliavete this risk I have reached out to some of the people in managing positions and they have given verbal indications of being willing to participate.	Low	Low	Low
R5 – Tainted data	While conduction data gathering people and the corporations may get increased universal design awareness as a result of interviews and awareness of participation in the project. Alleviating measures include interviews that does not ask direct questions, with the especially the beginning of the interview being vague. Other measures include close guidance from guidance counsel from OsloMet on how to conduct interviews and interact with businesses.	High	Medium	Medium
R6 – Access to developer tools and tools used	The tools the developer use can contain source code or future concepts the business does not want outsiders to see. Alleviating measures can include signing	Medium	Low	Low

for universal design testing	a confidentiality agreement regarding source code and coming products seen there.			
R7 – Paper writer gets sick	As there is only one writer on this paper any illness can have a significant impact on the production of this paper. How ever OsloMet has routines and it is possible to complete the project using an extra year if illness should occur.	Medium	Low	Low

8.3 Interview contract

Vil du delta i forskningsprosjektet

 «Universell utforming av IKT innen forretninger, drivende og hindrende faktorer»?

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å finne drivende og hindrende faktorer for universell utforming av IKT innen norsk næringsliv. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

Prosjektet er del av en masteroppgave ved OsloMet – storbyuniversitetet. Formålet er å se hvordan ett knippe av norske bedrifter arbeider med universell utforming av IKT. Denne dataen sammenliknes med hva litteratur i forskningsfeltet mener er «best practices». Data samlet inn i dette arbeidet skal benyttes i masteroppgaven og en potensiell publisering som vil være ett sammendrag av oppgaven. Både masteroppgaven og den eventuelt publiserte oppgaven skrives av Andreas Jacobsen (intervjuer), opptaket vil ikke bli hørt av eller delt med noen andre.

Hvem er ansvarlig for forskningsprosjektet?

OsloMet – storbyuniversitetet er ansvarlig for prosjektet, ansvarlig veileder for prosjektet er professor Frode Eika Sandnes. Hverken ansvarlig veileder eller ansvarlig institusjon vil få tilgang til lydopptak

Hvorfor får du spørsmål om å delta?

Bedriften du jobber i ble kontaktet om å delta i denne oppgaven, her ble bedriften spurt om de kunne

stille med ansatte som jobbet med front end og/eller universell utforming. Bedriften har så fremmet deg som potensiell kandidat for dette intervjuet.

Hva innebærer det for deg å delta?

Din deltakelse i dette prosjektet innebærer at du deltar på ett en til en intervju. Intervjuet blir tatt opp på en dedikert lydopptaker som aldri kobles til en datamaskin eller internett, resultatene av intervjuet vil bli manuelt transkribert. Under transkripsjon vil data som regnes som personidentifiserende ikke skrives ned. Intervjuet har flere spørsmål om hvordan du jobber med og ser på universell utforming av IKT. Skulle du angre på noe du har sagt har du rett til å kreve at dette fjernes opp til to måneder etter at intervjuet er gjort. Lydopptaket lagres i maksimalt en måned etter at intervjuet er gjort.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykke tilbake uten å oppgi noen grunn. Alle opplysninger om deg vil da bli anonymisert. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg. Du kan trekke deg når som helst under intervjuet uten å oppgi grunn, om ønsket kan det som har blitt sagt i intervjuet slettes på stedet når du trekker deg.

4

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

- Kun Andreas Jacobsen som gjør dette intervjuet og skriver oppgaven vil ha tilgang til lydopptak gjort i dette intervjuet. Prosjektveileder vil kunne se transkribert data etter at Andreas Jacobsen har fjernet personidentifiserende opplysninger.
- Opptaket lagres ikke med navn om deg eller bedriften du jobber i. Kun Andreas Jacobsen har tilgang til opptaksutstyret. Anonymiserte transkripsjoner vil lagres lokalt på to datamaskiner eid av Andreas Jacobsen som begge har kryptert lagring aktivert.
- Databehandler som samler inn, bearbeider og lagrer data er Andreas Jacobsen.
- Ingen personidentifiserende opplysninger vil publiseres, du som deltaker vil ikke være mulig å kjenne igjen i publikasjon eller masteroppgaven.
-

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Prosjektet skal etter planen avsluttes 10.05.16. Alle opptak vil være slettet innen prosjektslutt, transkripsjonene vil også slettes innen prosjektslutt.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke personopplysninger som er registrert om deg,
- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet), og
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra OsloMet – storbyuniversitetet har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- OsloMet – storbyuniversitetet ved student Andreas Jacobsen på s236778@oslomet.no. Ansvarlig veileder for prosjektet er Frode Eika Sandnes som kan kontaktes på Frode-Eika.Sandnes@oslomet.no
- Vårt personvernombud: Personvernombudet ved OsloMet, kontaktepost for personvernombudet ved OsloMet er personvernombud@oslomet.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Frode Eika Sandnes

Andreas Jacobsen

(Forsker/veileder)

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet Universell utforming av IKT innen forretninger, drivende og hindrende faktorer, og har fått anledning til å stille spørsmål. Jeg samtykker til:

6

☐ å delta i intervju

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 10.05.19

(Signert av prosjektdeltaker, dato)