PROMOTING AND OBSTRUCTING FACTORS FOR SUCCESSFUL UNIVERSAL DESIGN OF ICT

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ABSTRACT

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

1 INTRODUCTION

The necessity to ensure that the one billion individuals with various disabilities can use information and communication technology (ICT) in the same way as individuals currently not experiencing disabilities, is acknowledged by The International Telecommunication Union (ITU) (Msimang 2014). Today, ICT-solutions are more frequently linked to civil rights, for instance voting. It is therefore vital to avoid discriminating against any part of a country’s population when digitalizing such services. Legislation regarding UD is only present in certain countries, and may vary from one country to another. In some countries only certain providers, such as official public web sites, are affected by UD legislation. Therefore a synchronized international effort might be essential in order to create a common UD standard (Vanderheiden & Treviranus 2011, Abascal et al. 2015).

There are both ethical and commercial benefits of UD. To exclude disabled users from receiving the benefits of new technology is unfortunate. By doing so, there is also a risk of eliminating a considerable group of potential customers; for instance those with physical and cognitive limitations, ageing people, individuals with low socioeconomic status, low literacy skills, children and individuals who do not speak the native language (Fuglerud & Sloan 2013, Cremers et al. 2014, Scott, Spyridonis & Ghinea 2015, Abascal et al. 2015). In Norway, the government initiated an ambitious goal for the country to be universally designed by 2025 (Anti-Discrimination and Accessibility Act 2009). A section of the Norwegian legislation for UD is dedicated specifically to ICT. However, despite this legislation, as few as five of Norway’s 50 most visited websites met the minimum criteria for universal design in 2014 (Aune 2014). According to Rygg and Brudvik (2015) a sample survey performed by the Agency for Public...
Management and eGovernment (DIFI 2016) to check web accessibility on 304 Norwegian websites returned disappointing results regarding Norway’s standards for UD. There were large variations amongst the sample web sites, and scores ranged from 18 to 79 percent of the possible obtainable points in their measuring system, with an average at 51 percent.

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

2 PREVIOUS WORK

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

When working towards assuring accessible ICT-solutions a main goal is to meet all the requirements specified by the World Wide Web Consortium (W3C) Web Content Accessibility Guidelines (WCAG). Several researchers agree that accessibility standards and guidelines are necessary tools to ensure UD (Røssvoll & Fuglerud 2013, Schulz et al. 2014, Scott, Spyridonis & Ghinea 2015). However, there seems to be a growing consensus that compliance with these guidelines alone is not adequate for achieving universally designed ICT-solutions. A large cross-sector survey performed amongst web development projects in Brazil, with 613 participants, reports a lack of consciousness regarding accessibility issues in web development processes (Freire, Russo & Fortes 2008). The study suggests educating web developers in how individuals use assistive technologies, and implies that it can be very effective to show developers how a user struggles with their solutions. Cremers et al. (2014) argue that the most suitable approach to UD is by enriching inclusive design methods with qualitative methods from anthropology to enable personalized systems. Sachdeva et al. (2015) on the other hand, explore how to make technology affordable and socially accepted using social and systemic innovation alongside already existing technical innovations.

For an ICT solution to be completely accessible, a distinction between technical and usable accessibility must be in place (Rossvoll & Fuglerud 2013, Garrido et al. 2013, Schulz et al. 2014, Abascal et al. 2015, Aizpurua, Arrue & Vigo 2015, Jung et al. 2015). A gap is identified between the theory of inclusive design and the industry practices. According to Fuglerud and Sloan (2013) there is a heavy focus on standards in the requirements provided by the legislations, without any emphasis on the development process. Seven key principles for an inclusive design process are identified in the literature 1) holistic and interdisciplinary teams and/or process, 2) based on user-centered design principles, 3) adopting and applying accessibility standards and guidelines, 4) using an iterative development, 5) focus on users with disabilities, - early and throughout, the entire design process, 6) use of empirical evaluations with various impairments represented and 7) focusing on the entire user experience (Fuglerud & Sloan 2013, Røssvoll & Fuglerud 2013, Schulz et al. 2014, Scott, Spyridonis & Ghinea 2015).

3 RESEARCH APPROACH

Due to the nature of our research topic, we consider it appropriate to use an exploratory and qualitative approach for data collection. Semi-structured in-depth personal interviews are selected in order to maintain a solid foundation and framework, exposing the respondents to the same questions and themes while simultaneously allowing for flexibility and follow-up questions (Rogers, Sharp & Preece 2011). The interview guide is divided into two main sections. The first part concerns personal experiences related to practices for successfully achieving UD in Norwegian ICT projects and consists of 5 questions. The second part concerns methodological style and epistemologies and consists of 10 questions. In addition 6 questions map out background variables about the informants. The entire guide consists of 21
questions. This study focuses on the first section of the interview guide and the questions concerning UD practices in Norwegian ICT projects. Questions are neutrally formulated to avoid creating bias.

A prerequisite for participation is affiliation with an ICT project linked to success in regards to UD. “Success” is defined as either having won an award or getting an honorable mention for efforts concerning UD. Based on this, 12 ICT-projects is included, and 13 informants representing these projects recruited for the study. The 13 informants are interviewed over a total of 11 interviews: 9 individual interviews and 2 group interviews where two informants are interviewed together.

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

3.1 Data Analysis

A thematic content analysis was selected for data analysis. There are few pre-defined codes in the existing literature. Therefore, emergent coding (also called “open coding”) was chosen for a bottom-up analysis of the transcribed interviews. After completing the interviews, the 13 transcripts were reviewed in order to form an initial overview of and familiarization with the data. Questions giving overlapping answers were identified: regarding specific practices in successful projects (Q7), the preferred methodologies in an imagined project (Q8) and general practices that promote UD (Q9). Overlapping questions regarding negative practices were also identified: practices inhibiting UD (Q10), and factors affecting the choice of methods (Q13). As a consequence of the overlapping responses, the transcripts were analyzed as a continuous text, as opposed to questions consecutively.

The textual material from the transcripts was analyzed and each emerging theme was given a respective code. A second transcript review was conducted separately by the two authors with the goal of identifying unique thematic codes in the text. Upon reviewing the total of codes, two overarching categories were identified, one considering positive promoting aspects, and one considering the negative obstructive aspects. For researcher 1 this resulted in 103 thematic codes across the 13 transcripts, separated into 75 promoting and 28 obstructive. Researcher 2 identified 104 codes: 75 promoting and 29 obstructive. Final codes for each category are specified in the tables in sections 3.1.1 and 3.1.2 for increased transparency, but please note that as the full list of thematic codes is too extensive to be presented as part of this article, it will instead be made available by the authors upon request.

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

For the 57 obstructive codes there is a 95 % overlap. Again there are 3 diverging codes: researcher 1 has a code on handling resistance, while researcher 2 has one related to lacking utilization of available UD resources and another on the challenge of frameworks and tools in violation of the Web Accessibility Initiative (WAI) by the W3C (W3C 2016).

All the positive thematic codes within the overarching promoting category were then divided into groups based on what type of practices they referred to: organizational level, project process level or individual level. These groups were based on the data, thus emerging – not predefined. The same was done for all the negative codes within the overarching obstructive category. In order to quality control the categorization process, codes and code-categories were again discussed amongst the researchers, and codes cooperatively sorted and categorized. The result was 13 promoting and 6 obstructive categories, see sections 3.1.1 and 3.1.2.
Through iterative transcript reviews by the two researchers, frequencies were also mapped out for 1) how many informants mention codes associated with each category, and 2) how many times in total codes associated with each category are mentioned. Since a grouped category includes several thematic codes, the frequency-of-mention per category embraces all included codes in the category. Informants who answer together in a group interview, on behalf of one project, are still counted as two individual informants. A total of ten transcripts reviews are completed as part of the analysis; four for coding and categorization and six for frequency mapping.

3.1.1 Promoting Categories

Promoting, positive categories are divided into organization level, project process level and individual level practices; 5 categories on organization level, 6 on process level and 2 categories on individual level (a total 13 categories). The finalized categories from the thematic analysis of UD promoting factors are presented in Table 1, Table 2 and Table 3. Note that codes in the category Resources are relevant both for organizational aspects and for specific project processes, and the category is here placed on organizational level due to perceived more focus on overall resources, but could also have been placed on process level.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top level Focus</td>
<td>UX/UD-department</td>
<td>1, 18, 20, 28, 48, 49, 64, 76, 78, 86, 89, 109, 133, 143, 149</td>
</tr>
<tr>
<td></td>
<td>UD specialist group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ensuring UD competence</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disabled co-workers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good-practice library</td>
<td></td>
</tr>
<tr>
<td>Resources</td>
<td>Available ATs, Human resources, Economic resources</td>
<td>19, 94, 95, 96, 115</td>
</tr>
<tr>
<td>Anchoring</td>
<td>Understanding, awareness and competence at all management levels</td>
<td>2, 6, 10, 11, 41, 45, 69, 71, 77, 79, 80, 81, 82, 83, 84, 90, 91, 102, 138</td>
</tr>
<tr>
<td></td>
<td>Internalized UD culture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UD strategy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Usability strategy</td>
<td></td>
</tr>
<tr>
<td>Reputation</td>
<td>External recognition (awards, nominations...)</td>
<td>7, 70, 73, 74, 85, 87, 88, 144</td>
</tr>
<tr>
<td></td>
<td>Presentation, conferences</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visibility (internal/external)</td>
<td></td>
</tr>
<tr>
<td>Legislation</td>
<td>Legislation gives priority Feedback and support from supervisory authority</td>
<td>27, 145, 146, 147</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UD Focus</td>
<td>Early; from needs analysis</td>
<td>4, 12, 47, 54, 57, 59, 60, 92, 97, 98, 99, 100, 101, 108, 148</td>
</tr>
<tr>
<td></td>
<td>Throughout project process</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Requirement specification</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Costumer/resource priorities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In solution- and UI-design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Across groups; design for all</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UD process maturity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Agency collaboration</td>
<td></td>
</tr>
<tr>
<td>User Focus</td>
<td>Personification of users (persona/user stories) Early testing – from sketch</td>
<td>5, 21, 33, 34, 35, 38, 39, 42, 43, 50, 51, 61, 62, 63, 67, 68, 93, 107, 119, 120, 125, 126, 127, 128, 129, 130, 132, 150</td>
</tr>
<tr>
<td></td>
<td>Frequent user feedback</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequent QA-inspections</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Test accessibility + usability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Continuous low-cost formative (guerilla) testing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High-quality user testing with disabled users</td>
<td></td>
</tr>
<tr>
<td></td>
<td>User needs prioritized</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Real user feedback</td>
<td></td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>Clear UD quality demands</td>
<td>9, 22, 23, 26, 52, 53, 56, 116, 117, 118,</td>
</tr>
<tr>
<td></td>
<td>Test code, design, content</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Organizational Level Promoting Factors
### Table 2: Process Level Promoting Factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agile</td>
<td>Iterative development with continuous feedback</td>
<td>24, 25, 36, 46, 72, 103, 105, 106, 131</td>
</tr>
<tr>
<td></td>
<td>Flat structure: distributed, personal responsibility</td>
<td></td>
</tr>
<tr>
<td>Cooperation</td>
<td>Cross-disciplinary teams</td>
<td>15, 29, 30, 58, 65, 110, 111, 112, 113, 114</td>
</tr>
<tr>
<td></td>
<td>Interdisciplinary design, QA, discussions and user testing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Established collaboration, roles and dialogue</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Co-location and full team-member positions</td>
<td></td>
</tr>
<tr>
<td>Simplicity</td>
<td>Simple/Mobile UI/code first</td>
<td>37, 104</td>
</tr>
<tr>
<td></td>
<td>Start with common minimum</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3: Individual Level Promoting Factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>UD Competence</td>
<td>Understand UD principles Across groups; universal Beyond “disability” Education/experience</td>
<td>8, 40, 55, 66, 142, 143</td>
</tr>
<tr>
<td>Personal Qualities</td>
<td>Enthusiasm Empathy Innovative Collaborative</td>
<td>3, 13, 14, 16, 17, 31, 32, 44, 75, 137, 139, 140</td>
</tr>
</tbody>
</table>

### 3.1.2 Obstructive Categories

Likewise, obstructive, negative categories are sorted into organization level, project process level and individual level practices; 1 category at organization level, 4 categories on a process level and 1 category on individual level (in total 6 obstructive categories). The finalized categories for thematic analysis of obstructive practices are presented in Table 4, Table 5 and Table 6.

### Table 4: Organizational Level Obstructive Factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of Anchoring</td>
<td>Lack of UD understanding Lack of usability culture Resistance to UD</td>
<td>6, 8, 10, 11, 18, 20, 24, 28, 29, 31, 42</td>
</tr>
</tbody>
</table>

### Table 5: Process Level Obstructive Factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Lack of UD focus and priority Lack of user focus Lack of UD QA</td>
<td>2, 17, 30, 32, 40, 44, 45, 48</td>
</tr>
<tr>
<td>Process Issues</td>
<td>Lack of interdisciplinary cooperation in design &amp; tests Sequential process model with testing and UD at end</td>
<td>9, 15, 20, 23, 25, 26, 27, 33, 36, 37, 38, 39, 40, 43, 46, 52, 53, 54</td>
</tr>
<tr>
<td>Technical Challenges</td>
<td>Frameworks &amp; trends not supporting accessibility</td>
<td>12, 21, 56, 57</td>
</tr>
<tr>
<td>Constraints</td>
<td>Time, Budget, Resources Lacking competence Lacking test equipment User unavailability</td>
<td>1, 13, 16, 19, 22, 34, 35, 41, 50, 51, 55</td>
</tr>
</tbody>
</table>

### Table 6: Individual Level Obstructive Factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of Competence</td>
<td>Lack of knowledge and understanding Lack of interest</td>
<td>3, 4, 5, 7, 14, 47, 49, 50</td>
</tr>
</tbody>
</table>
4 Findings

The study investigates a total of 12 successful ICT projects. Table 7 presents an overview of the 13 informants from these projects, of which five are women and eight are male. They include five developers, and both front-end and back-end development is represented. Further, four are interaction designers, one a functional designer and one a graphic designer. Finally, two are UD advisors. One of the advisors has a background as developer. There are a total of eight agencies companies represented. Seven of the informants represent consulting agencies, three represent state agencies and three represent private firms, see Table 7. Consultants are associated with projects from both public and private sector. Five of the informants are affiliated with more than one successful project and several of the informants are affiliated with the same projects. Several participants want data to be held anonymous due to confidentiality agreements in their respective projects. As a consequence, all data is kept anonymous and more information on the agencies and projects is not made available.

<table>
<thead>
<tr>
<th>No</th>
<th>Age</th>
<th>Gender</th>
<th>Title/Discipline</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30-39</td>
<td>Female</td>
<td>Functional Designer</td>
<td>Consultant Agency #1</td>
</tr>
<tr>
<td>2</td>
<td>&gt; 30</td>
<td>Female</td>
<td>Interaction Designer</td>
<td>Consultant Agency #1</td>
</tr>
<tr>
<td>3</td>
<td>40-49</td>
<td>Male</td>
<td>Interaction Designer</td>
<td>Consultant Agency #2</td>
</tr>
<tr>
<td>4</td>
<td>30-39</td>
<td>Male</td>
<td>Interaction Designer</td>
<td>Consultant Agency #3</td>
</tr>
<tr>
<td>5</td>
<td>40-49</td>
<td>Female</td>
<td>Visual/Graphic Designer</td>
<td>Consultant Agency #2</td>
</tr>
<tr>
<td>6</td>
<td>30-39</td>
<td>Male</td>
<td>Developer</td>
<td>Consultant Agency #4</td>
</tr>
<tr>
<td>7</td>
<td>50-59</td>
<td>Male</td>
<td>Developer</td>
<td>Consultant Agency #2</td>
</tr>
<tr>
<td>8</td>
<td>&gt; 30</td>
<td>Female</td>
<td>Developer</td>
<td>State Agency #1</td>
</tr>
<tr>
<td>9</td>
<td>40-49</td>
<td>Male</td>
<td>(Web) Advisor</td>
<td>State Agency #2</td>
</tr>
<tr>
<td>10</td>
<td>40-49</td>
<td>Male</td>
<td>Senior UD Advisor</td>
<td>State Agency #1</td>
</tr>
<tr>
<td>11</td>
<td>30-39</td>
<td>Female</td>
<td>Developer</td>
<td>Private Agency #1</td>
</tr>
<tr>
<td>12</td>
<td>40-49</td>
<td>Male</td>
<td>Developer</td>
<td>Private Agency #1</td>
</tr>
<tr>
<td>13</td>
<td>30-39</td>
<td>Male</td>
<td>Interaction Designer</td>
<td>Private Agency #2</td>
</tr>
</tbody>
</table>

Table 7: Informant Profiles

Table 8 displays the informants’ years of experiences (rounded up), numbers of projects mentioned during the interview, self-rated competence (informants have evaluated their competence level on a scale from 1-7, where 1 is inadequate and 7 is excellent) and motivations for working with UD. Motivation is categorized as either personal or connected to legislation, where ‘personal’ reflects a personal interest in UD, while ‘legislation’ represents an interest that arose after the Norwegian legislation on UD went into effect. In order to increase readability all agencies and mentioned projects are numbered in Table 8, with asterisk (*) on projects proven successful on UD and not only included based on efforts (as described in section 3 on inclusion criteria).

<table>
<thead>
<tr>
<th>No</th>
<th>Experience</th>
<th>Competence</th>
<th>Project</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9 years</td>
<td>5</td>
<td>#7* #14*</td>
<td>Personal</td>
</tr>
<tr>
<td>2</td>
<td>4 years</td>
<td>5</td>
<td>#7* #14*</td>
<td>Personal</td>
</tr>
</tbody>
</table>

Table 6: Individual Level Obstructive Factors
Table 8: UD expertise and motivation

1  Factors Promoting UD

Tables 9, 10 and 11 summarize frequencies for UD promoting practices mentioned in the interviews – the counted sums of mentions of thematic codes for each specific category across all the transcripts. They also present which informants mentions codes associated with each category. Table 9 display frequencies on organization level. The importance of an established internalized UD culture, including ensuring available human resources with UD competences, is recognized. Many of the informants mention legislation as a useful tool for getting UD prioritized.

Table 9: Organization Level Promoting Frequencies

Table 10: Process Level Promoting Frequencies

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

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

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

<table>
<thead>
<tr>
<th>Category</th>
<th>Mentions</th>
<th>Informants</th>
</tr>
</thead>
<tbody>
<tr>
<td>UD Competence</td>
<td>34</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>(No. 1,2,3,4,6,7,8,9,10,11,12)</td>
<td></td>
</tr>
<tr>
<td>Personal qualities</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>(No. 1,2,3,4,5,6,7,8,9,10,11,12,13)</td>
<td></td>
</tr>
</tbody>
</table>

Table 11: Individual Level Promoting Frequencies

Table 11 shows promoting factors on individual level. Here, informants mention how important it is to have sufficient UD competence attached to a project. Key persons such as project owner, designers and developers need to have a holistic understanding of UD rather than only focusing on legislated WCAG criteria. Many mention overlapping needs and how UD benefits individuals without impairments e.g. using mobile technologies or experiencing challenging contexts of use, and highlight the necessity of motivations to ensure usability for all. One says: “In my experience, it is effective to compare UD to usability in general, and to look at it from an elevated perspective where UD is not simply about having ‘visually impaired or blind people also able to use a website’. UD is the other side of usability, and when you focus on UD, you also focus on usability – that way the solution becomes better for everyone.”

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

2 Factors Obstructing UD

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

<table>
<thead>
<tr>
<th>Category</th>
<th>Mentions</th>
<th>Informants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of Anchoring</td>
<td>26</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>(No. 1,2,3,4,5,6,7,8,9,10,11,12,13)</td>
<td></td>
</tr>
</tbody>
</table>

Table 12: Organizational Level Obstructive Frequencies
All informants point out lack of anchoring of UD on top levels as obstructive. The interviews indicate that if UD-culture is not anchored in the organization, UD is likely not to be prioritized in processes. Thus, constraints may become an issue. Also, all informants mention that budget constraints affect the process, and most mention at least once during the interviews that tight constraints limit the capability to succeed. Time constraints are quite frequently mentioned as an important factor, as is available competent human resources and available test resources – including user unavailability. Further, lack of anchoring and focus is tied to lack of individual UD competence, as the priority and time resources to ensure employees have the needed knowledge and skills are not allocated. More than half of the informants mention that a lack of knowledge and experience regarding UD will damage the team’s ability to implement UD.

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

5 DISCUSSION

The study identifies a set of positive and negative factors affecting the implementation of UD in Norwegian ICT projects. The positive factors may be seen as indicators as to what may promote successful implementation of UD, while the negative factors on the other hand may be seen as indicators of obstructive elements. An interesting tendency in the data is almost all the negative factors identified are merely opposites of a corresponding positive factor, such as the lack of anchoring, competence, resources or interdisciplinary cooperation. This inclination supports the notion of the positive factors being important promoting practices. It also indicates there might be hygiene factors present – something that is very negative if not present in a sufficient manner, at an acceptable level (Burke & Barron 2007, p. 288).

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

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

The informants mention human resources as vital for UD, pointing to UD competence. The need to give QA and testing priority is also emphasized, tying time resources to obstructive/promoting practices. As such, increased costs related to UD seem to be mostly tied to time, pointing to the necessity of UD focus in requirements and processes. Several mention how an early UD-positive “usability for all” focus in an iterative process limits the need for extensive resources. The lack of funding and/or time may as such be viewed as a consequence of missing anchoring, thus further implying that without proper anchoring, UD practices will be obstructed.

The important factors identified in this study coincide well with seven key principles identified for an inclusive design process in the literature (Fuglerud & Sloan 2013, Røssvoll & Fuglerud 2013, Schulz et al. 2014, Scott, Spyridonis & Ghinea 2015). First, having a holistic and interdisciplinary team and/or process (principle 1) was mentioned by 11 of 13 informants in this study and grouped in the code category cooperate which was mentioned 37 times. The fact that this was brought up more than once per informant, suggests that it is of great importance for successful implementation and that the team plays an important part. Several of the informants mention the term “interdisciplinary” and there were also several mentions of how important good communication and co-location is. Not being able to talk directly to the other team members is identified as obstructive, and a root cause for misunderstandings and difficulties.

Basing the process on user-centered design principles (principle 2) is also strongly supported in our findings. Early and frequent user focus is mentioned as many as 53 times by 12 of the 13 informants. A quite intriguing finding is how several of the informants describes a ‘proper understanding’ of UD as the recognition of a link connecting UD and general usability; and how making a solution universally designed, also makes it more usable for all users. Several informants share this vision, and agree that it is important for management, costumers and team members to see this link in order to fully understand why UD is important. This is consistent with the literature key factor; focusing on the entire user experience (principle 7).

Further, the informants also support using an iterative approach (principle 4) to development, and specify how separating UD from the design and development process is adverse, as is delaying UD focus until towards the end of a project and treating UD as one step in a sequential process. 12 informants mention having an early focus on users with disabilities as well as a continuous focus throughout the design process (principle 5). This study coded and grouped these thematic mentions as “UD focus”. “UD focus” is the category mentioned the most frequently across both obstructive and promoting categories – 59 times (see Table10).

12 of the 13 informants mention various degrees of internal and external quality assurance such as the use of empirical evaluations with various impairments represented (principle 6). QA is mentioned as a promoting factor 37 times and is the third most frequently mentioned code category. Allowing all parts of the team, including developers, to witness usage difficulties is mentioned several times during the interviews. Depending on the informants’ descriptions and focuses, these topics were coded both under the promoting categories Cooperate and UD Competence and the obstructive category Process Issues.

Linked to the ability to adopt and apply accessibility standards and guidelines (principle 3) all informants mention the importance of having the right resources and the right competence, and 9 informants specifically mentioned legislation. The need for project requirements specifying UD is emphasized in the category UD focus.

Principle 3 is also tied to UD competence and personal qualities, which are highlighted in the interviews. Four of the five developers interviewed report a personal motivation for UD, five out of six if the UD advisor with a developer background is included. Paired with the fact that all the designers interviewed specifically mentioned how the developers on their team were interested in, and took UD seriously; the
study may suggest that having a developer with high UD competence may be an important promoting factor. This finding also coincides with the study performed in Brazil by Freire, Russo and Fortes (2008). None of the informants mention difficulties with understanding the WAI accessibility guidelines, but several mention how in-depth understanding of usage issues related to advanced ATs (such as screen readers) are challenging.

Finally, the results from this study are aligned with studies exploring implementation of a user-centered design in agile processes (Raison & Schmidt 2013, Begnum & Thorkildsen 2015, Silva da Silva et al. 2015). These studies also points out that anchoring of user-centered design at a business level may affect how well implementation will work in an agile process. The identified key factors in this study are thus not necessarily unique for the implementation of UD in an ICT-project, but may also be true for user centeredness, usability and user experience work in general. Several informants link user focus, usability focus and UD focus. Iterative and interdisciplinary user-centered processes with early and continuous UD focus and UD QA seems to be best-practice approaches. Having user contact is further regarded as important when designing for disabled users, including allowing developers and non-designer team members to witness usage difficulties.

The findings in this study are reinforced by previous findings in the literature and vice versa. The validity of the findings are further supported by the fact that two researchers performed the analysis; coding, categorizing, determining frequencies and interpreting the data, and came to similar conclusions. It can however be argued that this study to a larger degree than in previous studies emphasizes having some form of top-level anchoring of UD as necessary in order for other promoting practices to fall into place. Without an understanding of what UD is among stakeholders such as leaders and costumers, projects will not be granted the right resources they need to succeed. Resources identified as important by the participants are not mainly linked to budgets, but rather to the necessary competence and authority to prioritize focus on users and QA, making it possible to maintain an early and continuous focus throughout the process.

3 Limitations of the Study

This study identifies a set of promoting and obstructing factors based on a limited number of successful projects; therefore there is a potential that the study could have identified more, or entirely different factors had a larger population been represented. It may also be speculated on whether or not interviewing only “successful” projects makes this a non-representative population. Finally, the definition of “successful” could be discussed – e.g. what awards and/or honorable mentions should be regarded as valid for “success” inclusion.

6 CONCLUSION

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

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

6.1 Future Work

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

Future research may also focus on the integration of both UD and UX work into the agile approaches commonly used in Norway ICT project processes. The overall goal is to be able to make contributions towards more reliable best practices based on verified success factors, as well as attempt to create a measuring tool for ICT-projects related to UD that can be used to indicate to what degree a project is likely to achieve UD based on organizational, individual and process properties.

7 ACKNOWLEDGMENTS

A warm thank you to all informants for their participation and continuous work to ensure usability for all.

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