Can access be accessible?
Facilitating digital access to information for everyone

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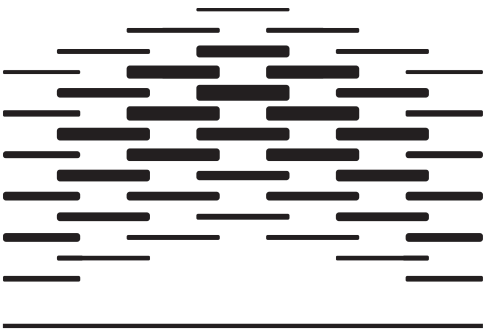

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1 Introduction

The spirit of library science seems to be related to the concept of *access to information*, a sentiment that is shared by Turock & Friedrich: "For the library and information professions no value is more fundamental than a commitment to providing the people with access to information" (2009, abstract). In this thesis, I work from the premise that the digital presence of libraries should also be included in this maxim, and that consequently, libraries should work to ensure that their websites function as "intermediaries between literature and readers" (Knut Oterholm & Åse Kristine Tveit, cited in Ridderstrøm, Skjerdingstad, & Vold, 2015, p. 17).

This thesis evaluates two Norwegian library websites, Deichman Public Library[1] (deichman.no) and Norwegian Library of Talking Books and Braille[2] (nlb.no), in light of universal design and accessibility, following the *Web Content Accessibility Guidelines* established by W3C. I will attempt to identify some usability problems, compare the results from the two websites, and discuss some possible causes and resolutions to these problems. The research question guiding this thesis is, "How can two Norwegian library websites improve how they facilitate digital access to information for people with disabilities?"

1.1 Motivation

Libraries, particularly public libraries, have traditionally attempted to offer services to the entire populace. It is a welfare service ensuring equal access to information for everyone. Ranganathan writes in his *The five laws of library science* that, "books are for all" (2006, p. 74) and connects it with the concept of universal education (2006, pp. 84–85). Books are for education, he writes, and since the concept of education for all was already being implemented by many countries in the 20th century, it seemed to follow logically that access to books should be part of this service[3].

Working in a different time, Ranganathan didn't include music, film, internet access, events, or other library services in this "law", but service offered to all is still a cornerstone of the public library institutions, as is noted in the Norwegian law on public libraries:

> Public libraries should promote enlightenment, education, and other matters of culture, through active mediation[4] and by making books and other media freely available **to everyone living in the country**[5]. (Folkebiblioteksloven, 2013, §1)

[1] "Deichman" from here on.

[2] "NLB" from here on.

[3] This is only a normative argument about the value of libraries and books, not a description of actual chain of events in the 20th century.

[4] This term translates *formidling*, as suggested in (Ridderstrøm et al., 2015, p. 16)

[5] Emphasis and translation is mine.

However libraries may be defined, a case can be made that their services should stretch to include everyone, at least with respect to library services in Norway (the law is clear in this regard.) In practice, this seems to be the case, at least if we look at the calendar of Deichman, which includes activities targeting people of all ages. In other cases, unpopular groups have been allowed to hold events in the library, such as Document.no and Lars Vilks in 2014. Kristin Danielsen, head librarian at Deichman at the time, told *Bok og bibliotek* that, "the law states clearly that the library should be defined as an arena for all, regardless of religion, political affiliation or cultural background"[6] (Kristin Danielsen, quoted in Letnes, 2014, p. 9). Following this line of thought, could we say that the *digital presence*—that is, websites and networked services—of libraries should be included as something accessible and usable by all?

Today, information is in large part discovered and consumed on the internet, and Oxford philosopher Luciano Floridi describes ICT[7] as intrinsically linked to one's life as a human being[8]. The *Habermasian Public Sphere* is increasingly being digitized, and because of this there is a law in Norway which regulates the production of ICT services, and—among other things—mandates making them more accessible in accordance with universal design[9] (Diskriminerings- og tilgjengelighetsloven, 2013, § 14).

Considering these two threads—libraries' services for all, and the ever-increasing relevance of ICT in peoples' lives—an investigation into the accessibility of libraries' websites seems warranted. On the one hand, it will be informative to see if they follow the relevant laws in Norway. On the other hand, it seems to be an issue at the core of librarianship and libraries.

2 Theory

These previous remarks involve several different terms—usability, accessibility, universal design, access to information, etc.—used in specific ways, and it will be helpful to clarify their meaning before continuing. I interpret these terms as being part of larger *theoretical traditions*, which will serve as points of discussion in this thesis. I hope that this theory might explain some of the findings from the evaluation, and conversely that the findings might have some implications for the theory.

Broadly speaking, two such theoretical traditions influence this thesis. One is a sub-field of library and information science, and seeks to explain *information seeking*, *information needs* and *information behavior*. The other seeks to explain interaction between humans and computers. The first tradition will be collectively referred to as, simply, *information behavior*

[6] Translation mine.

[7] Information and communication technology

[8] See e.g. ch. 3 of *The 4th revolution* (2014)

[9] A concept I will be describing in the next section.

and research on information behavior (IB from now on). The second tradition is, of course, human-computer interaction (HCI from now on). In this section, I will deal with HCI first before moving on to IB.

2.1 Universal design, usability and accessibility

Universal design (UD from now on) is related to the field of HCI, and it will be helpful to map the terrain of HCI in order to provide a more complete picture of UD. Dix, Finlay, Abowd, and Beale distinguish three aspects of HCI, which is also illustrated in the name of the discipline, namely: 1. the human, 2. the computer, 3. the interaction. Traditionally, they write, research had been directed at the physical attributes of the computer system in itself. This reflected the idea that research and development should primarily be concerned with the systems themselves; any problems the user might have simply meant that the user was unaware of the configuration of the system. Later, attention was increasingly directed at the *process* of interaction, and its physical, psychological and theoretical aspects (2004, p. 3). The role of the person was gradually made more and more important in this study. A practical goal of HCI is the development of systems that are usable (a term I will come back to.)

With respect to 1. the human, an important concept in HCI is that of *input-output channels*, signifying the ability of humans to receive sensory input as information, process this information, and potentially acting on this information (the "output"). This process involves many different faculties of the body and mind, and describing this process in depth would be stepping out of the bounds of this thesis. Still, it is important to keep in mind the concept of the human as "information processor" (Dix et al., 2004, p. 55).

Moving on to 2. the computer, Dix et al. describes many devices and characteristics of computers, all of which have in common the fact that they provide input and output capabilities. For example, keyboards and mice provide text entry and pointing, and monitors provide the graphical interface as output (2004, p. 120).

Lastly, 3. the interaction, deals with the meeting of the human and the computer. Since the human is described in terms of their inputs and outputs, and the computer is described in the same way, the interaction can be thought of as a sort of duality: the output of the computer becomes the input for the human, and the output of the human becomes the input for the computer. It is at this point that we can begin to effectively talk about how interaction between humans and computers can be good or bad: good interaction becomes a matter of gauging the success of this duality between humans and computers. For example, if the human is unable to operate a computer program because they suffer from vision impairment, then we understand at once that the computer needs to output in a way other than a monitor. This is what Don Norman calls *affordances*, the relationship between a physical object and a person (2013, p.

11).

In this context, UD involves the notion that the channels of input and output of humans cannot always be taken for granted. Some of these channels might be unavailable, i.e., an affordance that might be present for some might not be present for all. People are *diverse*. Following this, there is an argument for UD that goes: it is incorrect to try and design a product with a single ideal user in mind. Dix et al. says succinctly, "we cannot assume a 'typical' user" (2004, p. 366). Frode Eika Sandnes, in his *Universell utforming av IKT-systemer* echoes this: "We are very different both on the inside and on the outside, and it is this diversity which makes work on usability so challenging and interesting"[10] (2011, p. 23).

A number of definitions on UD have been developed over the years. *The Center for Universal Design* defines UD as "[t]he design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Connell et al., 1997). Dix et al. expands on this, using a similar definition, stating that computer systems should be *multi-modal*. This means that the system should allow for the use of more than one channel of interaction (2004, p. 368). In the example above, the computer system might provide for a way to hear the output, should the user require. Using this technique of providing more than one affordance for the same basic functionality, input and output between human and computer might work after all and the interaction can proceed.

Universal design is closely connected with the concept of *usability*, which might also be worded as, "how easy is it to use?" Sandnes describes various characteristics of usable design: easy to learn, efficient in use, easy to remember how to use, minimize risk of error, and pleasent in use (2011, p. 16). Don Norman uses the example of doors to illustrate this point, that doors can either be pushed or pulled, but he always seem to get this wrong (2013, p. 1). From personal experience, I always struggle with USB ports and the direction they are supposed to be connected. Usability is important in the context of universal design, because it increases the chance that users can use and enjoy the product. Universal design *depends on* usability.

Talking about usability can be more precise than anecdotal experiences. Sandnes describes a useful framework for gauging usability in his previously mentioned book, a sort of cycle of *action* and *evaluation*. Dix et al. calls this cycle *the execution-evaluation cycle* (2004, p. 125). This framework posits that, in any interaction between humans and computers (e.g. a computer program), there is in play a goal of the interaction, i.e., what the user is trying to achieve. After some planning, the user *acts*, before the program responds to the user's input. This response (or lack of) serves as the target of an *evaluation*. Did the action realize or bring the user closer to the goal? If the user was unable to act on the program, then there is a gap in terms of action. If the user was unable to perceive any effect from the action, then there is a

[10]My translation

gap in terms of evaluation. A cryptic pop-up, for example, will leave the user unable to gauge whether their actions were successful. Both of these gaps are grounds for questioning the usability of the program. Usability becomes a matter of ensuring that the cycle works for everyone. (Sandnes, 2011, pp. 39–60)

Accessibility is another important concept in this context, and can be usefully understood as a special case of usability. Where usability involves no particular type of user, accessibility is about ensuring usability for people with disabilities. Henry, Abou-Zahra & Judy Brewer define accessibility as "design that enables people with disabilities to interact with buildings, products, services, etc." (2014, section 1.1).

There is an important distinction here concerning people experiencing disabilities. Historically, in disability studies, there have been two prevalent views or models explaining disability. For a long time, the prevalent view was what is called the medical model (Sandnes, 2011, p. 24), which has focused exclusively on the person as a patient. The patient is a machine, which might have an objectively identifiable disease that can either be cured or not (Harris & White, 2014a). Fixing the disability was limited to medical procedures and, if the procedures were insufficient, there was nothing more that could be done.

An opposing view, the social model, takes a broader look at the situation and distinguishes between *impairment* as the focus of medicine, and *disability* as a social problem. The relational model, another name for this view, might illustrate the main point here: disability is not simply a medical condition, but also an imperfect relationship between society and the person experiencing disability. It is called relational because disability exists because of a discrepancy between what society expects *and* the abilities of the person experiencing disability (Harris & White, 2014b). "Disability arises in the gap between the prerequisites of the individual and the demands of society"[11] (St.meld. nr. 40 (2002-2003), 2003, p. 5). A crucial implication of this model is that, if perfect accessibility were to be achieved, there would be no disability.

This distinction illustrates what UD is all about. No longer is it solely about designing the computer system through a study of computers as such; the maxim of UD is about designing with people of all dispositions in mind. Inability to operate the system is no longer a case of simply being uneducated or unsuited for its use, it is a case of faulty design and improper expectations on the abilities of the user. In HCI terms, there is a wrongful assumption concerning the channels of input and output that facilitate interaction between humans and computers. The execution-evaluation cycle describe gaps of action and of evaluation, gaps between the expectations of society and the abilities of the individual, and UD bridges these gaps and includes everyone, providing a way to eliminate disability.

These three terms–universal design, usability, and accessibility–are all related to the

[11] My translation.

problem of using products, but they stand for subtle differences that are not always so clear. The reader might ask, "what is the difference between usability and universal design?" pointing out that both of these concepts talk about how a person makes use of a product, and that usability is a good thing. In this case, the easiest way to spot the difference is to look at the motivation for each concept: the motivation for the concept of usability is to have a way of estimating how easy a product is to use, while the motivation for the concept of universal design is the practical *design* of products for maximum usability. One is about describing how usable something is, the other is about a practical art of designing products with the most usability.

Likewise, there is a subtle difference between usability and accessibility, and universal design and accessibility. I have already touched upon the former difference: while usability presumes no individual characteristics of the user, accessibility involves people experiencing disabilities in particular. As such, products that are usable implies that they are accessible, since the latter concept is included in the former. But the contrary might not always be true: a product that is accessible says nothing about how usable it is to people not experiencing disabilities. A key tenet of universal design is to create products that are usable by all people, including those experiencing and not experiencing disabilities.

2.2 Information behavior

Whereas HCI considers humans in relation to computers, IB consider humans in relation to information. It stands together with a family of fields, all involving particular facets of this relation. IB, however, is often referred to as an umbrella term, including within it any kind of activity pertaining to information: seeking, consuming, and even avoiding, information (Case & Given, 2016, p. 6–7). There is in play here a number of relevant concepts, all of which might fruitfully contribute to the discussion on the findings. IB as a field has come to include a good number of *models* for interaction with information, none of which will be paid much attention here. Instead, I will concentrate on the *general* idea of information behavior as described in Case and Given's *Looking for information*.

Before continuing, the reader might wonder what the relevance of IB is to the problems at hand. Surely, an evaluation of websites in terms of universal design can be explained perfectly well with the vocabulary of HCI. What is the place of IB in this context?

I would tend to agree with the reader here: there might be no apparent reason to include IB. Still, this thesis evaluates *library* websites, and library science as a field of study includes within it IB as an established sub-field. The research question guiding this thesis is, as will be remembered, "How can two Norwegian library websites improve how they facilitate digital *access to information* for people with disabilities?". It is my conviction that HCI is a proper

tool for explaining the websites' user interfaces, but this still leaves the important concept of information behind. I will therefore include IB as a sort of *supplement* to HCI.

In HCI the *computer* is something clear and easy-to-grasp, but the same cannot easily be said about information. Computers are tangible, but information is something else. Seeking information might seem clear enough, but *interacting* with information is an entirely different matter. What is this concept that can be sought after, interacted with? IB considers it a central element of its study, in the same way HCI views computers.

Case and Given describes information as being any difference perceived in the environment (2016, p. 6). Consider the case of looking for the bus schedule: having no idea when the bus arrives, you look through the website of the bus company, and at last find the schedule you need. In this case, there is a difference in your *state* before finding this information, and after. It is this difference Case and Given calls information. Interestingly, this definition can also accomodate degrees of information. Consider a similar case, only this time, you think you already know the bus schedule, you just want to make sure you remember correctly. You do the same procedure, locating the schedule on the website, and confirm the schedule. In this case, the difference in your state before and after is only slight. It is not *as informative* as the previous example.

Buckland notes the inherent ambiguity of this concept (1991, p. 351). There are at least three ways of talking about information: 1. information-as-process,
2. information-as-knowledge, 3. information-as-thing. Information-as-process is roughly the same as Case and Given's definition, emphasizing what happens when an individual is *informed*. Information-as-knowledge is directly related to this definition, and signifies "that which is perceived in 'information-as-process'" (Buckland, 1991, p. 351).
Information-as-thing refers to documents, events, and other "physical" objects that can be informative.

Buckland makes an interesting point about this last aspect, saying that,
"'information-as-thing' deserves careful examination, partly because it is the only form of information with which information systems can deal directly" (1991, p. 359). Information is like evidence or data, which *informs* people by virtue of itself. It is an interesting point because this interpretation makes it easy to fit into the framework of HCI. Earlier, I described interactions in HCI as goal-oriented: the human has a goal in mind, and interacts with the computer in order to achieve this goal. In some ways, it might be useful to think of this goal in terms of information. The goal of computer interactions, especially library website interactions, is in many cases *information*. More specifically, it is about using the computer in order to reach a state which is informative to the user, a state that is information-as-thing.

Information *seeking* is the process of attaining information, typically (in the context of computer programs) using navigation menus or search systems. Case and Given notes that

information seeking occurs in response to a gap in the user's knowledge (2016, p. 6). Again, looking at this through the lens of HCI, information seeking can be described in terms of the *interaction* with computer programs. The user wants to find prices on a certain product, for example, and in order to do this, they must interact with some sort of ecommerce website. Following Sandnes' cycle, the user has a plan (discover what product x costs), initiating some set of actions (navigate to website, browse menu structure, scroll list of items), resulting in some evaluation (did this conclude the process of information seeking?). Interestingly, usability in HCI provides a framework for discussing how interactions (i.e. information seeking) might *fail*, something I will discuss further later in this thesis.

2.3 Web Content Accessibility Guidelines 2.0

Web Content Accessibility Guidelines 2.0 (WCAG from now on) is a web standard documenting a range of recommendations that aim at making web content more accessible. It is the result of work done by the World Wide Web Consortium (W3C), becoming a W3C recommendation[12] in 2008. The WCAG document claims that following the guidelines "will make content accessible to a wider range of people with disabilities" and "will also often make your Web content more usable to users in general" (Web Content Accessibility Guidelines Working Group, 2008), aligning it with the goals of UD.

WCAG is organized as a hierarchy, with general principles at the top level, guidelines at the middle level, and particular success criteria at the lower level. This provides a topical categorization of accessibility guidelines, from those ensuring proper parsing by web readers, to visual requirements such as color contrast restrictions.

At the top level WCAG distinguishes four principles: 1. perceivable, 2. operable, 3. understandable, 4. robust. In HCI terms, 1. perceivable provides guidelines for ensuring that content can function *as input for* humans experiencing disabilities. This means, e.g., that text-alternatives should be provided for images, audio, and video, that content can be presented in alternative formats, or that there is a minimum level of contrast between the foreground and the background of the page. Likewise, 2. operable recommends ways websites can *receive input from* humans experiencing disabilities. This means, e.g., that a keyboard should be usable as a navigation tool. These groups of criteria help maintain the interaction between humans and computers. 3. understandable expands on this, facilitating *cognition* of both the content itself and the user interface. 4. robust involves ensuring compatibility with assistive technologies–such as screen readers–as technologies advance.

Each success criterion is classified as one of three conformance levels, A, AA, and AAA. *conformance* means that a web page is in accordance with the criteria of the conformance

[12] "W3C recommendation" is synonymous with "web standard"(W3C, n.d.)

level in question. Level A is the minimum level required in order to claim conformance to WCAG 2.0 (Web Content Accessibility Guidelines Working Group, 2008, Conformance), while level AAA is considered the ideal target. These degrees of conformance offers some nuance to conformance claims of websites. For example, conformance at level AA minus some particular criteria is mandatory in Norway[13].

The Web Content Accessibility Guidelines Working Group has also published an extensive documentation on the individual success criteria. This includes texts on how the criteria should be interpreted and what their intended consequences are. Following each success criteria there is a list of documented techniques for meeting the criteria as well as some documented *failures*. (Web Content Accessibility Guidelines Working Group, 2016)

Berget, Herstad, and Sandnes make an important point concerning WCAG in relation to people with dyslexia: "[t]he criterion most clearly directed towards users with dyslexia, namely 3.1.5 regarding a clear and simple language, is classified as level AAA" (2016, p. 456). Some guidelines which seem intuitive with respect to dyslexia, such as tolerance for misspellings in user input, are not included at all (2016, p. 457). This illustrates a shortcoming of WCAG in that it does not properly address some prevalent impairments, with the implication that some disabilities are left unsolvable by WCAG[14]. The reason for this is that reaching conformance level AAA is rarely explicitly required, and is even discouraged as a general requirement of websites by W3C in (Web Content Accessibility Guidelines Working Group, 2008, Conformance) which states, "[i]t is not recommended that Level AAA conformance be required as a general policy for entire sites because it is not possible to satisfy all Level AAA Success Criteria for some content." This is the case in Norway, which does not require conformance at level AAA.

3 Methodology

The goal of any evaluation of computer programs, including this evaluation, is to assess to what degree the program meets user requirements. Dix et al. expand on this, identifying three main goals in evaluations: to assess the extent and accessibility of the system's functionality, to assess users' experience of the interaction, and to identify any specific problems with the system (2004, p. 319).

Following Dix et al., there are two main ways of evaluating a computer program: expert analysis and user participation. User participation is characterized by experiments and observations involving users and their feedback. This type of evaluation is useful because it can give real world insight into usability problems of the computer program. On the other

[13] More on this towards the end of section 3.2.

[14] Following the social interpretation of "disability" in section 2.1.

hand, it can be an expensive procedure, involving many users and potentially a long time.

For this evaluation, I have instead opted for an expert analysis. Expert analyses are characterized by only involving a "panel of experts", typically a designer or a human factors expert, attempting to identify aspects of the computer program that might be problematic for users, often citing accepted standards or empirical results (Dix et al., 2004, p. 320).

I will be using what is known as *heuristic evaluation*, a type of expert analysis that makes use of *heuristics*: guidelines or general principles that might be of the form, "always keep users informed about what is going on" (Dix et al., 2004, pp. 324–325). It involves evaluators inspecting the computer program and noting where it diverges with heuristics, with the result being a list of usability problems.

Heuristic evaluation was developed by Jakob Nielsen and Rolf Molich (Dix et al., 2004, p. 324), and Nielsen himself recommended ten heuristics to be included in evaluations of computer programs. I will not be using these heuristics. For these I will instead substitute WCAG as the heuristics.

3.1 Advantages and disadvantages

Heuristic evaluation is advantageous because the evaluation itself can be significantly more cost-effective than the alternative. Jakob Nielsen even calls heuristic evaluation a method to be used in "discount engineering" (1994, p. 25). Potentially, this leads to more usability problems being identified. In this thesis, I was only required to follow the established guidelines and testing them in relation to each web page I chose to evaluate. This made it possible to do a wide variety of testing with a relatively small amount of resources.

Another motivation for this choice of method is that it facilitates evaluation with a basis in an established standard (WCAG 2.0) of user interface design. Furthermore, a subset of this standard is defined as a legal requirement imposed on norwegian ICT services (including websites) (Diskriminerings- og tilgjengelighetsloven, 2013; Forskrift om universell utforming av IKT-løsninger, 2013). It will be interesting, for me as well as for owners of the websites of Deichman and of NLB, to see if the websites have any accessibility problems. Following these guidelines as heuristics allowed me to test the web pages in accordance with best practices of experts in the field, and possibly identify problems I might not have identified, had I opted for an evaluation using user participation.

On the other hand, the main problem in choosing this methodology is that it is difficult (if not impossible in this context) to establish conformance to WCAG 2.0 because this evaluation is done by me alone. Despite having established standards as its premise, and therefore appearing more objective and true, heuristic evaluation is dependent on the number of evaluators in judging its effectiveness at identifying usability problems. This means that an

evaluation with more experts participating will likely yield more results. Since WCAG 2.0 conformance claims can only be made after exhausting all aspects of the website, a heuristic evaluation can only realistically result in such a claim if the evaluation involves a good number of experts.

In the same vein as the point made in section 2.3, where I explained a shortcoming of WCAG in that it does not properly address some impairments, this might render heuristic evaluation as a less attractive method of evaluation. This is because a heuristic evaluation depends for its authority on the *heuristics themselves*, which in this case is hinted at being insufficient.

I will therefore not aim at a WCAG 2.0 conformance claim for the websites of Deichman and NLB. Furthermore, because of the potential insufficiency of WCAG in addressing all impairments, I make no claims on the *accessibility as such* of the websites in this evaluation. My findings should be treated as a set of discrete accessibility problems, which will be the foundation for a discussion and some possible resolutions to these problems.

3.2 Scope

The evaluation targets the websites of Deichman (deichman.no) and NLB (nlb.no), but because a website can be an ambiguous entity, this needs to be elaborated. Mozilla Developer Network, 2016 clarifies this, stating that there is a distinction between a *website* and a *web page*. A web page, "[is] a document which can be displayed in a web browser," while a website, "[is] a collection of web pages which are grouped together and usually connected together in various ways."

The websites of Deichman and NLB both have numerous web pages organized as one coherent group. Some sets of these web pages display their own distinct theme, indicating that there are more than one software solutions for presenting all of their services. For instance, the main landing page of Deichman, which primarily deals with events and non-circulation services such as the public workshop, appear to be served from the Drupal 7 content management system:

```
<meta name="generator" content="Drupal 7 (http://drupal.org)">
```

While the OPAC, which enables search and display of bibliographic records, is an in-house developed solution built on React as the frontend and KOHA as the backend (personal communication, Arve Søreide, February 28, 2017). Since the underlying software is different, this might have consequences for what problems I can identify depending on which page I am evaluating.

In this thesis, I will not target the entire websites of Deichman and NLB, but instead focus on a selection of what I hypothesize to be the most used web pages:

```
www.deichman.no
www.deichman.no/filialer
www.deichman.no/hovedbiblioteket
sok.deichman.no/profile/.+
sok.deichman.no/search?query=.+
sok.deichman.no/work/.+/publication/.+

nlb.no
websok.nlb.no/cgi-bin/mappami
nlb.no/boker/.+
nlb.no/boker/.+/.+
nlb.no/boker/.+/.+/.+
nlb.no/soek?optsearch=library&search=.+
```

The first block of addresses represent Deichman, while the second block of addresses represent NLB. In the first block and from the top the links point to the front page, the list of satelite libraries and their opening hours, the main library and its news and information, the user profile's information and loans page, a search results list in the OPAC, and a single result. In the second block and from the top the links point to the front page, the user profile's information and loans page, a list of categories for books, a categorized listing of books, a single result, and a search results list in the OPAC.

Note that `.+` in the addresses above signify a "regular expression" which represents at least one symbol, any symbol. Thus this list represents the *types* of addresses I will work with.

The heuristics for this evaluation will not include the entire WCAG 2.0 specification, but a subset as specified in the "Regulation on universal design of ICT products"[15]. This subset is the whole of WCAG 2.0 levels A and AA, with the exception of success criteria 1.2.3, 1.2.4, and 1.2.5 (Forskrift om universell utforming av IKT-løsninger, 2013). The motivation for this restriction is that I want to put the evaluation in the context of Norwegian law with a clear relevance for Norwegian public libraries.

The evaluation will be done using the web browser Google Chrome without extensions and without specialty programs such as text-to-speech. The reader might question this decision, wondering why a WCAG 2.0 evaluation excludes the use of assistive technologies. I answer that, as I specified in section 3.1, the purpose of this evaluation is not to conclude with a "WCAG 2.0 Conformance Claim", which is defined in the WCAG 2.0 specification (Web Content Accessibility Guidelines Working Group, 2008, Conformance Claims (Optional)). Instead, I will try to identify possible *problems with accessibility*, using a subset of WCAG 2.0 criteria as heuristics. I make no claims on exhausting the set of all problems of accessibility.

[15]My translation. The original reads, "Forskrift om universell utforming av IKT-løsninger."

4 Findings

During my evaluation I made extensive use of the *Understanding WCAG 2.0* document in trying to understand and properly assess each success criterion. Each criterion was explained and presented along with example techniques for conformance. Sometimes, I identified what are called *sufficient* techniques, which indicate a definite conformance with the criterion. Other times, I identified documented failures, which, conversely, indicate that the web page does not conform to the criterion.

At first, I meticulously attempted to account for every possible sufficient technique, in the hopes of declaring a web page as definitely conforming to the criteria. I ended up abandoning this project, realizing that it would not actually be that interesting in light of my delimination in approach. What I needed were accessibility problems, and if I could not find such problems I would simply mark the combination of web page and conformance criterion as a pass. What interested me in regards to this thesis were problems that could be included in the discussions on accessibility and access to information.

I worked with the set of 12 web pages specified in section 3.2, and the set of 35 success criteria also specified in section 3.2. This amounted to a total of 420 results. The evaluation was done during week 18 of 2017.

4.1 Perceivable

There are 11 applicable success criteria under the perceivable principle, and I found that 5 of these failed in some of the web pages. Listing 1 displays each web page and their non-compliance with the success criteria. Interestingly, `websok.nlb.no/cgi-bin/mappami` is not represented in this list, even though it is not served with NLB's new web platform.

The most prominent failure in this group seems to be success criteria 1.1.1, with failures on 7 out of 12 web pages in my sample. In most of these cases, the problem stemmed from not including an `alt` attribute with an explanatory text in an `img` tag, or including an insufficient or meaningless text. Including such attributes ensures that information contained in the image can still be understood when the image is unsuited for the user, for example when the user is blind and needs a text-to-speech program to browse the page.

Figure 1: Screenshot of color contrast from `www.deichman.no`.

In 3 of Deichman's pages, I discovered that the color contrast between a light orange color on the headings was insufficient together with the white background, as illustrated in figure 1.

NLB, on the other hand, has ensured good contrast on their pages, with a dark gray background coupled with white or green text.

In 5 out of 12 web pages, I found problems with criterion 1.3.1 in that the page visually presented some information as lists, while the underlying HTML did not use the proper `ul`, `ol`, or `dl` tags for this purpose. This results in some users (e.g. those displaying the page normally without assistive technologies) understanding this content as lists, while others (e.g. those using assistive technologies) might encounter problems because the program they use is unable to deduce this information (i.e. that this is a list) from the HTML code. When the format changes, relationships should be preserved.

Listing 1: Failing success criteria on each web page under the perceivable principle

```
'www.deichman.no':
  - 1.1.1 Non-text Content
  - 1.4.3 Contrast (Minimum)

'www.deichman.no/filialer':
  - 1.3.3 Sensory Characteristics
  - 1.4.3 Contrast (Minimum)

'www.deichman.no/hovedbiblioteket':
  - 1.1.1 Non-text Content
  - 1.4.3 Contrast (Minimum)

'sok.deichman.no/profile/.+':
  - 1.1.1 Non-text Content
  - 1.3.1 Info and Relationships

'sok.deichman.no/search?query=.+':
  - 1.1.1 Non-text Content
  - 1.3.1 Info and Relationships

'sok.deichman.no/work/.+/publication/.+':
  - 1.1.1 Non-text Content
  - 1.3.1 Info and Relationships

'www.nlb.no':
  - 1.1.1 Non-text Content

'www.nlb.no/boker/.+':
  - 1.1.1 Non-text Content

'www.nlb.no/boker/.+/.+':
  - 1.3.1 Info and Relationships
```

```
'www.nlb.no/boker/.+/.+/.+':
  - 1.2.1 Audio-only and Video-only (Prerecorded)

'nlb.no/soek?optsearch=library&search=.+':
    - 1.3.1 Info and Relationships
```

4.2 Operable

Under the operable principle, there are 12 applicable success criteria. Out of these, I found that 6 failed on one or more of the web pages in my sample. These failures are laid out on listing 2. Like the perceivable principle, I could not identify failures under this heading on `websok.nlb.no/cgi-bin/mappami`.

Listing 2: Failing success criteria on each web page under the operable principle

```
'www.deichman.no':
  - 2.4.3 Focus Order
  - 2.4.4 Link Purpose (In Context)
  - 2.4.5 Multiple Ways
  - 2.4.7 Focus Visible

'www.deichman.no/filialer':
  - 2.4.3 Focus Order
  - 2.4.4 Link Purpose (In Context)
  - 2.4.5 Multiple Ways

'www.deichman.no/hovedbiblioteket':
  - 2.4.4 Link Purpose (In Context)
  - 2.4.5 Multiple Ways
  - 2.4.7 Focus Visible

'sok.deichman.no/profile/.+':
  - 2.1.1 Keyboard
  - 2.4.2 Page Titled
  - 2.4.4 Link Purpose (In Context)
  - 2.4.5 Multiple Ways

'sok.deichman.no/search?query=.+':
  - 2.1.1 Keyboard
  - 2.4.4 Link Purpose (In Context)
  - 2.4.5 Multiple Ways

'sok.deichman.no/work/.+/publication/.+':
  - 2.1.1 Keyboard
```

```
  - 2.4.2 Page Titled
  - 2.4.4 Link Purpose (In Context)
  - 2.4.5 Multiple Ways

'www.nlb.no':
  - 2.1.1 Keyboard

'www.nlb.no/boker/.+':
  - 2.1.1 Keyboard
  - 2.4.7 Focus Visible

'www.nlb.no/boker/.+/.+':
  - 2.4.7 Focus Visible

'www.nlb.no/boker/.+/.+/.+':
  - 2.4.7 Focus Visible

'www.nlb.no/soek?optsearch=library&search=.+':
  - 2.4.7 Focus Visible
```

On all of Deichman's pages, I found that they did not conform to 2.4.4. The purpose of 2.4.4 is to make sure that every link can be understood in regards to its purpose or function. On all of the pages, the failure was due to the `alt` attribute text on the logo at the top of the page. The `alt` text in such cases will function as a description of the purpose of the link if the only contents of the link is that image. There were 3 pages which had simply "logo", while 3 pages had "Sort logo med tekst"[16]

The use of keyboards (i.e. success criterion 2.1.1) was not properly supported on 5 of the pages. In all cases, this was because it was impossible to select certain buttons or links on the page. For instance, Deichman's user profile page will not let a keyboard user select a row of navigational items, preventing the user from seeing their loans, account information and settings. In other cases, an "In English" button could not be similarly selected, preventing users from switching the language of the page.

Navigating a website is done in different ways by different users, and an important feature of accessible websites is providing multiple ways of navigating to meet these diverse demands. Success criterion 2.4.5 failed on all of Deichman's pages, because they only provided one way of navigating between pages in the website. NLB, on the other hand,

[16]This translates to "Black logo with text", which is an example of an `alt` text that was probably added with good intentions, since it describes the image in *some* way, namely in terms of design, but is in the end not of any worth to the user, which in many cases is looking for equivalent information as that contained in the image. In this case, the equivalent information should at least include the fact that the text in the image is "Deichmanske bibliotek".

provides a search box with an option to search the website itself[17].

Figure 2: One link is shown with visible focus, another with no visible focus. From `www.deichman.no`.

6 of the web pages failed 2.4.7, because when parts of the user interface were selected with the keyboard (i.e. focused) they did not provide any visual aids to indicate this. For example, the button on some of Deichman's pages, shown in figure 2, which takes the user to the login page, did not provide any visual feedback when focused with the keyboard. This might be confusing as the user needs to deduce this from the context of the next and previous items being focused when tabbing through the page.

4.3 Understandable

In the understandable group there are in total 10 applicable success criteria. Applied to my set of web pages, I found that 3 were not in compliance on some of the pages. Deichman's main page, list of satelite libraries and the main library page did not have any problems here, while NLB's pages in some cases had all 3 problems. Listing 3 shows each error on each page.

Listing 3: Failing success criteria on each web page under the understandable principle

```
'sok.deichman.no/profile/.+':
  - 3.2.2 On Input

'sok.deichman.no/search?query=.+':
  - 3.2.2 On Input

'sok.deichman.no/work/.+/publication/.+':
  - 3.2.2 On Input

'www.nlb.no':
  - 3.1.1 Language of Page
  - 3.3.2 Labels or Instructions

'websok.nlb.no/cgi-bin/mappami':
  - 3.1.1 Language of Page

'www.nlb.no/boker/.+':
```

[17] I.e. not the bibliographic data

```
  – 3.1.1 Language of Page
  – 3.3.2 Labels or Instructions

'www.nlb.no/boker/.+/.+':
  – 3.1.1 Language of Page
  – 3.2.2 On Input
  – 3.3.2 Labels or Instructions

'www.nlb.no/boker/.+/.+/.+':
  – 3.1.1 Language of Page
  – 3.2.2 On Input
  – 3.3.2 Labels or Instructions

'www.nlb.no/soek?optsearch=library&search=.+':
  – 3.1.1 Language of Page
  – 3.2.2 On Input
  – 3.3.2 Labels or Instructions
```

On Deichman's OPAC pages, I only discovered one problem, 3.2.2. This success criterion limits the ways the page may react when the user makes inputs or changes the interface controls in some ways. In this case, the problem is that checking check boxes causes focus on the check box to disappear. This problem is also manifest on 3 of NLB's pages, where activating the "Lytt"[18] control causes the viewport to immediately scroll to the top of the page. Changing the context of the page in such a way is unexpected and might disorient some users.

A common problem on all of NLB's pages is the lack of language specification, since the root `html` element does not have a `lang` attribute. Not including this attribute might cause problems for assistive technologies because they cannot easily identify the language of the page. Identifying the language helps e.g. text to speech programs in loading the correct settings.

Another problem on 5 of NLB's pages involves the labeling of the main search bar at the top of the pages. In order to inform users sufficiently on the function of form fields, the page should include an explicit label or explanation for the functionality. In NLB's case, there is no adequate labeling technique. Instead, the search bar has only a `placeholder` attribute, which can function as a label to those users who can view the page normally, but cannot in the case of the visually impaired. The reason is that not all assistive technologies identify `placeholder` attributes as labels.

[18] Translates to "Listen"

4.4 Robust

This group includes only two applicable success criteria. As shown in listing 4, there were problems on the pages only in respect to 4.1.2, and only on NLB's pages.

Listing 4: Failing success criteria on each web page under the understandable principle

```
'www.nlb.no':
  - 4.1.2 Name, Role, Value

'www.nlb.no/boker/.+':
  - 4.1.2 Name, Role, Value

'www.nlb.no/boker/.+/.+':
  - 4.1.2 Name, Role, Value

'www.nlb.no/boker/.+/.+/.+':
  - 4.1.2 Name, Role, Value

'www.nlb.no/soek?optsearch=library&search=.+':
  - 4.1.2 Name, Role, Value
```

The reason these pages did not conform to 4.1.2 is the same as the reason they did not conform to the labeling criterion in the previous group: there is no programmatically determinable label attached to the main search bar at the top of the pages.

5 Discussion

Before presenting my findings in section 4, I made a note in section 3.2 on some differences in the underlying software used to serve the different web pages. I want to start my discussion from a hypothesis I made in that section. I wrote that, given that some pages use one piece of software while other pages use different pieces of software, it could be reflected in the results in that the same accessibility problem is made manifest on the set of pages using the same software.

For example, when Deichman failed to succeed with criterion 1.4.3 on color contrast, this failure was evident on the home page, the page listing all the satelite libraries, and the page on the main library. These pages all use the same general design and layout, and include the telling piece of html code reporting that the page was generated using Drupal 7. Likewise, the pages relating to the OPAC; the user profile page, the search results list, and the single post display page, are all built with the custom React solution (personal communication, Arve Søreide, February 28, 2017), and they all succeed in complying with the criterion.

Likewise, Deichman failed to succed with criterion 2.1.1 on keyboard use, and this failure

is manifest only on the pages relating to the OPAC. The other pages (e.g. home page, satelite libraries, etc,) do comply with the criterion.

The reason for these failures occuring on the related web pages is that software such as Drupal 7 and (presumably) the custom solution for the Deichman OPAC relies heavily on the principle of reusability. In the earlier days of web development, when writing websites plainly and directly in HTML, each page was a complete unit in itself, containing all the markup for the different parts of the interface. For example, on a website with a navigation bar at the top, and a sidebar with links to different parts of the website, all of the markup had to be recreated on each page. If a change was needed, every page had to be changed accordingly. Consistency in the user interface was achieved by manual labor.

When web pages are programmatically built, the principle of reusability can be exploited. This is done in various ways, but a common technique is to isolate the pieces of the website that the administrator wants to reuse into functions. Functions take an input and deliver an output, and given the same input the function will in all cases deliver the same output. Using WordPress, for example, a web developer can isolate the sidebar into a function, and then simply call this function on all of the pages that will be using it. If there is a change required in the sidebar, that change can be done in one place–the function–and the change will be reflected on all pages.

Making use of this principle of reusability ensures that web pages function consistently with each other, but it can also ensure that an accessibility problem isolated into a function will be reflected on all pages making use of that function. In the case of Deichman, the headings are probably generated dynamically in this fashion, and predetermined to be of the low contrast color which can be seen in figure 1[19]. Increasing accessibility by conforming to this success criterion is a simple matter of making changes to the "templates" used in generating all the different pages.

Reusing content can also itself be the source of problems if it is not done correctly. This was seen on Deichman's OPAC where the title of the pages was–in all cases–"Deichmanske bibliotek - søk"[20]. In this case, what probably happened was that the reusable content pertaining to the title was statically defined to be this piece of text. Ideally, each page would have a title defined, and the reusable content pertaining to the title on each page would dynamically fetch the title and display it appropriately.

Using different pieces of software for different groups of pages on the same website can be problematic, because it is difficult to reuse content in this way when dealing with different software. One software has one way of defining reusable content, and another software might

[19]Specifically, the color itself is probably not determined in the function to output headings, but the heading tags and classes are. The color itself is determined using css selecting the appropriate html elements and classes.

[20]Translates to "Deichman public library - search"

have another way of defining such content. This can be problematic for the website administrator seeking to make an accessible website, especially when it comes to those criteria dealing with user interface control and functionalities. Such features should be consistently presented and labeled to users.

For example, the page `websok.nlb.no/cgi-bin/mappami` seems to be based on different underlying software compared to the rest of NLB's pages, because of the drastic change in design and layout. In this case though, another search box is included on the page, but it takes the user to a results list that is also very different from the results list on `http://nlb.no/soek?optsearch=library&search=.+`.

From the perspective of the website administrator, such problems might be easily explained as being rooted in the differences between the different software. This makes it inherently difficult to consistently present functionality to the user, and there is not much to do about it, they might claim. But the user does not know about these underlying pieces of software. The user knows that Deichman or NLB has a website, and knows that this link presents such and such functionality, and that link presents other functionality.

In HCI terms, the user has been familiarized with a certain output, and in order to properly interact with the website, this output should not suddenly change. It is not the duty of the user to educate themselves on the particular differences; features should be consistent and accessibility should be implemented in the entire website.

5.1 Shared problems

While evaluating each page according to each success criterion, I identified a few problems that were shared between Deichman and NLB. First, there is the problem of not supplying text alternatives for non-text content. This is usually done by including an `alt` attribute on `img` tags, which should briefly describe what the image is about.

I want here to reiterate the main points about UD in the context of HCI because I believe this accessibility problem is a clear exemplar of the idea of UD. I stated that an important element of HCI is the concept of channels of input and output: from the perspective of the user, their input is the output of the computer program. From the perspective of the computer program, its input is the output of the user.

This vision works well when talking about an ideal computer program and an ideal user, but it is lacking when applied to the real world. Some users might have difficulty accepting certain input, or they might have difficulty providing certain output.

The idea of UD in providing a solution to this problem is really about establishing redundancy. Redundancy has multiple meanings, among them the notion of being superfluous, but *Oxford English Dictionary* describes a meaning in engineering that I think

might be fitting to illustrate my point: “containing duplicated parts such that its function is not impaired in the event of failure of a part” (“redundant, adj. and n.”, 2017).

UD is about redundancy because of this: it is about ensuring more than one channel of input and output in the interaction between human and computer. The interaction itself is made redundant by ensuring that, should one channel be inapplicable, another channel might still do the job. Supplying text alternatives for non-text content by including `alt` attributes on all images might seem like a mundane job, but it is a part of the engineering effort in securing the system with redundancy.

From an information science perspective, though, there seems to be a problem with this idea. On NLB’s website, there is an in-built text-to-speech module on each page, which reads aloud the text on the page. For example, on pages displaying information on a single book, this module will read the title, author, description, and so on. In this case, the information being audibly presented is equivalent to the text. But is it not problematic to talk about equivalent information in the case of text alternatives to images? An image can contain more information than a brief phrase in an `alt` tag.

This claim has implications for the social model of disability. If the challenge is true, then it is not possible to remedy the disability in this case, because the text alternative is not truly an example of redundancy. Information which is presented to those with sight is simply qualitatively more than the information presented to those without sight.

One possible reply to this challenge is to simply demand a more substantial text alternative for non-text content. For example, instead of an `alt` attribute on images, a website administrator could make use of a separate tag with a longer description of the image and establish a programmatic relationship between the image and the description tag with the use of the `aria-labelledby` attribute. In this case, the author is free to describe the image at any length, while ensuring that assistive technologies can still accurately infer that the text describes the non-text content. The challenge is answered by simply providing enough text.

Another reply is to question what *equivalent information* really means. The challenge rests on the assumption that the non-text content and the text alternative must somehow be equal. But is this really an honest interpretation of the criterion? Does equivalent information mean a qualitatively identical experience for those with sight and those without sight? A more reasonable interpretation is to point out that *information* is not the same as such an experience. Information is related to the concept of knowledge.

Following Buckland, two qualitatively different pieces of *information-as-thing* could conceivably present the same *information-as-knowledge*. In other words, the same bit of information is provided by two different media.

This argument could go on much farther than the limits of this thesis, but the points made so far illustrate how important the argument is. It forces us to question what *information* really

is, and how librarians should view their mandate of mediating information to *everyone*. Whether true redundancy in the channels of input and output between humans and computers is possible seems to be an essential issue in norwegian librarianship, because of the way the law is worded.

Tentatively, I think librarians should interpret this redundancy as being possible, because it aligns well with the vision of universal access to information. This conviction would be reflected in the way digital library services are built: serious attempts would be made in designing the systems to be accessible to all, and the law could be followed with greater confidence.

Taking a few steps back, another common problem to both Deichman and NLB is 1.3.1 Info and Relationships. This criterion specifies that visually perceived structures should also be programmatically determined as structures. For instance, lists on web pages should use the `ul`, `ol`, or `dl` tags, because such tags programmatically determine list relationships. The alternative, simply encoding lists as separate `p` tags, for example, will make it difficult for assistive technologies to accurately interpret their meaning.

This is an element of what Glushko, Mayernik, Pepe, and Maloney describe as relationships in organizing systems (2013, p. 190). Such relationships "enable interactions with the resources" (2013, p. 190), referring to the way computers can process structured data and facilitate relationships between resources. In their view, relationships as described in the WCAG criterion would be defined as structural relationships *within* a resource (2013, p. 210).

This perspective is interesting because it is not immediately clear how this benefits people with disabilities. The previous problem, which emphasize the need for text alternatives for non-text content, is immediately beneficial to the visually impaired because text can be processed and delivered by audio. But a criterion that emphasizes explicit programmatic structures for relationships inside documents seem at first to be less useful.

The key in this case is that this is also an example of providing for alternative channels of input and output, but the difference is the fact that this alternative is not directly provided by the web page. What I mean by this is that a text alternative to an image is directly embedded in the HTML document, ready to be parsed by assistive technologies, but programmatically determined relationships and structures are more like *facilitators*.

Norman makes a small remark about affordances also being available for machines: "[a]ffordances represent the possibilities in the world for how an agent (person, animal, or **machine**[21]) can interact with something" (2013, p. 18). I believe that the point the WCAG criterion is trying to make is somehow related to this fact, that affordances also exist for machines.

Let me illustrate this more clearly: I made the point that the relationships and structures

[21] Emphasis mine.

can be viewed as facilitators. They are facilitators, because the browser (or an assistive technology) can make use of the programmatically determined structures when presenting the information to the user. For example, if the user prefers a browser with predetermined CSS styles specifically tailored to the user, these relationships within the HTML document ensure that the browser can preserve the structure while presenting the information in a visually different way. The structures *facilitate* these changes to the user agent. In this way, the structures can also be seen as affordances for the browser. They make possible different interactions, with the larger goal of providing alternative channels of input and output.

In addition to these two problems there was the problem of 2.4.7 Focus Visible. Focus is a certain state of the web page such that an element is selected by the user, awaiting further input as to the next step. For example, when a button in a form is selected by the user, either the button can be activated or the user can cycle forward to the next element, focusing that one instead.

Where text-alternatives and relationships were part of the "perceivable" principle, visible focus is a part of the "operable" principle. In other words, this is a distinction between what the user can perceive or take in as input from the computer program, and how the user can operate or provide output to the computer program.

Ensuring that focus is visible helps the user in operating on the web page, by providing a visual feedback on what the user is doing. For example, when cycling through the controls for the user interface the page might provide a visual signal (e.g. a blue square around the control.) This helps users understand what state the page is in, and what actions are possible. On the other hand, not providing visual feedback leaves the user unable to perceive this state, and therefore unable to know what actions are possible.

This requirement is actually related to a principle of keeping users informed on the status of the system, one of Nielsen's ten heuristics (Dix et al., 2004, p. 325). Although the WCAG criterion only deals with *keyboard* focus, this general principle is an important aid to all users. It involves what was described by Dix et al. as well as Sandnes in section 2.1 as the cycle of *action* and *evaluation*. Without any satisfactory response by the computer program, the user is unable to evaluate the success of their action.

From an *information seeking* perspective such evaluation gaps can be explained in terms of a failure in the process of looking for information. In Deichman's case, for example, there was a problem with this criterion in that the button used to navigate to the OPAC login page did not provide any visual feedback that it was focused with the keyboard.

The user might have an information need, perhaps they are looking for the due date on a book they borrowed. The user has trouble using a mouse to navigate web pages, and opts for a keyboard instead. Since the button does not provide visual feedback of being focused, the user might be confused or perhaps unable to navigate to the proper page. The user might not

succeed in finding the information they need, and might need to resort to other means (e.g. a telephone call.)

Again, such short-comings demonstrate how the channels of input and output might not work for all users, and the clear course of action is to identify this and reestablish redundancy.

Continuing with the IB perspective, this seems to indicate a distinction that is not so apparent in the information science field. The distinction seems to be this: there is the information that the user seeks, which is what Buckland described as information-as-knowledge, and there is the information *about the computer*, i.e. about how the web page works.

IB seems to be slanted towards the former, perhaps because of the dominant position of librarians in this field. In library science, what receives the most attention is the document, access to which is the central concern. In this digital age, however, information regarding *the use of* computers is clearly an important concern as well.

Both Deichman and NLB also demonstrated failure in regards to 3.2.2 On Input. The intent of this success criterion is to ensure that the computer responds predictably when the user makes some changes, e.g. entering text into a text field.

This criterion expands on the previous point in that, not only is the web page to respond and keep the user informed on its state, the page should also respond in a *good* way. When checking the check box of a search facet on a page and the search results list updates to reflect the change, this is not good enough if there is also a change in the viewport (e.g. scrolling the page to the top,) or a change in the focus of the controller (e.g. removing the focus altogether.)

5.2 Unique problems

I have briefly mentioned Deichman's problems with color contrast on some of their pages in sections 4 and 5, and I want to address some issues relating to this problem. Again, the same points I have made earlier may be used in explaining this problem, but in this case there is a legitimate concern that actually competes with concerns of accessibility.

Figure 3[22] shows an advertisement for Deichman, but I would like to point out the color at the bottom. Again, figure 4[23] shows a sign at a library, making use of the same color. In fact, a lot of Deichmans "outwards appearance" makes use of this color. I am here referring to Deichman's and *branding*.

Muñiz defines a brand as "the total constellation of meanings, feelings, perceptions, beliefs, and goodwill attributed to any market offering displaying a particular sign" and branding as "the advertising, marketing, and managerial practices designed to develop, build, and sustain the characteristics, properties, relationships, and signifiers of a particular brand"

[22]Image is taken from Deichman's facebook page

[23]Image is taken from Deichman's facebook page

Figure 3: Photograph of an advertisement for Deichman.

(2007). Whereas branding is the outward, apparent marketing, a brand is something like an attitude towards an organization.

In this case, Deichman is using the orange color as branding for its own brand. The motivation for this is of course to market itself as a good source of books, music, and other services. But a greater goal is fulfilling the law of public libraries in Norway, with its statements on developing library services for all. Continuing with this, it seems only natural to make use of this color on Deichman's website. After all, this is only a matter of doing branding for itself for the purpose of delivering services to all.

In light of the success criterion on color contrast, what is the correct course of action here? On the one hand, developing a brand is a legitimate concern for organizations, perhaps also for large libraries like Deichman. On the other hand, in this case the usual branding does not work well in terms of accessibility, at least when used as the foreground color of headings on white backgrounds.

This is problematic for Deichman, because remedying this accessibility problem, e.g. by simply reverting back to a black foreground color, will potentially decrease the effectiveness of its branding efforts. On the other hand, continuing with this color contrast will leave the website not in compliance with regulations on ICT services, which include this criterion.

A possible solution is to choose another design which incorporates the orange color while still conforming to the criterion on color contrast, perhaps by changing the background color, or even using the orange color as a background color with a high contrast foreground color for text elements.

This is done by NLB on their website, by choosing a dark gray background color with white text elements in general and green text elements for emphasized headings and buttons. The green-on-gray, seen in figure 5, is used consistently across the website, serving as a recognizable branding for NLB, while conforming to proper color contrast.

There are concessions in WCAG for cases of this sort, for example success criterion 1.4.5

Figure 4: Photograph of a sign at a Deichman library.

on images of text. The criterion recommends using text instead of an image of text where possible, for the purposes of easing the parsing done by assistive technologies. Nevertheless, the criterion recognizes branding as a concern where images of text is allowed: in such cases, recreating the specific design possible in an image may not be possible with the use of text and e.g. CSS (Web Content Accessibility Guidelines Working Group, 2016, Criterion 1.4.5). Likewise, In the case of 1.4.3, only text that is part of a logo or brand name takes precedence (Web Content Accessibility Guidelines Working Group, 2008, Criterion 1.4.3).

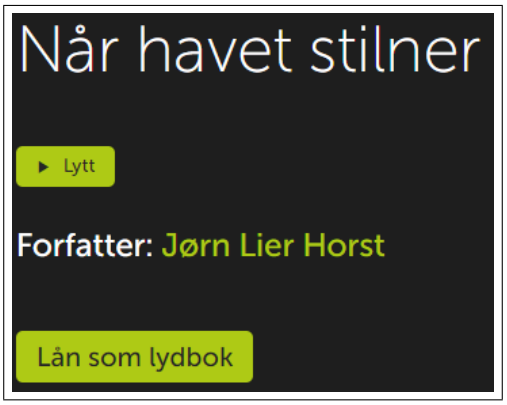
Branding seems to be recognized as a valid concern in WCAG, but is limited to the core logo or heading of the organization: in regards to any other features–such as the use of a general color scheme–accessibility takes precedence.

6 Conclusion

In this thesis, I wanted to identify and examine some problems relating to accessibility on two Norwegian library websites. I worked with a basis in WCAG 2.0, examining a sample set of pages against a set of success criteria as specified in Norwegian regulations, and I ended with a discussion on these issues in relation to HCI and IB.

I found that the theories function well in explaining *how* these problems relate to accessibility and the relationship between human and computer. Problems can occur in channels of input and output, and I demonstrated some particular examples of these problems,

Figure 5: Screenshot of a part of NLB.no



e.g. text alternatives to non-text content, internal structure and page language specification.

I posited that the concept of redundancy is useful in understanding the thinking behind universal design, in that providing alternative channels ensure that the page will be usable by a greater variety of people.

In parts of this thesis, I have discussed how the issue of digital accessibility lies at the heart of librarianship and the essential character of the profession. Librarians are committed to universal access to information, and we see signs of this in the debates on open access, open science, and copyright. Yet a large part of the population experiences disabilities, and an integral part of modern life is the web, and it is therefore important for librarians to also educate themselves on these issues and ensure an accessible web presence.

This thesis shows that there are some accessibility problems on Deichman's and NLB's websites, but it does not show the full picture of accessibility on these websites, because of the angle I took with regards to methodology and scope. WCAG 2.0, for example, does have some limitations as I briefly discussed in section 2.3. And the heuristic methodology does not guarantee a complete understanding of the usability problems in the system.

As such, I suggest that future research on these websites should make use of user participation in the evaluation, in order to identify more potential problems, as well as alternative frameworks for gauging accessibility in user interfaces.

Still, my findings should be valuable to website administrators of Deichman and NLB, and hopefully provide some suggestions for improving the accessibility on the various pages.

References

Berget, G., Herstad, J., & Sandnes, F. E. (2016). Search, read and write: An inquiry into web accessibility for people with dyslexia. In H. Petrie, J. Darzentas, T. Walsh, D. Swallow, L. Sandoval, A. Lewis, & C. Power (Eds.), *Universal design 2016: Learning from the past, designing for the future* (pp. 450–460). Amsterdam: IOS Press. doi:10.3233/978-1-61499-684-2-450

Buckland, M. K. (1991). Information as thing. *Journal of the American Society for Information Science*, *42*(5), 351–360. doi:10.1002/(SICI)1097-4571(199106)42:5<351::AID-ASI5>3.0.CO;2-3

Case, D. O. & Given, L. M. (2016). *Looking for information: A survey of research on information seeking, needs, and behavior* (4th ed.). Bingley, UK: Emerald.

Connell, B. R., Jones, M., Mace, R., Mueller, J., Mullick, A., Ostroff, E., … Vanderheiden, G. (1997). The principles of universal design. North Carolina: The Center for Universal Design. Retrieved from https://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm

Diskriminerings- og tilgjengelighetsloven. (2013). Lov, 21. juni 2013 nr. 61, om forbud mot diskriminering på grunn av nedsatt funksjonsevne (diskriminerings- og tilgjengelighetsloven). Retrieved from https://lovdata.no/lov/2013-06-21-61

Dix, A., Finlay, J., Abowd, G. D., & Beale, R. (2004). *Human-computer interaction* (3rd ed.). Harlow, England: Pearson.

Floridi, L. (2014). *The 4th revolution: How the infosphere is reshaping human reality*. Oxford: Oxford University Press.

Folkebiblioteksloven. (2013). Lov, 21 juni 2013 nr. 95, om folkebibliotek. Retrieved from https://lovdata.no/dokument/NL/lov/1985-12-20-108

Forskrift om universell utforming av IKT-løsninger. (2013). Forskrift, 3. juli 2013 nr. 951, om universell utforming av informasjons- og kommunikasjonsteknologiske (ikt)-løsninger. Oslo: Kommunal- og moderniseringsdepartementet. Retrieved from https://lovdata.no/forskrift/2013-06-21-732

Glushko, R. J., Mayernik, M., Pepe, A., & Maloney, M. (2013). Describing relationships and structures. In R. J. Glushko (Ed.), *The discipline of organizing* (pp. 189–234). Cambridge, Massachusetts: MIT Press.

Harris, J. & White, V. (2014a). Medical model. In *A dictionary of social work and social care*: Oxford: Oxford University Press. Retrieved from http://www.oxfordreference.com/view/10.1093/acref/9780199543052.001.0001/acref-9780199543052-e-998

Harris, J. & White, V. (2014b). Social model of disability. In *A dictionary of social work and social care*: Oxford: Oxford University Press. Retrieved from http://www.oxfordreference.com/view/10.1093/acref/9780199543052.001.0001/acref-9780199543052-e-1422

Henry, S. L., Abou-Zahra, S., & Brewer, J. (2014). The role of accessibility in a universal web. In J. P. Bigham, Y. Borodin, & L. Carriço (Eds.), *W4A 2014: Proceedings of the 11th Web for All Conference (Seoul, 07–09 April 2014)*: W4A. doi:10.1145/2596695.2596719

Letnes, O. (2014). Den vanskelige debatten. *Bok og bibliotek*, (6), 8–13.

What is the difference between webpage, website, web server, and search engine? (2016, December 6). Online. Retrieved March 2, 2017, from https://developer.mozilla.org/en-US/docs/Learn/Common_questions/Pages_sites_servers_and_search_engines

Muñiz, A. M. (2007). Brands and branding. In G. Ritzer (Ed.), *The blackwell encyclopedia of sociology*. Malden, Massachusetts: Blackwell. Retrieved from http://www.sociologyencyclopedia.com/subscriber/tocnode.html?id=g9781405124331_yr2016_chunk_g97814051243318_ss1-47

Nielsen, J. (1994). Heuristic evaluation. In J. Nielsen & R. L. Mack (Eds.), *Usability inspection methods* (pp. 25–62). New York: John Wiley & Sons.

Norman, D. (2013). *The design of everyday things*. New York: Basic Books.

Ranganathan, S. R. (2006). *The five laws of library science*. New Delhi, India: Ess Ess Publications.

redundant, adj. and n. (2017), In *Oxford english dictionary*: Oxford University Press. Retrieved from http://www.oed.com/view/Entry/160538

Ridderstrøm, H., Skjerdingstad, K. I., & Vold, T. (2015). Kulturformidlingens hva, hvordan og hvorfor. In *Litteratur- og kulturformidling: Nye analyser og perspektiver* (pp. 15–37). Oslo: Pax.

Sandnes, F. E. (2011). *Universell utforming av IKT-systemer: Brukergrensesnitt for alle*. Oslo: Universitetsforlaget.

St.meld. nr. 40 (2002-2003). (2003). Nedbygging av funksjonshemmende barrierer. Retrieved from https://www.regjeringen.no/no/dokumenter/stmeld-nr-40-2002-2003-/id197129

Turock, B. J. & Friedrich, G. W. (2009). Access in a digital age. In M. J. Bates & M. N. Maack (Eds.), *Encyclopedia of library and information sciences* (pp. 23–33). doi:10.1081/E-ELIS3-120043096

W3C. (n.d.). Standards faq. Retrieved May 9, 2017, from https://www.w3.org/standards/faq

Web Content Accessibility Guidelines Working Group. (2008). Web content accessibility guidelines (WCAG) 2.0: W3C recommendation 11 december 2008. W3C. Retrieved from http://www.w3.org/TR/2008/REC-WCAG20-20081211/

Web Content Accessibility Guidelines Working Group. (2016). Understanding WCAG 2.0: A guide to understanding and implementing web content accessibility guidelines 2.0. W3C. Retrieved from https://www.w3.org/TR/UNDERSTANDING-WCAG20/complete.html