The benefits from an accessible web: a case study.

Web Accessibility Quality Assessment at a Major Swedish Industry Manufacturer

Elin Bäcklund

ISSN 1650-2884, LU-CS-EX 2016-24

MASTER THESIS, INSTITUTE OF TECHNOLOGY AT LUND UNIVERSITY

This research was done under the supervision of Prof. Martin Höst, Prof. Björn Regnell and Ph.D student Johan Linåker, all from the Computer Science Department at Lund Institute of Technology. Niclas Lillman and Mattias Hyll have supervised the case study at Scania. The research was performed during 20 weeks, from January 18th to June 3rd of 2016.

I have permission to publish the Scania related information in this report. Scania wishes to be transparent with the information to contribute to the research and show their interest in the subject.

First release, June 2016

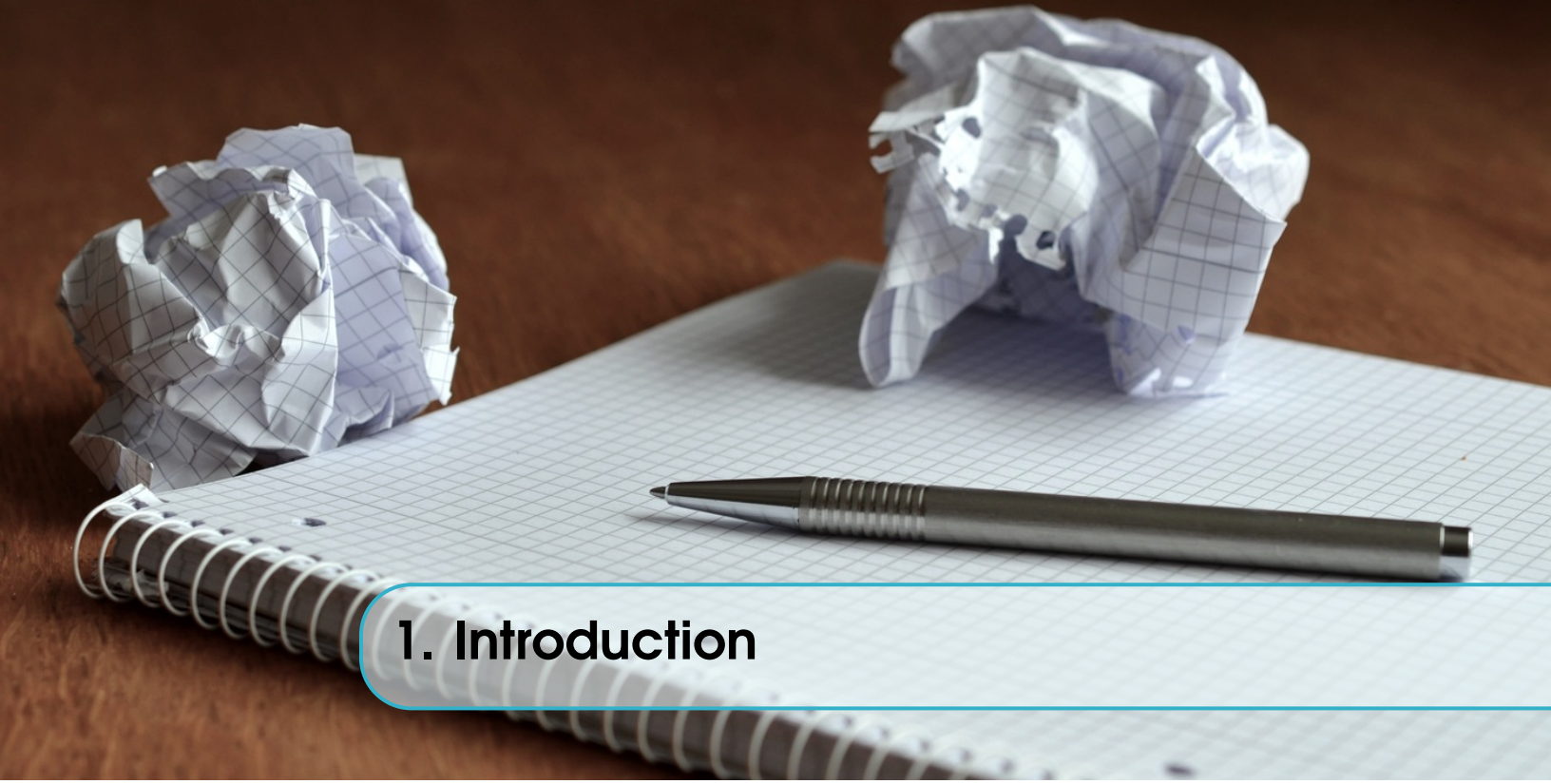
Abstract

There is an explosive growth in on-line information and interactive services provided on the Web. Web accessibility refers to designing these websites so that all people, no matter disabilities, can access Web content. Recently in Sweden, laws and regulations have been imposed, requiring private corporations to ensure an accessible digital work environment.

Scania is a major Swedish automotive industry manufacturer with more than 44,000 employees in 100 countries and hundreds of Web based solutions for internal communication. To ensure that all Scania co-workers can access work related Web content, this master thesis aims at providing Scania with guidelines and quality requirements for a continuous sustainable web development. The results are based on requirements from society, business value assessment and case study at Scania.

The results of this research focus on *Universal Design* or *Design for All* which means combining accessibility and usability and designing websites that are functional for the end user. The concept of designing for all, no matter abilities or conditions, is what has come to be the focus of this research, resulting in accessibility quality requirements, guidelines and success factors for improving accessibility for web based applications in internal systems.

Contents



1. Introduction

1.1 Motivation

Web accessibility refers to the design of websites for people with disabilities (Web Accessibility Initiative 2016a). Because of an explosive growth in on-line information and interactive services provided by the web many people are at risk of being excluded from society unless accessibility matters are addressed.

Many websites, around the world, lack even the most basic accessibility features (Seal 2016). The problem has been overlooked for a while but stricter laws and regulations are appearing around the world. In a tech-obsessed culture where digitization is happening everywhere there is no excuse not to make websites accessible and therefore useful to anyone, no matter age, injury or disability.

As one of Sweden's largest enterprises, Scania works a lot with attracting, retaining and developing qualified and dedicated employees to deliver long-term growth with profitability (Scania Group, 2016). Scania emphasizes the importance of a motivated and diverse workforce and among the company's core values are quality focus and respect for the individual. With employee well being at top priority Scania aims to adapt a web accessibility mindset and lead by example as more companies will have to follow. There is however limited knowledge of the current situation at Scania and how to improve it. This research study aims to investigate the 2016 web accessibility situation at Scania and come up with guidelines for continuous development.

1.2 Objective

The research questions for this master thesis are presented in Table 1.1.

1.3 Method

To investigate the situation at Scania I have performed a case study. I have interviewed and observed key individuals to understand the way they work with accessibility and how they could work with it, provided the right tools. I have also interviewed people working with human resources to gain an understanding of how Scania handles employee information and how I can perform a case study at the

ID	Question
Q1	How does Scania, deal with Web accessibility in their internal communication, now and in the future?
Q2	Is there a reason for Scania to work with Web accessibility? If so, what are the motives?
Q3	What requirements are there from the Swedish law and from the society?
Q4	Which key success factors are there for making web based solutions functional and accessible?
Q5	Which accessibility quality requirements should be established as part of Scania's software development plan?

Table 1.1: Research questions. Answered in chapter 7.

company. After these interviews I did a large survey with Scania co-workers to collect quantitative data. This part of the research I call elicitation. With the goal to produce quality requirements (based on key factors such as benefit, cost and risk) I have applied a requirements engineering approach to establish guidelines and requirements for future development. Because there are limited research on quality requirements within web accessibility I have studied previous publications about a similar subject - Quality Requirements within Sustainability.

1.4 Report Outline

In chapter 2, I explain the work related to my study to give the reader a background to key subjects and a better understanding of the area. In chapter 3, I explain the methods I have used when conducting research at different stages of the process and here you can read about the interviews and survey I have used to elicit problems and solutions at Scania. Furthermore I present my stakeholder analysis in chapter 5. Stakeholders include Scania IT, the end user and laws and regulations. In chapter 6, I present the results I arrived at from performing my research. Finally I analyze and discuss those results in chapter 7 and arrive at my conclusions and recommendations for Scania in chapter 8. In Appendix A, the reader can dig deeper into interviews, survey and also read an article featuring this master thesis, published in Scania IT newspaper.

At the end of this report there is an index with key words and page numbers. There is also the bibliography which I refer to in the text.

1.4.1 How to Read the Report

If you are new to Web accessibility or requirements engineering start with the Related Work chapter (2) to get a deeper understanding of the concepts discussed in the report.

If you work at Scania and want to get straight to the recommendations go to the 7. Analysis and Discussion chapter to skip to the discussions about business value for Scania and then read the 8. Conclusion chapter for final recommendations. You might want to jump back to the 6. Result chapter to look at images and tables.

1.4.2 References

Since I have found a lot of good information about Web accessibility and useful tools to achieve it along the way I have created a remark to let you know where you can find more specific information.

See example below.

For more information about Scania's core values, review *About Scania: Scania Core Values*, from www.scania.com.

1.5 Result

In my conclusions of this research and case study I motivate why a company like Scania should work with improving Web accessibility, highlighting benefits such as better efficiency, a larger talent pool to recruit from, inclusion and a social responsibility. I have also produced a quality requirements checklist and a list of guidelines and key success factors for succeeding with the accessibility work within the organization.

I hope to see someone taking responsibility for executing the changes at Scania and I hope that this master thesis will be part of creating an accessibility web standard for corporate intranets.

2. Related Work

2.1 Literature Study

Today there are several works on Web application evaluation techniques that define how to evaluate websites based on accessibility requirements. However, despite existing requirements, such as (Web Accessibility Initiative 2016d), there are few approaches offering support for incorporation of the accessibility requirements in the software development process. There is little discussion in literature regarding Web accessibility at private corporations. There is clearly a lack of attention to accessibility issues in web development at private corporations, especially regarding intranet applications.

To analyze the accessibility of Scania's software system and establish quality requirements I have researched a study about sustainability software-quality requirements (Lago et al. 2015) since this publication discusses a similar research approach. This research discusses the different dimensions of sustainability and how to include them in a quality evaluation that involve software, hardware, human and system elements.

2.2 Disabilities

Disability is the consequence of a physical, mental, intellectual or sensory impairment (World Health Organization no date). A disability may be present from birth, or occur during a person's lifetime. There are permanent disabilities, e.g. hearing impairment or paralysis, and also disabilities that can heal, like a broken bone or sleeping difficulties. Disabilities vary over our working life and many of us have some type of disability at some point in time.

There are approximately 9.7 million people in Sweden. The grown up population (age 16 and above) consists of 8 million people. Almost 7.2 million people are in a fit-for-work age (15-74 years). Here are some interesting facts about this population (Arbetsmiljöverket 2016):

- Mental illness is the most common reason for people having to go on sick leave. Almost 4 out of 10 people report mental illness as cause to their sick leave.
- About 1.9 million Swedish people have reading disabilities.
- About 1.3 million of the grown up population have mobility impairments in arms or hands.
- 780 000 people have some form of rheumatism.

- 700 000 people in fit-for-work age have hearing impairment.
- About 50% of all people in the fit-for-work age have a temporary disability at some point during their working life.

Internet users can experience problems when using the web because of different disabilities but also because of functional limitations, environmental factors or technology matters. Therefore Web accessibility is closely related to usability and other social factors of accessibility.

Examples of users who might experience problems using web applications due to the above mentioned reasons (Web Accessibility Initiative 2016b):

- Persons with disabilities such as visual, auditory, physical and cognitive.
- Older persons, persons with low literacy, others.
- People experiencing technology-related limitations or incompatibility caused by browsers, platforms, devices and mobile web.
- People experiencing accessibility problems due to environmental factors such as place, illumination, noise and slow connection.

2.3 Web Accessibility (WA)

Web accessibility refers to the design of websites for people with disabilities. An accessible design is easy to perceive, understand, navigate and interact with (Web Accessibility Initiative 2016a).

Accessibility obstacles occur when a person is prevented from interacting with the surroundings because of a disability. The obstacles need to be removed to enable disabled people in their work life.

Many national authorities in Europe are committed to the accessibility of public websites and have introduced guidelines and regulations based on WCAG 2.0. As a consequence government websites have a much higher standard of accessibility than private sites.

Figure 2.1: WCAG 2.0 level AA is a widely spread standard for Web Accessibility.

2.3.1 The importance of WA

Accessibility is subject of broad and current interest, according to EU:

> "Accessibility has become particularly important because of the explosive growth in on-line information and interactive services provided on the web. If web accessibility is not achieved, many people are at risk of being partially or totally excluded from society." (European Commission 2016).

Improving Web accessibility creates high quality Web content with better structure and crawlability while at the same time enables more clients and employed people using the services. Improving Web accessibility for people with disabilities will also improve accessibility for older people since common impairments due to age are visual and auditory. Older employees often have high valued competence and experience which should be taken advantage of and cared for.

What does a UX Designer or a web developer focus on when building a website? It is easy to get distracted by the *"shiny stuff"*, like search engine optimization. We need to make website readable to users and not only web developers (Seal 2016).

2.3.2 WCAG 2.0 Level AA

WCAG is an abbreviation for Web Content Accessibility Guidelines which is an internationally established set of guidelines for Web accessibility. WCAG 2.0 includes a wide range of recommendations for how to make web content accessible to people with disabilities (Web Accessibility Initiative 2016d). A user of a web based product can require the product to follow the WCAG 2.0 recommendations and by implementing the solutions create a sustainable website from start.

WCAG 2.0 offers guidance consisting of measurable criteria, different techniques and methods as well as examples and common mistakes. The standard was ratified by the EU convention (European Commission 2016), in December 2010, and it is a standard followed around the world (Figure 2.1).

2.4 Usability

Usability is a quality attribute that assesses the ease of use of an user interface. Usability is defined by five quality components (Nielsen 2003):

- **Learnability**: How easy is it for first-time users to perform tasks?
- **Efficiency**: How quick can users perform tasks?
- **Memorability**: When a user returns to the application after a period of not using it, how easy can they establish proficiency?
- **Errors**: How many errors does the user make and how severe are they?
- **Satisfaction**: How pleasant is the design to use?

Usability is a key to success for websites (Nielsen 2003). If a website is difficult to use people leave, or get inefficient in their work. When people surf the web they do not read a user manual to navigate websites, they expect them to be understandable and user friendly without instructions. For intranets usability is a matter of employee productivity (Nielsen 2003).

At the Web Accessibility Initiative website, usability and accessibility and how they are connected are discussed:

> *Web accessibility and usability are closely related; their goals, approaches, and guidelines overlap significantly. It is most effective to address them together in many situations,*

> *such as when developing websites. There are a few cases when it's important to distinguish between accessibility and usability, such as when looking at discrimination against people with disabilities and when defining specific accessibility standards.* (Web Accessibility Initiative 2010)

Many of the accessibility guidelines presented in WCAG 2.0 also improve usability of websites and can especially improve the experience for older users, people using assistive technologies or have low bandwidth and people with geographical barriers such as language (Web Accessibility Initiative 2010).

Accessibility quality requirements include both requirements that are more specific for users with disabilities, e.g. making websites compatible with assistive technology, and also requirements that are crucial for people with disabilities but are really general usability principles because they benefit everyone using the service. E.g. creating a website that can be navigated without a mouse benefits people with motor disabilities but is also general good usability.

Read more at *Web Accessibility Initiative: Usable* www.w3.org.

2.5 Quality Requirements

Software is becoming more and more a substantial part of industrial and consumer products (Berntsson Svensson 2011) and as software products become more complex the need for requirements engineering becomes a key to success. Apart from functional requirements there are also non-functional aspects - quality requirements, such as usability, accessibility and performance. These requirements ensures the user's satisfaction. Not dealing with quality requirements can lead to more expensive products and an increased time-to-market (Berntsson Svensson 2011).

There are challenges in working with quality requirements because they are often poorly understood, non-quantifiable and difficult to validate. A situation can become complex when there is a large number of requirements from internal and external sources and a continuous flow into the development organization (Berntsson Svensson 2011). To create the optimal end user experience a certain level of quality, at a certain point in time, should be achieved. A challenging problem when considering accessibility is to set the right quality target in relation to requirements from society, business values and resources. To put the quality requirements into context and decide what quality level is *good enough* the QUPER Model has been used in this report.

2.5.1 QUPER Model

Less than perfect software may be ideal when the product is put into context. Deciding when it is good enough is the hard part. QUPER defines a prioritization model that includes a third dimension related to quality, as a complement to cost and value (Berntsson Svensson 2011).

Figure 2.2 shows the breakpoints that mark the shifts between quality levels (Regnell et al. 2008). The utility breakpoint marks the shift from useless to useful quality, while the differentiation breakpoint marks the shift from useful to competitive quality (which only a few competitor's products reach) (Berntsson Svensson 2011).

Figure 2.3 illustrates the relation between cost and quality in terms of cost barriers. A barrier occurs at the shift from *cheaper* quality to *expensive* quality (Berntsson Svensson 2011). The cost

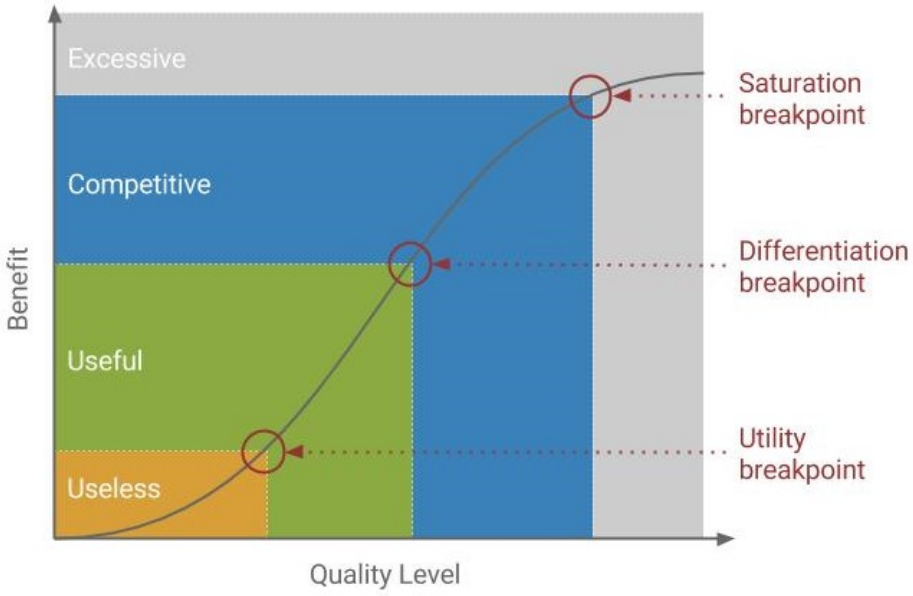


Figure 2.2: Benefit view from the QUPER Model.

Figure 2.3: Cost view from the QUPER Model.

curve has a plateau-like shape when an increase of quality does not increase the cost significantly. At a barrier the cost increase for every quality improvement.

When using the QUPER model in the requirements engineering process it is important to elicit the quality breakpoints (Figure 2.2) and the cost barriers (Figure 2.3). For every project a scale and unit needs to be defined to support the context of the software. After having elicited and estimated quality breakpoints and cost barriers, candidate requirements are set and finally cost dependencies are identified (Berntsson Svensson 2011).

Quality is continuous and typically viewed as different shades of quality on a sliding scale (Berntsson Svensson 2011). Quality is also non-linear and questions that are relevant to answer regarding quality requirements are:

1. Would slightly better performance be significantly more valuable from a market perspective?
2. Would significantly better performance be just slightly more expensive to implement?

3. Methodology

For this Master Thesis I have looked at Scania's way of dealing with Web Accessibility. The main focus of my research has been on the Scania IT department, since most of the Web development is done there. As a first step in the web development process, towards better accessibility, I have used Requirements Engineering to define and validate quality requirements. I have also focused on maintaining these requirements by establishing a way of thinking at Scania. In the requirements engineering process I have elicited issues, problems and possible solutions by performing an case study at Scania. The reason for doing a case study is to solve a particular problem and produce guidelines for best practice at Scania. As an individual I have led the problem solving process to improve the way issues and problems are addressed within the Scania corporation. To establish valid quality requirements I have used both qualitative and quantitative research in the elicitation process.

3.1 Research Process

As seen in Figure 3.1, I have had an iterative research process, starting off with the *Invention Stage*. At the invention stage I did background research, literature study and narrowed my topic down. From the invention stage came many ideas of how I could collect data. I constructed material for my data collection consisting of interview and survey questions. I also formed a hypothesis for the expected outcome.

In the *Data Collection Stage* (Figure 3.1), I first found participants for my case study and interviews. At the beginning I used the networks of my mentors at Scania and at Lund Institute of Technology to reach various experts in IT, Accessibility and HR. When I had found people to interview I started collecting data through interviewing and also broaden my network by getting referrals from participants.

The final step of my iteration process was the *Drafting and Revision Stage* (Figure 3.1) where I organized, concluded and analyzed the data I had collected. I drafted my results and sent it for revision to my mentors. After getting feedback from mentors and having learned more about the subject I went back to the first stage to innovate once more and come up with new ideas.

In the second round of the iterative process I narrowed the topic and my focus even more. As I

went into collecting more data I performed a survey with well formed quantitative questions that where based on interviews performed in the previous iteration. For each person I met and interviewed with I got more referrals and contacts.

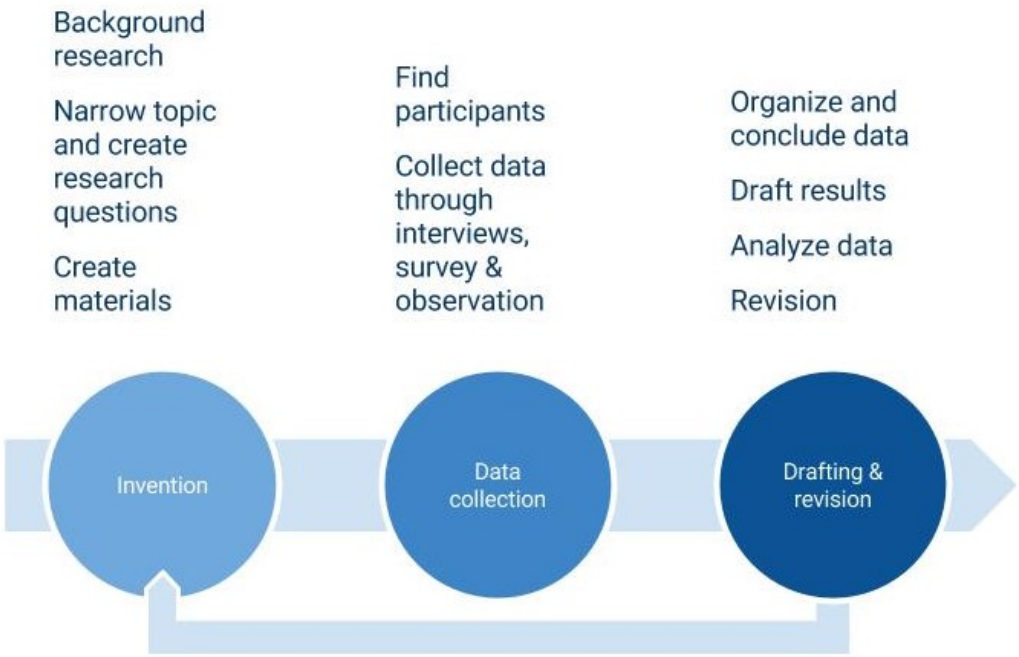


Figure 3.1: Stages of my research process.

The iterative research method have enabled me to keep a high quality throughout the process. After each iteration I have saved well worked through versions of my report that lacked major errors and mistakes. As I finished the text body of my report, writing the last chapter, at the end of the research process I was basically done. My figure texts, references and indexing was done in parallel with writing, throughout the process. The iterations and well planning of the report outline has helped me produce a high quality result without putting too much effort into correcting and altering in the end.

3.2 Case Study

To be able to report the Web accessibility situation at Scania I performed a case study over a few months time. Case Study Research has long been used in different professions and sciences. This research strategy aimed at investigating the work with Web accessibility within its real-life context.

A case study can be based on a mix of quantitative and qualitative data. To investigate the current situation at Scania regarding working with Web Accessibility and to gain a deeper understanding of how information flows and how decisions are made I have answered a lot of *how?* and *why?* questions. Asking these questions result in qualitative results.

The aim is not to manipulate the behaviors of the people at Scania but to simply covering contextual conditions that are relevant to the study. Hence, a case study approach is suitable.

Key Actions These key actions are inspired by Web Accessibility Initiative 2016c. I have considered these actions when performing the case study even though they have not been followed

in detail.

Accessibility Quality Goals: these need to be identified and planned. These goals should be specific, measurable, achievable and realistic. The goals should be based on the elicitation of the current situation at the company and the requirements from stakeholders.

Current approach, understanding and view of Web accessibility: What is the understanding and view of web accessibility today at the company? This information will be used to define what goals can be realistically achieved and elicited through interviews with app owners and architects, managers, experts and end users of IT-services.

Key quality requirements for Web accessibility and motivation: Why has Web accessibility become important? This information is important in the making of a business case and should be used to convince stakeholders of the benefits of making websites more accessible. Important quality factors of an accessible website should be listed.

Find interested colleagues and promote awareness: I will use the Scania intranet to explore different organizations within the company and try to find people who care about the accessibility issue and are able to influence the decision making. These people will be the key to success and hopefully help influence the business goals and project outcome. Those interested in participating in the study will also be used to validate the final model. This step will be informative and raise awareness of the Web accessibility issue through the various social Web applications at Scania.

Find backing from executives and managers at Scania: Using the business case as motivation I hope to meet with managers and seek their backing of the project goals. To have the backing of executives and managers will simplify the process of making the project successful and make websites more accessible.

3.3 Qualitative Research

Qualitative research (Corbin and Strauss 2008) is a wide concept. What we mean is research that produce findings that are not from statistical procedures or other means of quantification. In this project it refers to organizational functioning, social movements, experiences, competences and many more factors of how Web accessibility is addressed at a large Swedish company.

There has not been many case studies about Web accessibility within an internal organization. Since Web accessibility regards people with disabilities it is important to gain an understanding of qualitative things like personal preferences, experiences and feelings and therefore a qualitative research has been performed.

Performing brainstorming sessions with mentors and experts have helped me define problems descriptions and questions for this project to answer. Through brainstorming sessions I have structured my ideas and possible solutions. A tool I have found very helpful during brainstorming is the mind map. By creating mind maps I have categorized ideas and stimulated idea generation. Sessions of brainstorming in combination with letting ideas form and mature have helped ensure the right focus of this research.

To gather qualitative data I have also performed semi-structured interviews, documents and observations. After having collected data I used methods to organize and interpret the data. I used methods like conceptualizing and reducing data. Putting data into different categories enabled me to elaborate on dimensions and properties and create models for understanding stakeholders, domain and key actions. Finally I concluded my findings in this report. (Höst et al. 2006).

Interview Method

The reason for performing interviews is to gather information about people's beliefs and behaviors regarding Web Accessibility. The data collected through interviews is not first-hand, like that from observations, but rather self-reported or indirect data. There are risks with doing interviews since people might be biased and report actions in a favorable way. Even so, interviews are a great way to get a deeper understanding of a situation and also get more contacts and connections.

Finding people to interview is an important part of this master thesis. I have put a lot of effort into choosing the most relevant people. Through brainstorming with my mentors I got names of people at the HR department and at Scania IT who, when interviewed, passed me along to colleagues and added people to my network. The process clearly depended on real life interaction with people for them to fully understand my aim and be able to direct me to the next person that could be relevant to talk to.

When constructing the interview questions (Appendix A) I prepared questions but then adapted during the interview and came up with new questions as I learned more about the individual and his/her field of expertise. I combined qualitative questions with a few quantitative (yes or no) questions that I asked every individual I interviewed to be able to discuss my results quantitatively and qualitatively. I also carefully considered these guidelines when constructing my interview questions:

- Ask one thing at a time.
- Avoid leading questions.
- Ask clear questions.

When beginning an interview I started with telling the person about myself and my project as well as the focus of the questions and what I expected to learn. Sometimes I sent questions by email before hand so that the interviewee could prepare answers. After getting permission I recorded the interviews to be able to quote the individual and re-read the interview as I was writing. I also took notes during the interviews to make sure my questions got answered and to cover for the case where the recording went wrong.

Since the interviews were not always right on target but more of an inductive study I did not feel the need to transcribe the whole interviews but rather summarize the relevant information I learned. In the Result section (chapter 6) I present the relevant results of the interviews and the full interview summaries I have put in Appendix A.

Following are interview questions that have laid the foundation for the semi-structured interviews I have performed with the HR and IT departments as well as with end users.

Interview Questions: HR, Scania

- What are any legal issues I should consider when sending out a survey to all Scania co-workers in Sweden?
- What information about the health or disabilities of employees do you keep?
- How do I reach the different departments of Scania with my survey?

Interview Questions: Scania IT

- How do you, as an expert, work with WA in your daily work?
  - Do you work actively with WA or only when problems arise?
- From your perspective, how would you like to get guidelines about how to work with WA?
- Have you experienced any problems regarding WA in your work?

Interview Questions: End User

- Do you have a disability?
  - If yes, explain how it hinders you in your daily work?
  - If yes, give an example of a task on a web application that gives you accessibility problems?
- How much time do you spend in front of web applications during your work day?
- What would it mean to you if Scania integrated a full accessibility focus in their web development?

3.4 Quantitative Research

Quantitative data is any data that is expressed in numerical form such as statistics, percentage or numbers. When I performed my quantitative research I analyzed the data with help of statistics and tried to yield a result from a survey that can be generalized to all Scania employees. Since the number of employees, in Södertälje at Scania, is large my hypothesis was that statistics regarding any disabilities would follow statistics for the Swedish population. The survey I performed aimed at verifying if my hypothesis was true.

When performing the quantitative research I started with collecting data based on the hypothesis that disabilities among Scania employees would follow statistics of the Swedish population. After gathering a large amount of data I needed to verify, validate and record the data in order to analyze it and draw conclusions. For this purpose I used the Google Forms software which can both collect data and present it with visualized statistics.

Survey Method

When conducting a large questionnaire at a company it is important to test the quality of the questions and also gain approval from people responsible for Human Resources. I double checked my survey questions and layout many times with different HR managers at Scania. I first discussed the survey with the HR department at Scania IT after which I also confirmed legal matters with the department for labor affairs. Finally I presented the survey for the Scania HR steering committee and gained their approval so that I could send the questionnaire to all departments of Scania. The interview process for verifying and gaining approval of the survey is explained in more detail under section 6.1.1.

3.5 User Test and Observation Method

Performing observations of and tests on actual and users have given me both qualitative and quantitative results. I have been able to measure results from performing tests but also get qualitative input from observing the users performing the tests.

To validate the use of the QUPER model applied to the accessibility quality requirements I performed a user test where I compared quantifiable results from users with different abilities, performing the same task. I could then apply the QUPER Benefit model to the result and connect accessibility quality levels to the measured quantities.

When performing the user tests and observations I asked a color blind user to perform a task on a website with color coding and then had a person with normal sight perform the same task. I measured the number of seconds it took for the users to perform the task and could then draw conclusions from the difference in time. By putting the performance in seconds, on the horizontal axis of the QUPER benefit model (presented in chapter 6) I could quantify the quality levels.

3.6 QUPER / Quality Requirements

I have applied the QUPER model to my research to be able to identify the key quality factors that will make a significant change without costing too much. By using the QUPER model to define benefit breakpoints and cost barriers I have been able to motivate the prioritization of actions to take and produce guidelines for Scania. Since the QUPER Model focuses more on usability and market value I have adapted the model to fit accessibility requirements. The adaption included changing quality levels and breakpoints.

To be able to define benefit breakpoints and cost barriers, I listed benefit factors and cost factors and sorted them based on impact for the user or developer. I found the benefit factors through interviews, observations and literature study. The cost barriers are related to the impact actions have on the development process.

3.7 Validation of Quality Requirements

To validate my results I wanted to put my lists of quality requirements into context. I constructed two models for visualizing and checking the lists. One of them I call the *Matrix Model* and it is used to check which requirements are already being worked with or implemented for a specific application. To check this I constructed a matrix with the requirements and different states for each requirement and then handed the list to the application owner who took responsibility for filling in the matrix. Many people contribute to an application and are stakeholders in fulfilling the requirements so the application owner needed to check with the different stakeholders to be able to fill in the matrix. Based on the results I changed the prioritization of the requirements and could validate that the ones I have chosen are understandable and applicable. I also got quantitative results for how many of the requirements were fulfilled for the specific application and put that in relation to the other model I created - the *Staircase Model*. Read more about the models in chapter 7.

4. Threats to Validity

4.1 Threats to Internal Validity

4.1.1 Interview Validity

When performing interviews at a company, with interview questions regarding the company itself, it is possible that the interviewees are bias or feel influenced by their manager. If this happens the answers from the interview is not valid. To prevent this from happening to my research I chose to interview people from different departments. My interviewees have not been effected by each other in their answers or by me, since I kept an observing and objective attitude and asked open questions. I believe the fact that I am a student, doing a research, made people relaxed and confident during the interviews and that they felt they could be open and honest.

When performing interviews and interacting with people there are natural differences between people that might interact with the variable measured. In my case, the interviews were about learning about Web accessibility and also getting to know the situation at Scania. In the later case people's characteristics might influence the result of the interviews. Appearance, motivation, willingness to participate and attitude are examples of characteristics that could lead to selection bias. To avoid this as much as possible, I tried to choose people that were diverse. I interviewed both women and men, architects and developers, experts and non experts and found people with different variables.

4.1.2 Survey Validity

Another possible threat to internal validity is the fact that the survey had multiple choice questions. A multiple choice questions is open for interpretation and it is impossible to know how the participants interpreted the question and therefore answered. To avoid this threat I added free text answers for clarification to those questions that were open for interpretation. I also clarified questions with examples to emphasize my meaning. One question, for example, was about whether or not the person had a disability and to clarify my definition of a disability I gave a number of examples, such as dyslexia, color blindness, hearing impairment, etc.

Another threat to validity for the survey results is the sampling process. The survey was published through one of Scania's web based communication applications *Inline*. The news article with the

link to the survey is estimated to have reached approximately 8,000 people and out of these 1,004 participated in the survey. The 8k people that saw the news article at the front page of *Inline* do probably represent the Scania workforce relatively well. The people who chose to answer the survey might however be biased. I believe there is a great risk that people with disabilities were more inclined to participate than others. This could explain the high rate of people with sight impairments that the survey result shows.

4.1.3 User Test Validity

When I performed the user testing with two users, one with color blindness and one with no visual disability, I only received two measured points to use with the QUPER model. This makes the result hard to validate and generalize. Possible threats to validity, like the test persons levels of skill in using the testing material can not be disregarded since I only tested two users. Therefore the test results are used only as specific examples than general findings.

4.2 Threats to External Validity

4.2.1 Generalization of Law & Regulations

Regarding law and regulation, which is an important part of this research, it is difficult to generalize the result to be applied to a context outside of Sweden since the law aspect in this report is based on Swedish law. In many cases it can, however, be applicable to other countries that have either similar laws for Web accessibility.

4.2.2 Generalization of Company Workforce

When I conducted the survey and concluded the results I drew conclusions that can be generalized for the Swedish population, since Scania has a diverse work force which correspond pretty well to the population in general. The fact that Scania has a large number of co-workers, working with diverse work tasks, such as production, research and IT, makes a cross section of the work force comparable with a cross section of the Swedish population. What makes the Scania cross section differ from the Swedish population is the uneven sex and age distribution that the survey showed. There is considerable more men than women at Scania and 57% of the people answering my survey were in the ages above 40. If the results from this research were to be applied to another company, with a different work force, for example a young one, with a higher rate of women, the quality requirements for Web accessibility might have to be revised. There are, for example, not as many women with color blindness as men, and older people experience more accessibility troubles than young people do. However, the final recommendations of this project are based on the fact that increasing Web accessibility at a company's internal Web based solutions increase both usability and quality of the applications and improve the user experience for all people, no matter age, gender or disabilities and therefore I argue that the results can be applied to any company that wishes to improve their *Design For All*-focus.

4.2.3 Generalization of Company Values

The recommendations of this research report is based on the fact that Scania is a company with core values that emphasize the importance of inclusion, diversity and quality. To make a difference with Web accessibility it is important to firmly establish an attitude and a mindset in the company culture and strategy. To establish support for the cause, among management and leaders of the company,

is crucial for its success. Scania also has a culture were people are able to take responsibility for a cause and take action to execute it. The combination of motivation, open culture and enabled coworkers are what makes a project like this doable.

4.2.4 Constraints

I might be wrong in some of my generalizations in this research and if so that would be a threat to external validity. To enable the reader in drawing conclusions about the validity of this research I here present the constraints that holds for this particular case. Some conclusions can be generalized beyond these constraints but the result is first and foremost applicable to this context.

The following constraints holds for this research:

- When looking at accessibility I focus only on Web applications and not mobile apps or other platforms. I also do not consider different software tools or browsers but rather different websites.
- A disability is defined as any physical, mental, intellectual or sensory variation which can hinder a person from accessing web content.
- Even though I briefly discuss laws and regulations around the world I have chosen to focus on Swedish law and society.
- To be able to reach different types of disabilities I have chosen to include all of Scania's employees, working at the Södertälje offices. I have not made any constraints regarding department or work tasks of the employees I have interviewed or surveyed. Since I focus on Swedish regulations I have not included any employees working outside of Sweden.
- I do not aim at solving current accessibility problems at Scania but rather come up with guidelines and strategic goals for future sustainable Web development.
- I do not focus on the public website Scania.com but only web applications that are meant for internal use such as file sharing, social media and communication tools.

5. Stakeholders

5.1 Introduction

In this chapter I elicit the stakeholders to this research. When doing a case study at a company about a software requirement process it is important to reach the actual end user of the software. It is also important to motivate the importance of the requirements and anchor the decisions within management of the company. Figure 5.1 shows this master thesis in its context. I have been in

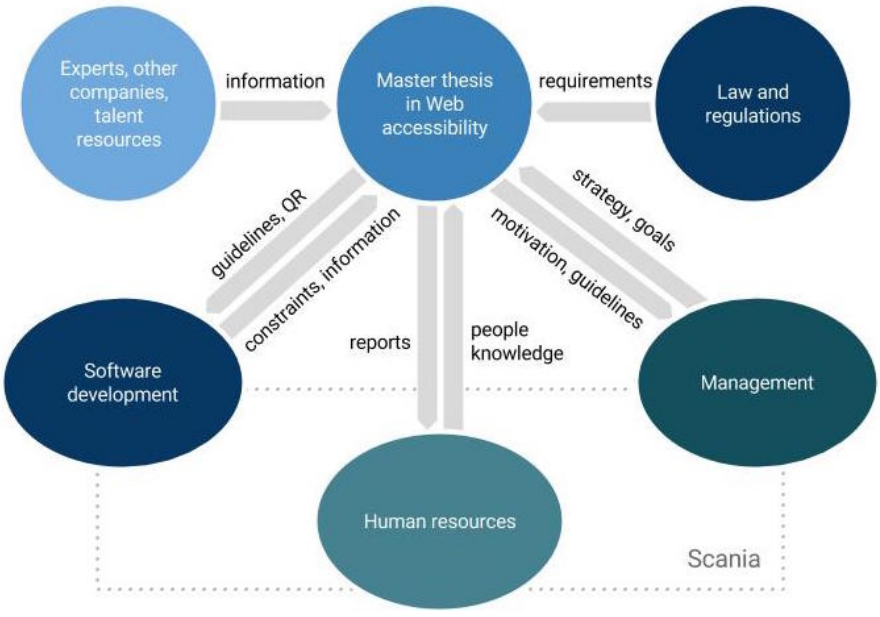


Figure 5.1: Context diagram showing the master thesis project in its context.

contact with the HR department at Scania to ensure the correctness of the research process and communication with employees and coworkers. In this chapter I also present the Swedish laws and

regulations regarding WA and I also elicit the human resources that Scania needs and how those relate to WA.

5.2 Scania

Scania is a major automotive industry manufacturer of commercial vehicles, specifically heavy trucks and buses, and has 44,000 employees in 100 countries around the world (Scania Group 2016b). Scania was founded in 1891 and has a culture of innovation which has made it one of the world's leading manufacturers of heavy trucks and buses. Figure 5.2 shows an old Scania office.

The corporate group has a wide variety of different areas of operation for conducting business affairs, selling products and services, and providing support to the organization. These are placed strategically where the customer need is.

Research and Development operations are based in Södertälje, with some 3,500 employees. Scania's aim is to use customers' specific needs to develop high-quality products, services and solutions with short lead times.

5.2.1 Scania Core Values

CUSTOMER FIRST, RESPECT FOR THE INDIVIDUAL and QUALITY are the core values of Scania's entire corporate culture, leadership, business success and day-to-day work (Scania Group 2016a). These core values are supposed to be the point of departure for all business development and tie the company together.

Among other things, the core values means:

- Recognizing and utilizing each employee.
- Ensure higher quality, efficiency and job satisfaction.
- Delivery of high-quality solutions from Scania, through good knowledge of customers' needs.
- Deviations from targets and standards are used as a valuable source of continuous improvement in Scania's processes.

Figure 5.2: An old office at Scania. Photo: Scania Archive 1943. ©Scania CV AB

5.2.2 Channels within the Organization (Scania Group 2016b)

Communications

Scania's communication activities aim to support the business by spreading knowledge about the company and the industry, primarily to customers and employees but also to other target audiences.

Promoting Scania's brand and core values, Scania's communications specialists work both within the company's central organization and globally, in cooperation with all markets. Other tasks include coordinating communications operations, managing press and media relationships,

maintaining contact with decision makers, competitive intelligence, business intelligence and market analysis, coordinating activities at trade shows, and organizing events like press conferences and driver competitions.

Research & Development

Scania has a strong focus on Research and Development in order to remain at the cutting edge of technology and drive development within the industry.

The focus is on sustainable solutions and minimal climate impacts. Every detail within the area of design, construction, and systems is continually being improved in order to meet demands from the community and customers. The area of R&D covers the whole chain from the underlying research, construction and testing through to quality assurance within production and in customer vehicles in service on the world's roads. Our aim is to maintain a broad competence so that we can ensure that Scania retains its leading position within the automotive industry.

Production & Logistics

Production offers the opportunity for you to challenge yourself and the people around to constantly search for smarter and better ways of working. Continuous improvement is a natural part of day-to-day activities.

Scania has production facilities in Europe and Latin America and assembly plants in Africa and Asia. The strategy is to work with continuous improvements in order to minimize workplace injuries, increase efficiency and develop working methods. All employees contribute to the improvement work, something that generates both engagement and pride.

Purchasing

Scania's strategy to be the leader in sustainable transport demands a sustainable approach across the whole supply chain. Consequently, purchasing plays a crucial role in the company's global development.

Scania Global Purchasing is responsible for the company's purchases of parts and components, both newly developed ones and those already in production, as well as of spare parts and non-automotive products and services.

Sales & Marketing

Scania's sales organization spans the entire company, with a presence in over 100 countries. While the central marketing department in Södertälje handles comprehensive analysis, strategy and method development, some 95 percent of sales occur outside Sweden.

Scania gains insights into different client needs through close customer contact, in turn driving Scania's product development and benefiting the end customer. Scania's relationship with its customers spans the entire life of the vehicle, with the actual sale just the starting point. The service market is a growing segment, and Scania stands ready to support customers, keeping them up to date with news and new services.

Finance & Business Control

The economic perspective is crucial for running an efficient organization. Scania's finance organization actively supports the whole company and is involved in all parts of the business, playing a key role in daily operations.

Employees within financial services work in a broad range of areas, including accounting, financial controlling, finance and credit analysis. They have a range of specializations and can be

found in the company's operations across the world. The job of finance employees is to provide an economic perspective throughout all processes, from product development to delivering the finished product and providing services. Employees within this area have an opportunity to influence decisions within their various areas and contribute to the sustainability of Scania, both as company and as an employer. In other words they enable better business.

Human Resources

Work within Human Resources is conducted in line with defined processes and in close collaboration with the organization. Each local area has dedicated resources working alongside managers and offering expertise within HR. The focus is on developing both the organization and its employees.

The work of Human Resources has a cross-functional focus, aiming to support Scania's managers in their roles as employers. Every manager is responsible for their staff, and has the support of both local and central HR resources. The central organization specializes in areas such as recruitment, labor law and competence development. In addition there are specialists working with health, safety and work environment.. Salary and personnel administration are also examples of central HR functions.

IT

IT is an integrated part of Scania's core business. As a result there is an IT organization tied to all our production sites around the world.

Global responsibility for development, operation and support is based in Södertälje, from where cross-functional assignments are initiated and coordinated. IT activities are carried out by the corporate unit Scania IT, whose main job is to deliver and develop IT services for both products and the operation.

Industrial Maintenance

Industrial Maintenance range from production maintenance and facility management, to running industrial projects. The service work close to Scania's core business and ensures the productions process efficiency and profitability. Industrial Maintenance make sure that investments are used in a productive and cost-effective way as well as suggests and implements future complete technical solutions, having expertise within automation, control and regulation, electrical installations and HVAC.

Safety, Health & Environment

Scania works actively across its global organization to create safe workplaces and to minimize its environmental impacts.

Central resources support the entire organization, working together with local operations within our business and production units. With focus on the needs of the business our experts in the area engage in active dialogue with different levels of the organization. The work is done cross functionally in teams that are put together to ensure broad competence.

5.3 Swedish Law

In a press release by the Swedish Discrimination Ombudsman (Diskrimineringsombudsmannen 2015), the new discrimination act and its consequences for accessibility is being discussed. There is an increased interest for how to improve accessibility within different areas, even though there has

not yet been any legal charges for this kind of discrimination. There are more ways to achieve better accessibility than to take cases to court.

According to the Swedish discrimination act, discrimination can be defined as inadequate accessibility which is defined as follows:

> ***Inadequate accessibility**: that a person with disability is disadvantaged through a failure to take measures for accessibility to enable the person to come into a situation comparable with that of persons without this disability where such measures are reasonable on the basis of accessibility requirements in laws and other statutes, and with consideration to the financial and practical conditions, the duration and nature of the relationship or contact between the operator and the individual and other circumstances of relevance.* (Diskrimineringsombudsmannen 2008)

In Article 9 of the FN Convention about Rights for People with Disabilities, the meaning of accessibility is that everyone should be able to use something, participate and achieve information in a way that suits their needs. The Swedish state shall make sure that information and services are accessible and that there are rules for what accessible means. People with disabilities should have the same right to work as everyone else and the Swedish state should make sure that no one is discriminated because of disabilities (Regeringskansliet 2016).

The Swedish Post and Telecom Authority (PTS) monitors the electronic communications and postal sectors in Sweden. PTS have established guidelines for public sector websites in Sweden. At the highest priority is the guideline to follow the Web Content Accessibility Guidelines (WCAG) to make websites, content and services accessible to a wide range of people (Webbriktlinjer 2016).

> *This maximizes the return of the resources you put into web development and at the same time increase inclusion of everyone.* (Webbriktlinjer 2016)

5.3.1 Human Right

Accessibility is a human right, according to the United Nations (Regeringskansliet 2016). Accessibility is part of a sustainable social development. According to guidelines from the Committee on the Rights of Persons with Disabilities (2014) new products and services should be developed to achieve a universal standard and actions should be taken to ensure the accessibility of people with disabilities. There are official guidelines for Web development (United Nations 2014), established by the Swedish e-delegation, which recommends the following of the standard WCAG 2.0, level AA.

As from January 2010 all new EUROPA websites have to be created in compliance with WCAG 2.0, level AA.

5.4 Competence Resources

The project aim is to improve the internal web based solutions for Scania intranet. The end user of these websites are the people working at Scania, i.e. the human resources of Scania. Part of Scania's core values is the employee focus. Scania emphasizes the importance of attracting and retaining competent people and finding talents to make long term investments in (Scania Group 2016b).

5.4.1 Employees

In a report by Unionen, one of the largest trade unions in Sweden, information about the effect of functional IT systems is presented (Unionen 2014). During the period 5-20 November 2013, 2033

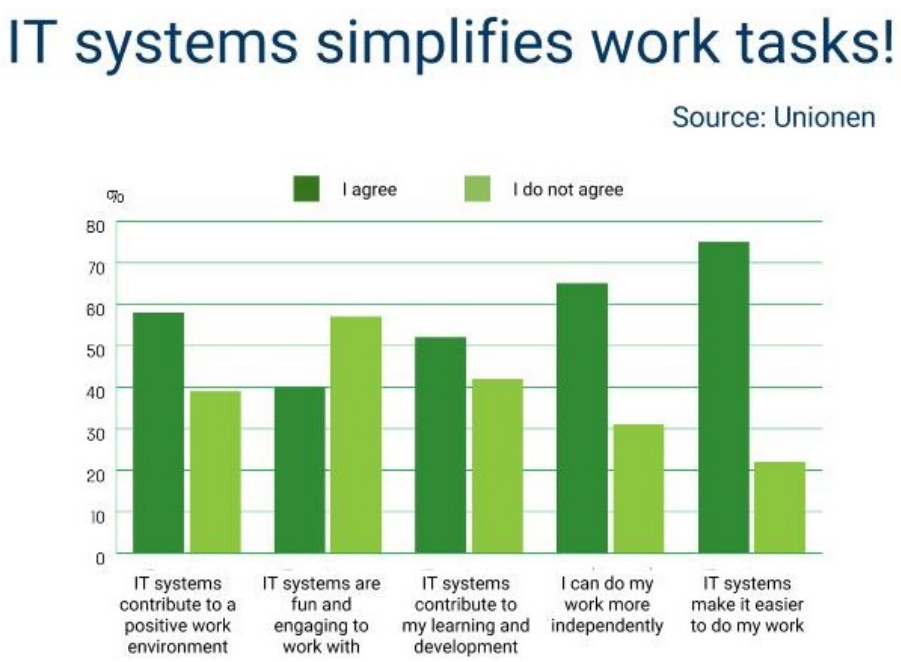


Figure 5.3: A study by Unionen shows that functional IT systems make is easier for people to do their work.

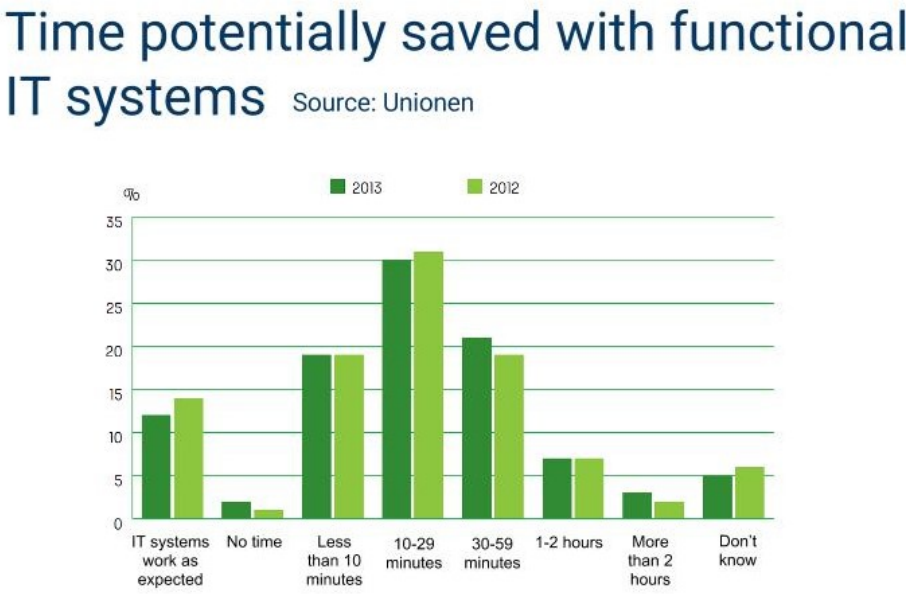


Figure 5.4: A study by Unionen shows that people can potentially save, in average, 26.5 minutes each day if the IT systems functioned properly.

workers in the private sector participated in the research. Parts of the result are presented in Figure 5.3 and Figure 5.4. In Figure 5.3, it is clear that functional IT systems could improve work efficiency. 3 out of 4 feel the IT systems simplifies their daily work (Figure 5.3). Also 1 of 3 does not think the

IT systems contribute to the ability to work independent.

Secondly, in Figure 5.4, there are results that show what potential amount of time the working participants could save if their IT systems were functional (Figure 5.4). The average amount of time that a person would possibly save was 26.5 minutes.

5.4.2 Talents

Statistics from Stockholm University (Studera Med Funktionshinder 2016) shows the number of registered students with disabilities from 2009 to 2015 (Figure 5.5). What we can see is that the number of students with disabilities is significantly increasing which could be the result of better assistive technologies that enables people with disabilities to be able to attend higher levels of education. This is competent people who will apply for qualified jobs and represent a talent resource.

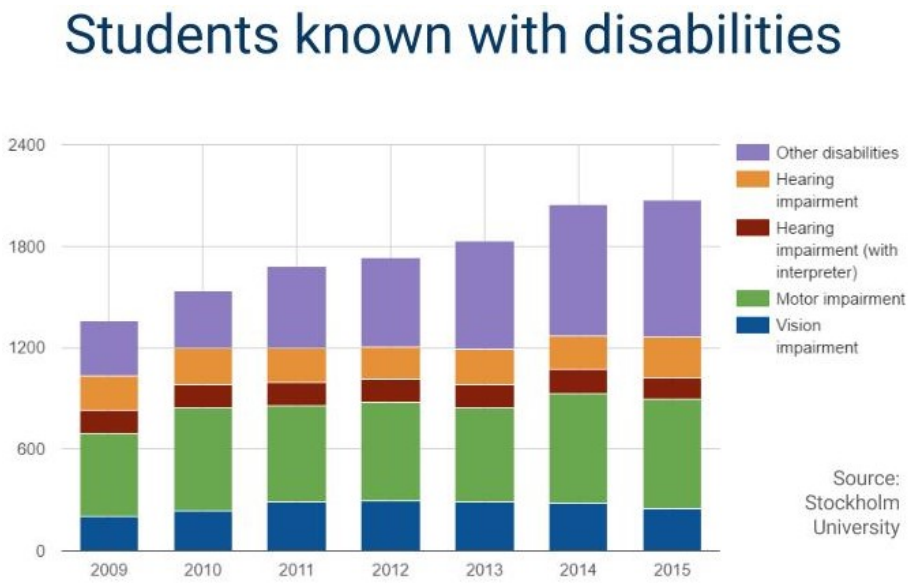


Figure 5.5: Statistics of the number of students registered with a disability from 2009 to 2015. The colors represent different types of disabilities.

According to a prognosis by the Swedish employment office, we will see a lack of workforce in Sweden in the near future. Especially engineers and computer scientists will be highly attractive on the talent market. Companies will have to find inventive ways of finding and hiring talents, like looking abroad or reaching a broader range of people in Sweden (Arbetsförmedlingen 2012).

5.4.3 User Story

> *"Sometimes I have no problem distinguishing colors because of the high contrast or because I know that bricks on a house more often are red than green. But too often, using web applications, I experienced red and green mixed together or color coding that makes me unsure of the meaning."*
> - Color blind end user

I have interviewed an end user of Scania's interactive web services. He works as a senior engineer with software processes, at the R&D department. He is color blind and can not tell the

difference between red and green. 8% of the male, Swedish population has this vision impairment (National Institutes of Health 2016).

The user tells me about his accessibility problems and I understand this is something that bothers him on a daily basis. The main issue is that he is afraid he will miss something because of the color blindness. He never knows if perhaps the button changed from green to red and there is usually no way to find out.

> *"This occurs in every application, everywhere. People make references to the color of the text and I can't see it."*

Since the user is an engineer who works with software processes it was interesting to hear his take on what should be done to improve accessibility: Alternative methods of conveying information must complement color. Change the text, font or the look of a button to indicate a change of state, do not use color coding alone. High contrast is also important.

> *"In every office this is an occurring problem. There are improvements but then the issue is forgotten. If I knew that accessibility was being worked with actively and the quality of the websites at my company held a certain level it would simplify my work. I would never have to wonder weather or not I have missed information because of my color blindness. I wouldn't risk missing something or misinterpret text or buttons."*

6. Result

6.1 Interview Results

The end users for the web based solutions at Scania are the employees and co-workers at Scania. Therefore this research is dependent on input from people working at Scania. The survey with questions for the coworkers is key in this research and to be able to perform it I had to communicate with the HR departments. I have performed interviews both with HR Managers at Scania IT as well as other departments. The interviewees are listed in Table 6.1.

The questions leading these discussion-like interviews can be found at the subsection 3.3.

ID	Name	Role/Title	Company	Date	Time [min]
I1	Ingvor Hoffström	Head of Human Resources	Scania IT	09/02/2016	30
I2	Sofia Vahlne	Head of Labor Affairs	Scania	18/02/2016	30
I3	Jesper Karlsson	Lead UX Designer	Scania IT	09/02/2016	15
I4	Daniel Bergman	Enterprise Architect	Scania IT	10/02/2016	35
I5	Eva-Lena Svensson	Enterprise Architect	Scania IT	10/02/2016	35
I6	Kirsten Rassmus-Gröhn	Associate Professor	Lund Institute of Technology	15/02/2016	25
I7	Stefan Johansson	Accessibility Expert, PhD Student	Funka, KTH	26/02/2016	80
I8	Claes-Göran Carlander	Senior Engineer, R&D	Scania	17/05/2016	15

Table 6.1: Interviewees.

6.1.1 Scania HR

At Scania IT's HR department, Web accessibility is viewed as an important topic. In a group discussion with several interviewees (lead by *I1*), it was highlighted how little information the company keeps about its employees in terms of disabilities or health problems. It is a confidentiality matter and the company can not keep such records because of the Swedish law.

From discussing legal matters regarding my survey with the central HR department at Scania (*I2*), I got approval of the survey I was about to send out. I got referred to a Steering Group Meeting with HR managers at different channels of Scania to be able further validate the survey. Meeting with the HR Steering Committee gave me final inputs on my survey and also gave me the approval of key persons in the Scania organization so that the survey could be sent out without complications.

> *"We work a lot with our employer brand and this question is important. Performing this survey checks Scania's accessibility work in a proactive way, which is good."*
> - Sofia Vahlne, Head of Labor Affairs.

6.1.2 Scania IT

At Scania IT people work closely with web applications and through interview *I3*, *I4* and *I5* I learned how they actually relate to the subject Web Accessibility and also how they, from their perspective, would like to improve in the matter. I got a better understanding of the way information and guidelines, regarding web development, flows in the organization so that I know how to present my own results. I also learned what kind of problems these people, working with IT solutions, have experienced related to Web accessibility.

Interview *I3* was with a Lead UX Designer who works closely with end users of internal web applications. These end users sometimes experience accessibility problems such as bad color contrasts or too similar labels and buttons. There is no one who actively works with WA but when a problem arises the team deals with it the best they can, always keeping in mind that the end user is the judge of quality.

The most common WA problem apparently relates to visual impairments and solutions include adjusted contrast, size and color. The problem is that these solutions can conflict with disabilities such as dyslexia and so the best solutions is to implement adjustable settings.

Through interview *I4* and *I5* I learned, also from an architect perspective, that there is little active work being done that has to do directly with WA.

> *"If any company would focus on this question it is Scania. We have a great employee policy and the right mindset to work with this kind of question."*
> - Daniel Bergman, Enterprise Architect.

I learned that Scania is moving towards focusing more on the end users and their actual needs. The problem at Scania is that there are so many different user profiles since Scania consists of very different departments with several web applications and tools that vary. There are challenges in making all IT-solutions accessible since people are unused to follow functional requirements and the different channels have such varying applications.

Another barrier is the way requirements get communicated and maintained. Many of the purchased products are grabbed right out of the box and installed which might cause different users to have different experiences. There are no overall strategy for how this should be done, across the channels of Scania.

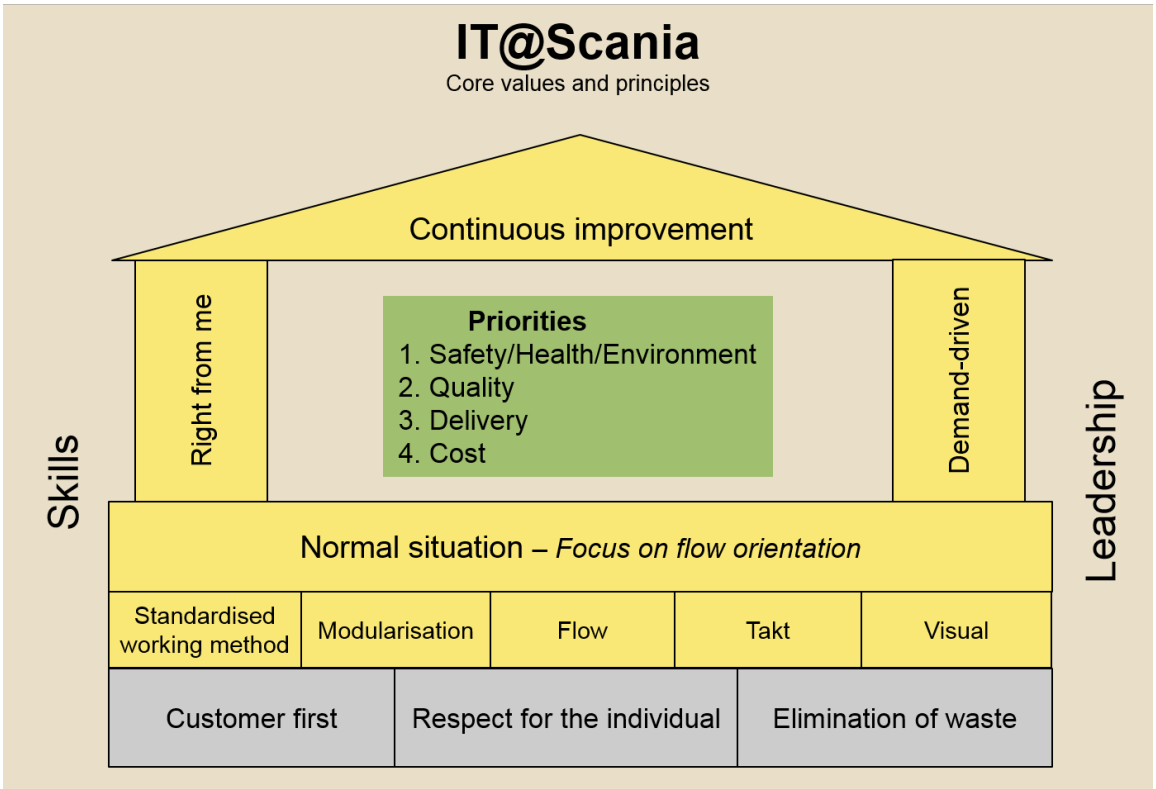


Figure 6.1: Scania IT core values and principles.

6.1.3 Experts in Accessibility

Interview *I6* was conducted with an assistant professor at the Faculty of Engineering at Lund University in Sweden. I learned that I should work informatively to raise the awareness of WA and its impact. It is crucial to make people aware of the benefits from increasing accessibility, not only for people with disabilities but for all people who might experience scenarios out of the ordinary. Like being on a remote sight and using mobile applications.

Interviewee *I7* is a PhD student at KTH Royal Institute of Technology in Cognitive Accessibility and also works at the Web accessibility-company Funka. From this interview I learned about why large Swedish companies should put an effort into WA. By making websites accessible the company becomes flexible and adaptable to people with different circumstances. Many of Funka's clients are companies such as IKEA, VOLVO and SCA. Large companies that are present on a global scale in markets with unique regulations and accessibility barriers. Furthermore these companies have a large number of employees that are above the average age of a Swedish worker which makes accessibility an urgent matter. With age comes more accessibility barriers and it becomes harder to use digital tools because of, often sight or motor, impairments.

R Funka started out as a non profit joint project between disability organizations in Sweden and they are today a market leader within accessibility. Funka works with governmental organizations but also with private corporations experiencing problems with accessibility regulations. *About Funka:* www.funka.com.

> *"With so many employees there are always some with disabilities and there are many problems related to people constantly getting information in a supplemented way. Therefore the intranet should be accessible to everyone."*
> - Stefan Johansson, PhD student in Cognitive Accessibility and Funka employee.

Corporations should focus on WA because it is bad to be seen discriminating in media these days, with accessibility being a hot topic. Swedish companies will realize that because they have a large work force with an average age higher than that of the Swedish population, they will have to find the tools to enable them in performing their work and secure the crucial competence they possess.

> *"Today there are reports showing that people are stressed out or experience pain because of the systems they work with. Inefficiency is bad both because people get stressed and ill but also bad for the economy of the company. This makes me believe that companies will work more with accessibility in the near future."*
> - Stefan Johansson, PhD student in Accessibility and Funka employee.

Lack of awareness is the largest barrier of WA. External websites often get a greater accessibility focus while intranets get forgotten even though the same disabilities are present among co-workers. When the awareness barrier is overcome there is often a lack of competence and consistency. There is no need to implement an accessibility focus in only one project. There has to be consistent improvement and maintenance.

6.2 Survey Result

The exact survey questions and answers are presented in Appendix A. Here follows a conclusion of the survey results with the answers that are relevant to the study.

In total, I managed to get 1,004 answers on the survey, from Scania coworkers. This represents a hit rate of 13%, since I estimate that the news article about my survey reached about 8,000 people.

I have concluded the statistics in a more visual way in the master thesis presentation that can be found in the git repository that goes with this report.

Git repository for the master thesis project. Including report and all visual material used in the presentation. https://backlnd@bitbucket.org/backlnd/webaccessibility.git.

6.2.1 An Old Workforce

57% of the Scania coworkers are over the age of 40. According to SCB, the average age of employed people in the labor register is 41 (Statistics Sweden 2016).

6.2.2 Time Spent in front of Web Applications

43% of the participants spend more than 30% (equal to 2.4 hours a day) of their working time in front of webbased solutions.

6.2.3 People Experience Problems

74% of the participants experience problems with either navigating or understanding any of Scania's common web based solutions *Inline*, *Agora*, *Team Room*, *Scania For Me* or *Easy 2 Buy*.

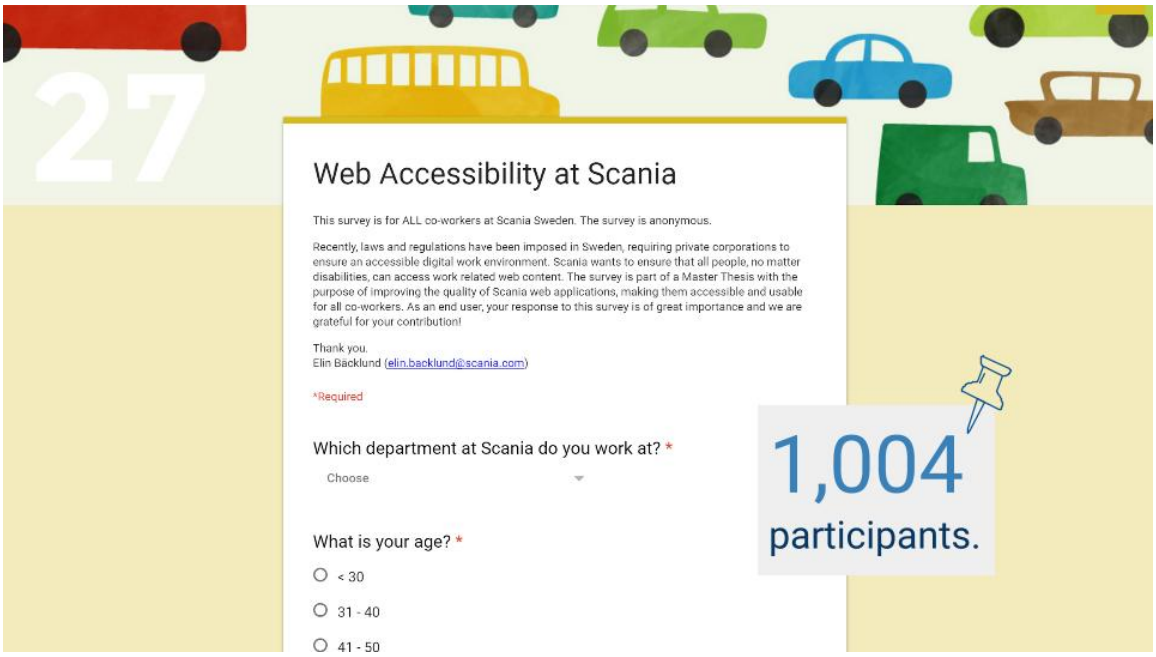


Figure 6.2: Screen shot of the online survey with the number of participants added.

6.2.4 People have Disabilities

Disabilities are clearly present among Scania coworkers. 8.3% of the people who answered consider themselves to have a disability. The top three present disabilities were sight impairment or color blindness (50%), dyslexia (22%) and hearing impairment (11%).

The survey participants who answered that they had a disability also got to rate how much their disability hindered them in their daily work. On a scale 1-5, 35% chose 2 or higher, implying that they are somewhat hindered by their disability. 11% of people with disabilities rate their problems 3 or higher on the same scale, implying that they experience significant accessibility problems.

Here are some quotes from the free text answers of coworkers with disabilities (translated from Swedish to English), that further specify the problems they experience:

> *"It is hard to read from the small phone screens that are allowed. All it takes is age related vision impairment for problems to arise."*
> - R&D, sight impairment, hindered 3/5 in his/her daily work.

> *"Huge problems with light backgrounds, it makes the text blurry. A dark background works much better."*
> - Scania IT, sight impairment, hindered 4/5 in his/her daily work.

> *"Small text sizes can be hard to read."*
> - R&D, sight impairment, hindered 1/5 in his/her daily work.

> *"If the text body is too long I loose focus and sometimes I have to put extra effort into understanding. As a result I sometimes become very tired."*
> - R&D, dyslexia, hindered 2/5 in his/her daily work.

"As soon as there are references to colored buttons, symbols or text, there are possible problems."
- R&D, colorblind, hindered 3/5 in his/her daily work.

"Some IT systems lack support for spell checking."
- R&D, neuropsychiatric disability, hindered 2/5 in his/her daily work.

"I am color blind and can't see some colors/shades."
- R&D, color blind, hindered 1/5 in his/her daily work.

6.2.5 Inaccessible Websites

From the survey I learned that Scania coworkers find both *Inline*, *Team Room* and *Agora* hard to navigate, when used. These are three of Scania's most common intranet applications. 45% of the participants think *Inline* and *Team Room* are hard to navigate and 34% think *Agora* is hard to navigate.

The website Scania For Me however, is easy to use, according to 83% of the participants.

6.2.6 Accessibility Matters

86% of the survey participants rated the importance of Web accessibility 4 or higher on a scale 1-5, where 5 was labeled very important. Apparently WA is an important issue, also according to the end user of Scania Web based solution.

6.3 User Test Result

I asked a color blind user to determine the number of wins and losses of the team *Swansea* during the last 10 games, using a website with football results that show a simplified view of the result and use green and red color coding. Part of the website is showed in Figure 6.3. It is possible to read the result instead of determining from the colors by hovering over the colored square but that takes longer time than just counting colors. I measured the time it took for the test person to perform the test and give the right answer. The result is shown in Table 6.2.

Figure 6.3:

I also had a user with no visual impairment take the test while I measured the time it took. The result of the tests are shown i Table 6.2.

I have put the number of seconds it took for the test persons to perform the task on the horizontal axis of the QUPER benefit model, shown in Figure 6.4. Here we can see the test results from Table

User	Visual Disability	Time [s]
1	Color blind	42
2	None	15

Table 6.2: User test: determine the number of wins and losses of the last 10 games played by Swansea.

6.2 in the QUPER model and notice that while the website is accessible to the person with no visual impairment it is only useful to the color blind user.

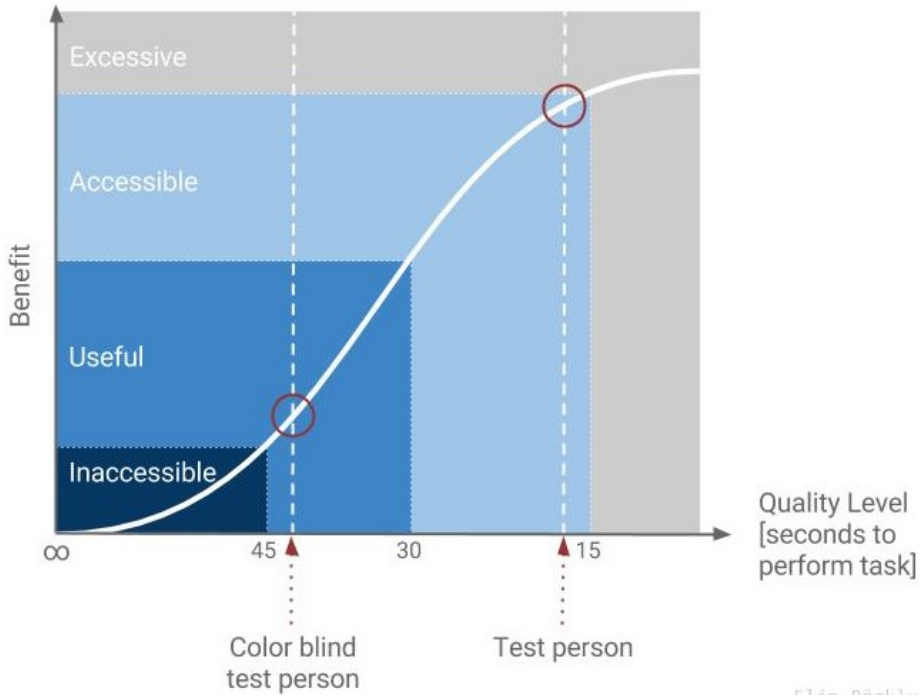


Figure 6.4: Test results from two users marked in the QUPER accessibility model. Horizontal axis showing quality level in number of seconds.

6.4 Accessibility Quality Requirements

The result of my research show that there are requirements for how accessible public, official websites need to be. There are no laws that force internal websites at private corporations to be accessible. However, due to the recent discrimination act (Diskrimineringsombudsmannen 2008) there could be cases of discrimination if no action is taken to ensure accessibility at work places.

It is clear that accessibility is closely related to usability and when it comes to quality requirements for functional websites these two attributes go hand in hand. It is hard to have accessible solutions if they are not usable.

7. Analysis & Discussion

7.1 The importance of WA

The answer to question Q2: **Is there a reason for Scania to work with Web accessibility in their internal communication, now and in the future?** (Table 1.1) is that there definitely are reasons for Scania to focus on and work with WA and the motivation is found below.

Making the Web accessible to people with disabilities, by eliminating accessibility obstacles and barriers, will improve efficiency, equality and participation. Improvement of accessibility improves quality and usually also everyone's experience. Also, improving Web accessibility creates economic gains for businesses since it enables corporations to reach both more customers as well as a larger competence base. As already mentioned in section 2.3.1, accessibility is a hot topic, discussed on an EU level. Because of the explosive growth in on-line information many people risk exclusion without accessible solutions. I discuss the monetary benefits from working with WA in section 7.1.1. In section 7.1.2 I motivate why increasing WA increase the possibility to find more talents to invest in.

The meaning of accessibility is to include everyone and enable everyone, no matter abilities, to access Web content. Companies should connect their accessibility work with their social responsibility to prevent discrimination and reach all stakeholders. It is important to establish a sustainable development early on and depart from the fact that all people have different needs, conditions and requirements, no matter target group. At Scania this is something that should be highly prioritized due to company core values (5.2.1), which for instance emphasize a quality focused mind set and respect for the individual. The meaning of the core values are *Recognizing and utilizing each employee*, *Ensure higher quality, efficiency and job satisfaction* and *Deviation from targets and standards are used as a valuable source of continuous improvement in Scania's process*. Working with WA fits well into the continuous improvement and concern for coworkers that Scania tries to obtain.

The most relevant reason to work more with Web accessibility is perhaps the increased efficiency. As I discuss in my Business Case there is money to be saved from increasing functionality of websites, especially for companies where employees work a lot with web applications. According to

my survey, 43% of Scania coworkers spend *more* than 2.4 hours a day in front of web based solutions. By increasing accessibility the functionality of the websites increase for everyone. As better lighting in an office benefits all people, no matter sight impairment or not, so does better accessibility on the Web benefit everyone. Simple navigation for example, is a feature that increase efficiency in every condition.

7.1.1 Business Case

I have used the results from the Unionen research presented in Figure 5.4. Since 26.5 minutes can be saved, per employee, per day, by creating functional websites calculated how much money Scania, with its 44k employees, could possibly save in money. The calculation is mainly to highlight the fact that there is business value in working with the quality of the internal websites.

Average time potentially saved per day	26.5 minutes = 0.44 hours
Number of employees at Scania	44,000
Cost per hour (average for member in Unionen, incl. Employer fees and insurance)	176 kr
Number of working days/year	220 days
Sum	**750,000,000 kr / year**

Table 7.1: Potential savings from creating functional IT systems.

The results of my calculations can be seen in Table 7.1. In the calculation I fetched data regarding the cost of an employee from the average Union member. Based on the fact that Scania has 44k employees and that each employee costs 176 kr/hour Scania could possibly save 750M kr a year from making internal web based solutions fully functioning.

The functionality is measured based on user satisfaction and relates to both usability and accessibility. In the QUPER model (section 2.5.1) benefit is presented as a function of quality level. In Figure 2.2 the competitive area represents the area were the quality level is high enough that websites can be considered functional.

7.1.2 Talent Search

According to a prognosis by the Swedish employment office, we will see a lack of workforce in Sweden in the near future (Arbetsförmedlingen 2012). Investing more in talents is already part of the Scania strategy and many other companies as well. Finding talent, especially engineers and computer scientists, will become harder and harder in the near future and it is important to include every competent person in the pool of candidates to optimize the probability of finding the crucial talents. Based on the part of my stakeholder analysis that is about students and data presented in Figure 5.5, I draw the conclusion that since there are a clear increase in the number of disabled students at university leveled educations, accessibility at the work space will enable companies to include more people in their talent search.

7.2 Regulations and Requirements from Society

Q3: What requirements are there from the Swedish law and from the society? (Table 1.1). This question is about the WA regulations in Sweden. From performing my research and talking to

experts in the matter I have found out what requirements exists and probably will come in the near future.

Regarding the Swedish law for accessibility it is today mainly focused on official websites. The recent update to the Swedish Discrimination Act states that an organization which acts within areas where there is a prohibition against discrimination must take appropriate action to ensure accessibility (Diskrimineringsombudsmannen 2008). It is still however unclear what this law actually means. The new discrimination act shows the interest for the accessibility matter and follows EU directives to harden the regulations for this kind of discrimination. Today, countries like USA and Norway are ahead of Sweden in their accessibility regulations. The U.S. Department of Justice expects that USA will see regulations of web accessibility for private sector websites in 2018 (Yerkes 2016). It is only a matter of time before Swedish law is sharpened even more and actions are taken to make sure that also private companies comply with the law.

7.3 Design for All

For a website to be functional to the user it needs to be usable and accessible by the user. As mentioned in section 2.4, usability and accessibility are closely related and both keys to success for a functional website. Because of the overlapping areas, an accessible website builds on usability of the website. I attended the yearly Funka Accessibility conference in Stockholm where the connection between usability and accessibility was a returning theme.

> *"Usability and accessibility are twins separated at birth."*
> - Whitney Quesenbery, Center for Civic Design

Many of the actions for improving web accessibility also improve usability. Usability is especially improved for older users or people who use assistive technologies. According to my survey (6.2), 57% of Scania coworkers are over the age of 40 and 2.7% use assistive technology, such as hearing aid or screen reader. The fact that Scania has a work force which is old, compared to the average age of a Swedish worker, is motivation enough to work with web accessibility and make sure it becomes a part of the company culture. The value of people that have been at the company many years and hold great competence is vital and should be cared for. Without websites that are designed for all, older people will become inefficient in their work and important knowledge might be lost.

Improving accessibility does not only improve the user experience for people with disabilities but are often more general usability principles and improve the experience for everyone. It is like improving lighting in an office space, it does not only improve the working environment for people with bad sight but for every person in the room. Creating a website that can be navigated without a mouse benefits people with motor disabilities but is also general usability. Combining usability and accessibility to improve user experience for everyone is called *Universal Design* or *Design for All* (Web Accessibility Initiative 2010).

> *Time users waste being lost on your intranet or pondering difficult instructions is money you waste by paying them to be at work without getting work done.* (Nielsen 2003)

7.4 Web Accessibility at Scania

7.4.1 Current Situation

To answer question Q1: **How does a large Swedish enterprise, such as Scania, deal with Web accessibility in their internal communication, now and in the future?**, I performed the case

study at Scania. Through interviewing UX designers, architects and HR people (Table 6.1) I got a better understanding of how thorough their work with Web accessibility is. When interviewing people at Scania no one answered *Yes* to the question *Do you work actively with WA?*. However, it was obvious that the incentive to work more with WA is present and that WA is a matter that comes up regularly and is then dealt with. I did not perceive any resistance towards working more with WA but rather excitement and a positive attitude. People at this kind of company can relate to the subject of WA. Accessibility has been worked with at physical work environments and people understand the importance of inclusion. The current WA situation at Scania is not great and there is room for improvement, but there is also a positive attitude towards change and improvement. 86% of the participants of my survey think Web accessibility is an important issue. The Scania culture, where people take initiatives and work for continuous improvement indicate that the situation will improve soon.

7.4.2 Success Factors

There are four dimensions (Figure 7.1) motivating working with Web Accessibility at a large corporation, such as Scania. The four dimensions are *Economic, Social, Technical* and *Company Core Values*. It is important to motivate working with the issue in all these dimensions so that the work can become permanent within the organization and anchored both in management as well as development strategy. By identifying the dimensions of the problem and the stakeholders involved, the results of this research can reach the right target and make a difference.

The economic factor to working with accessibility is the capital and financial values of accessibility-related software qualities. Accessibility requirements should be included in traditional quality requirements such as performance, usability, security and maintainability.

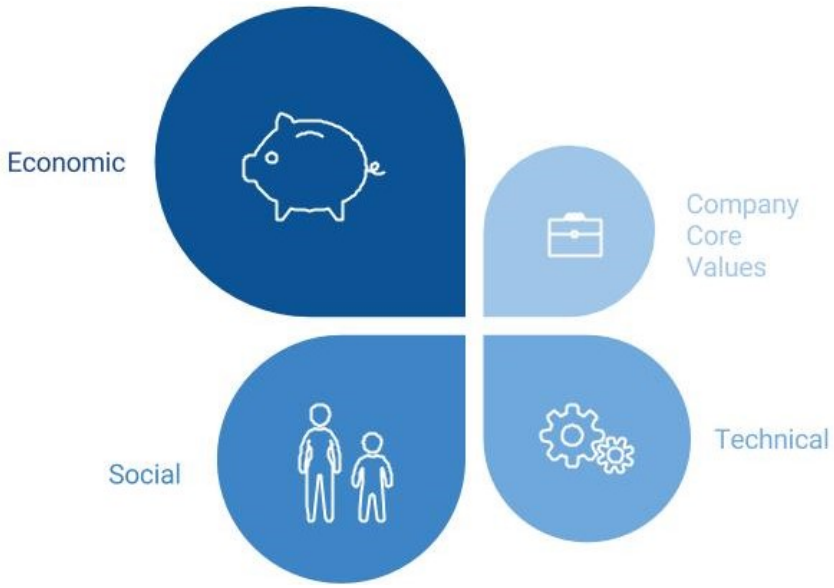


Figure 7.1: The four dimensions of Web Accessibility at Scania.

To answer question Q4: **Which key success factors are there for making web based solutions functional and accessible?** (Table 1.1) I have produced a list with key success factors for improving web accessibility at Scania:

- Combine usability and accessibility in software architecture and development. Follow standards.
- Make someone responsible and integrate accessibility in the company culture.
- Establish accessibility quality requirements for in-house development and purchased products.
- Acknowledge the fact that Scania has a work force with a high average age and with crucial competence, that needs functional and accessible websites to perform their tasks.
- Realize the economic gain from creating high quality, functional and accessible web based solutions for internal tools.
- Design for All and clearly define the user. Follow up how the websites are used.
- Plan for accessible websites early and also for easy maintenance, Web accessibility will only become more important.

7.4.3 Statistics

According to Funka, there are 1.3-1.8 million people in Sweden with disabilities (Funka 2016), depending on what the result is grounded on. 1.3 million people represent about 13% of the Swedish population. According to my survey, 8.4% of the Scania work force perceive that they have a disability. Out of the participants with disabilities, 31% have a visual impairment which make those with visual impairment consist of 2.6% of the Scania workforce. Comparing this to the Swedish population which has only 0.8% people with visual impairments (Statistics Sweden 2014) it is clear that the number from the survey is high. There are a number of reasons why this number is higher at Scania than in the general population. Since age is correlated with impaired physical abilities (European Agency for Safety and Health at Work 2016), the mean age of the participants of the survey might increase the number of visual impairments that the survey result shows. Also, a reason why my survey shows results that differ from the Swedish population, might be that people with disabilities were more eager to participate in the survey than those who do not have a disability and so the number of people with disabilities would be disproportionate and misleading. I discuss this more under Threats to Validity (Chapter 4).

7.5 QUPER Model for Accessibility

I have modified the QUPER model a little to fit my accessibility perspective. Figure 7.2 shows the modified benefit graph. I have replaced *useless* with *inaccessible* and *competitive* with *accessible*. So for my analysis I have new quality levels to refer to.

The modifications to the QUPER model clarifies the connection between usability and accessibility and that a website needs to be both usable and accessible to have a high quality and be functional.

I validated the use of the QUPER model when evaluating accessibility of websites by performing user tests (presented in chapter 6). It shows that the model is useful for visualizing quality level as a function of a quantifiable result. In my case the quality parameter is *time to complete a task* and the quality can be plotted as a function of the number of seconds. Depending on the time it takes to perform the task a quality level can be determined. The proportions on the horizontal axis needs to be adjusted to fit the context of the experiment. If a website is perceived as accessible and usable to the user then the time it takes for that user to perform a task can be put as a threshold for the saturation break point and any other test result can be analyzed in relation to the threshold value.

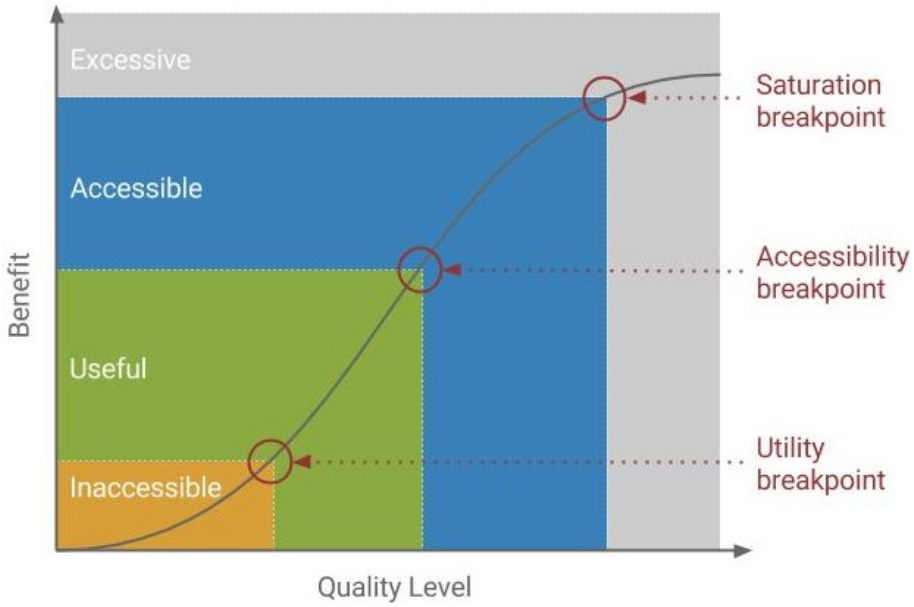


Figure 7.2: The QUPER benefit graph, modified to fit the accessibility perspective.

7.6 Quality Requirements

I have grouped requirements into four levels of quality. The goal with these requirements is to create high quality web based solutions for internal communication that are accessible and usable by people with the widest possible range of abilities, operating within the widest possible range of solutions.

The requirements I present in Table 7.2, 7.3, 7.4 and 7.5, are based on WCAG 2.0, level AA, which is the standard that is required by EU (section 2.3.2), but I have not included all of the requirements from the standard. The problem with WCAG and W3C (World Wide Web Consortium), which has developed the guidelines, is that it is broad and far reaching. The website itself is not a good example of an usable or accessible site and the guidelines can be hard to understand and put into context.

I have added requirements based on some of the guidelines that Funka has published (Funka Nu AB 2012) and also guidelines from PTS (Webbriktlinjer 2016). These two companies work a lot with interpreting WCAG 2.0 and prioritizing the requirements to fit user needs. However, their target group of websites are public websites, especially governmental ones but occasionally private, public websites. Since this master thesis targets internal websites at a private company the requirements need to be revised to fit Scania's needs. I discuss the differences between public and internal websites in section 7.6.1.

R The Swedish Post and Telecom Authority (PTS) monitors the electronic communications and postal sectors in Sweden. They have established a set of guidelines for web development. Here you can read more about the guidelines. www.webbriktlinjer.se.

I validated the requirements from the input I got from the survey. Quality requirements *QL1.7* (Table 7.2) ensures that color is not used as the only way to convey information and from one of the free text answers I got in the survey response you can read:

> *"As soon as there are references to colored buttons, symbols or text, there are possible problems."*

This quote is from a participant who is color blind and is quite hindered in his/her daily work because of the disability. This quote validates the importance of *QL1.7*. The user story about a color blind man, presented in section 5.4.3 also validates this requirement about ensuring that color is not the only way to convey information.

QL1.10 (Table 7.2) is about adjusting the website to fit also smaller screens, and this is clearly a functional quality requirements that the user is asking for. Consider this quote from a Scania R&D employed with sight impairment:

> *"It is hard to read from the small phone screens that are allowed. All it takes is age related vision impairment for problems to arise."*

QL2.13 (Table 7.3) refers to writing understandable texts and according to this user, an R&D worker with dyslexia, this is an important fix:

> *"If the text body is too long I loose focus and sometimes I have to put extra effort into understanding. As a result I sometimes become very tired."*

QL3.5 (Table 7.4) states that text should be re-sizable which is important to this user, an R&D worker with sight impairment:

> *"Small text sizes can be hard to read."*

QL4.7 (Table 7.5) emphasize the importance of making adjustable settings for the color of websites. This would be very useful for this Scania IT worker with sight impairment:

> *"Huge problems with light background, it makes the text blurry. A dark background works much better."*

7.6.1 Intranet vs. Public

What defines public websites is first and foremost the user. The user of a public website is a customer who want to know information about the product och service the company offers. Information on the public website is often brief and should be easy to access and understand. The accessibility requirements for public websites are described by WCAG 2.0 AA (Web Accessibility Initiative 2016d).

Looking at internal websites we have another user - the coworker. The coworker visits the internal web based solution to perform a work task and usually does this frequently. The web based solution probably offers necessary tools for the user to do their work. These tools might be complex solutions and involve a lot of information.

Another difference between internal and public applications is the fact that with the internal websites you do not have to consider bad bandwidth or multiple platforms as with the public website. You never know what tools your customer prefers to use, the coworker however, uses the company network and platforms.

These differences have an impact on which requirements get higher priority for internal websites. The quality requirements need to be reconsidered and put into this context to be effective.

7.6.2 Four Levels of Quality

I have divided the quality requirements into four levels. These levels are based on benefit and cost factors. The benefit from making the websites usable and accessible have already been discussed. What I have focused on when creating the levels is the cost barriers for implementing the solutions. Cost barriers are for example: making large changes in software architecture, effect many projects, dealing with hardware constraints, making a major infrastructure change and also the penalty of not implementing the solutions. Based on the penalty cost of not implementing accessibility solutions, I have put the most crucial requirements at level 1. These are also a foundation for implementing more solutions. E.g. to make links accessible they must first be usable (QL1.2, Table 7.2).

To be able to determine the costs of implementing the requirements I have performed an evaluation of an intranet application and the results are presented in the Matrix Model. Using the Matrix Model I was able to re-prioritize the quality requirements and better construct the staircase model to visualize levels of requirement completion as well as which requirements to prioritize in future developing processes.

The four levels of quality are mainly used in the staircase model, to give four stages of prioritization and completion. Jumping from one level to another is comparable with crossing a cost barrier in the QUPER model (Section 2.5.1). The four levels impose an abstraction to a continuous requirements list and simplifies prioritization and visualization.

7.6.3 Matrix Model

To validate the quality requirements I have listed and prioritized I created a matrix of all the quality requirements and six different "states" for each of them. I gave the matrix to an application owner at Scania and asked him to make sure each requirement got evaluated from every stakeholder too see which requirements were fulfilled for a particular application. For each requirement stakeholders could choose one or many of the following "states":

- ☐ We always do this.
- ☐ We sometimes do this.
- ☐ We don't do this but it would be easy to start.
- ☐ This would be hard to implement.
- ☐ This should have low priority.
- ☐ I don't understand what this means.

SiteVision is a module based web publishing platform with tools for making accessible websites. Scania has recently started using SiteVision for publishing websites. www.sitevision.se.

When we did this evaluation for the application *Reflex* (*SiteVision* framework) and for all requirements presented in Tables 7.2-7.5, I concluded that no requirements were hard to understand by any stakeholder. It was also clear that some of the requirements should have lower priority than they did. One example of such a requirement (from Table 7.5) is

QL4.12: Provide information in sign language.

which is an important accessibility requirement but since there are no laws requiring this yet, more people will gain from prioritizing e.g. this requirement (from Table 7.3)

QL2.1: Give understandable error messages and other feedback to the user.

Based on the results from the matrix research I moved quality requirements QL4.12-QL4.17 (Table 7.5) to the fourth and last quality level - the one with lowest priority. This means that they come last in the process but also that when they are fulfilled the websites should be accessible and high quality.

In Figure 8.1 I have visualized the progress of the requirement fulfillment for the *Reflex* application by writing the percentage of fulfilled requirements for each quality level in my staircase model. Observe that the *Reflex* application fulfills some requirements from each quality level which is natural. To continue the development process efficiently the lower steps of the staircase should be prioritized but it is not necessary to complete a step before climbing.

Figure 7.3: Accessibility quality levels in a staircase model. The percentages show the completion of requirements for each quality level, for one of Scania's web based solutions *Reflex*.

7.6.4 Staircase Model

I have constructed the four levels of quality into a staircase model (Figure 7.3) which implies that all the requirements at the first step needs to be fulfilled before the next step can be taken. My intention with this model is not to force the order of requirements and they are not necessarily dependent on each other. The staircase should rather visualize the prioritization of the requirements and the cost barriers. As the staircase is climbed the quality is increased and the website becomes more functional. The steps can be considered cost barriers and it is beneficial to aim at climbing higher using the steps.

7.7 Impact of this Master Thesis

I hope that this research will highlight the penalties of not including everyone and not making websites accessible and also the benefits from doing so. I want to motivate large companies to work more with Web accessibility to make it part of the company culture and iterative processes early. I hope that I with this report can emphasize the benefits from working actively with WA.

ID	Quality Requirement	★	✓
QL1.1	Make information understandable		
QL1.2	Make links, clickable areas and menus usable to everyone	*	X
QL1.3	Position the most important information at the top of the page		X
QL1.4	Write clear and informative headings to structure the information	*	X
QL1.5	Follow standards	*	
QL1.6	Create a flexible layout	*	X
QL1.7	Color is not used as the only way to convey information	*	X
QL1.8	Create headings with h-element	*	X
QL1.9	Use high contrast, follow thresholds from WCAG	*	
QL1.10	Adjust the website to fit also smaller screens		X

Table 7.2: Quality Requirements for websites, Quality Level 1 (first step in the staircase model). The ★-column indicates if the requirement is part of the WCAG 2.0, level AA, requirements. The ✓-column indicates if the requirement is already being implemented for the tested Scania application *Reflex*.

At Scania, I have gotten great feedback from my work and a very positive attitude towards working more with the problem. It will be interesting to see who will take responsibility for working with WA and integrating the quality requirements in development and purchasing. My guess is that accessibility will be paired with usability and that departments working with usability requirements will integrate also accessibility requirements in their specifications.

ID	Quality Requirement	★	✓
QL2.1	Give understandable error messages and other feedback to the user		
QL2.2	Make it easy to contact support		X
QL2.3	Clear link names	*	X
QL2.4	Provide alternative text for audio, images and video	*	X
QL2.5	Label graphic elements, icons and buttons with their reason or function	*	
QL2.6	Give information in other languages than SWE/EN		X
QL2.7	Be consistent in navigation, structure and design	*	X
QL2.8	Make the website readable		X
QL2.9	Create clear and clickable field labels	*	X
QL2.10	Make clear and usable buttons	*	
QL2.11	Make clickable areas large		X
QL2.12	Design clickable objects so that they look clickable		X
QL2.13	Write texts that are easy to understand	*	X
QL2.14	Strive to create a clean design and minimize the unnecessary objects		X

Table 7.3: Quality Requirements for websites, Quality Level 2 (second step in the staircase model). The ★-column indicates if the requirement is part of the WCAG 2.0, level AA, requirements. The ✓-column indicates if the requirement is already being implemented for the tested Scania application *Reflex*.

ID	Quality Requirement	★	✓
QL3.1	Customize the website for many languages		
QL3.2	Use simple navigation concepts and help the user navigate the website	*	X
QL3.3	Each form element must have either a caption or description	*	X
QL3.4	Minimize the number of fields in a form		X
QL3.5	Make text re-sizable	*	X
QL3.6	Group the fields in a form		X
QL3.7	Mark mandatory fields		
QL3.8	Don't use frames in web interfaces		
QL3.9	Use word and phrases in a consistent way		X
QL3.10	Use known icons		X
QL3.12	Show a progress bar		
QL3.13	Integrate external services so that they blend in		X
QL3.14	Never underline text that is not a link		X
QL3.15	Make sure the back-button works		
QL3.16	No keyboard traps	*	X

Table 7.4: Quality Requirements for websites, Quality Level 3 (third step in the staircase model). The ★-column indicates if the requirement is part of the WCAG 2.0, level AA, requirements. The ✓-column indicates if the requirement is already being implemented for the tested Scania application *Reflex*.

ID	Quality Requirement	★	✓
QL4.1	Choose names for documents that are descriptive of the content		
QL4.2	High quality translations		
QL4.3	Mention who is content manager of the site		
QL4.4	Use the start page to give information about the website	*	
QL4.5	Offer multiple ways of navigation	*	X
QL4.6	Make it possible to navigate with control buttons and keyboard	*	
QL4.7	Provide settings for inverted colors and for changing the font	*	
QL4.8	Don't use tables for layout		X
QL4.9	Add headings for tables		X
QL4.10	Use the right html elements for lists		
QL4.11	Mark quotes in the code		X
QL4.12	Provide information in sign language	*	
QL4.13	Create accessible pdfs		
QL4.14	Make registers and databases searchable		
QL4.15	Use JavaScript to increase accessibility		
QL4.16	Create shortcut commands		
QL4.17	Adapt the virtual keyboard to help the user input data	*	

Table 7.5: Quality Requirements for websites, Quality Level 4 (fourth step in the staircase model). The ★-column indicates if the requirement is part of the WCAG 2.0, level AA, requirements. The ✓-column indicates if the requirement is already being implemented for the tested Scania application *Reflex*.

8. Conclusion & Recommendations

Web accessibility is a frequently discussed topic. New laws and regulations put pressure on official websites. There are numbers of tools for analyzing the accessibility quality of websites and there are standards to follow. How come there is still no requirements for *companies* to ensure an accessible digital environment for their employees?

> *"Accessibility has become particularly important because of the explosive growth in on-line information and interactive services provided on the web. If web accessibility is not achieved, many people are at risk of being partially or totally excluded from society."* (European Commission 2016).

There is a lack of standards targeted at internal software development and companies lack clear guidelines for how to ensure quality from their in house development and purchased software products. In the near future this will have to change, since stricter regulations from society will put pressure on the private sector and also because companies will realize the benefits from making high quality and accessible websites.

8.1 Design For All

My survey showed that the majority of Scania coworkers experience problems navigating or understanding internal web applications at Scania which are crucial for their work tasks. This makes it important to focus the attention to *all users* of the web based solutions and not only those with disabilities. As I have discussed before, the combination of usability and accessibility (Universal Design) is what lies the foundation of a functional website.

In Figure 8.1 I have divided the company coworkers into those who, according to my survey, experience accessibility problems with any of the websites *Inline*, *Team Room*, *Agora*, *Scania For Me* or *Easy 2 Buy*, all common web applications of the Scania intranet. After having divided the workforce into these two groups we can consider whether or not they have disabilities, but that comes secondary to evaluating the problems that every coworker experience. The conclusion is to make functional websites for *everyone*, no matter abilities or conditions.

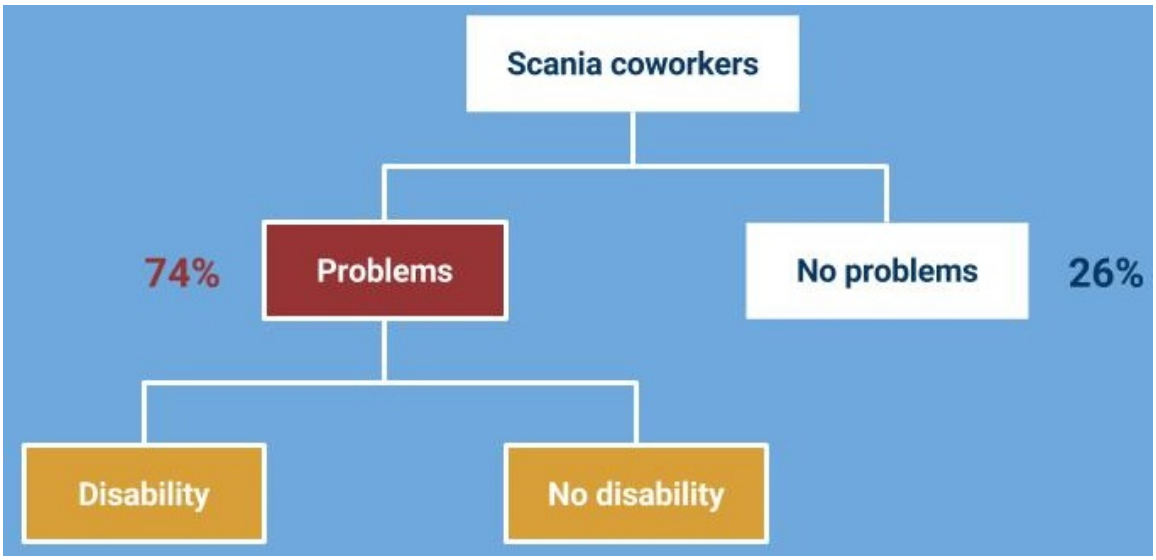


Figure 8.1: Tree showing the 74% of Scania coworkers who experience problems with the web based solutions (based on my survey). The tree symbolizes the focus of this research (red) - to improve the experience for the user, no matter disabilities (yellow).

8.2 Secure the Competence

There is a great business value in making websites functional. Scania has a large number of employees who spend many hours a day in front of web based solutions for internal communication. By making these websites functional and increasing efficiency for all coworkers, Scania could save tens of millions of euros.

Making an accessibility way of thinking part of the Scania culture and the development processes can also benefit in the long run by opening up to new talent resources for Scania. Since the number of students, at university level in Sweden, is significantly increasing, because of emerging assistive technologies, they should be included in the talent market that Scania hires from. Projections show that there will be a lack of workforce, especially engineers and computer scientists, in the future. Companies will have to do everything to attract the best competence and make sure they stay.

8.3 Motivation, Competence and Consistency

To make a difference with the quality levels of websites on the intranet we need to motivate every part of the organization, from IT division to HR and management. Motivation is the benefits from making websites accessible to everyone and penalties from discriminating and leaving out competence.

> *"Lack of awareness is the largest barrier of WA. When the awareness barrier is overcome there is often a lack of competence and consistency. There is no need to implement an accessibility focus in only one project. There has to be consistent improvement and maintenance."*
> - Stefan Johansson, phd student in cognitive accessibility and employee at Funka.

In this report I have concluded many of the benefits from making websites accessible. After the motivation stage, when the organization is fully on board with making an investment in accessibility,

it is time to find the right competence. According to Funka, the company that works a lot with large corporations reforming their accessibility quality, competence is usually a critical but missing component. I suggest making someone responsible for the accessibility work, integrates it with usability and makes sure competent people are assigned. At the final stage, the accessibility work needs to be maintained and secured in the roots of the company or the effort will only include a couple of projects before being forgotten. To make a difference in accessibility there has to be a real effort of thinking *Universal Design* in every process.

To conclude, someone needs to be responsible for the quality assessment. Educate and motivate people from all departments so that accessibility becomes a part of the corporation and integrated in every project. Make sure the requirements are part of the early web development process and then maintained throughout it. Strive for consistency by following standards and maintaining the high quality focus and universal design.

8.4 Scania is a Motivated Company

Through my research I have learned the Scania culture and gotten to know the coworkers. It is clear that the company culture is very open and that positive initiatives are encouraged. The core values that build on quality and respect for the individual indicate a will to work with quality requirements and inclusion.

I want to highlight some of the quotes from my interviews with Scania coworkers:

> *"We work a lot with our employer brand and this question is important. Performing this survey checks Scania's accessibility work in a proactive way, which is good."*
> - Sofia Vahlne, Head of Labor Affairs.

> *"If any company would focus on this question it is Scania. We have a great employee policy and the right mindset to work with this kind of question."*
> - Daniel Bergman, Enterprise Architect.

8.5 Establish Quality Levels

As software products become more complex the need for requirements engineering becomes a key to success. Non-functional aspects, or quality requirements, such as usability and accessibility ensure the user's satisfaction. Not dealing with quality requirements can lead to more expensive products and an increased time-to-market (Svensson 2011).

There are challenges with working with quality requirements that are poorly understood, non-quantifiable and difficult to validate. A situation can become complex when there is a large number of requirements from internal and external sources and a continuous flow into the development organization (Svensson 2011). To create the optimal end user experience a certain level of quality, at a certain point in time, should be achieved. I advice to set the right quality target in relation to business values, resources and requirements from society. The quality requirements can be based upon those I present in section 7.6. The QUPER model (Figure 7.2) is recommended for visualizing quality levels, putting requirements into context and decide what quality levels is good enough.

The quality requirements should be applied to in-house developed websites but also be included in specifications for purchased products. It is also important that the accessibility solutions that comes with purchased products are actually used and implemented and not just *lying in the box*.

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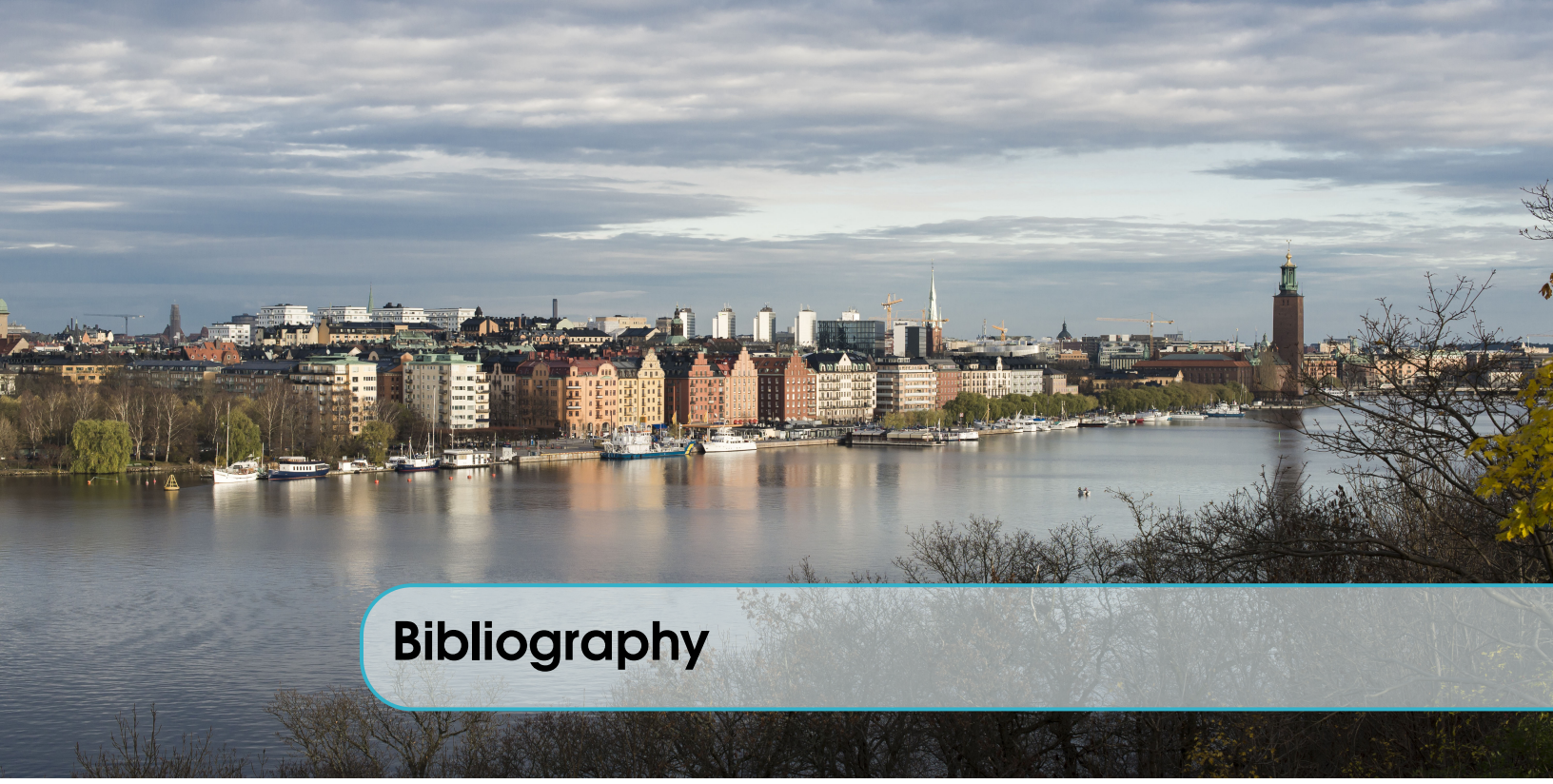

Bibliography

Arbetsförmedlingen (2012). *Var Finns Jobben*. Technical report. Arbetsförmedlingen (cited on pages 35, 46).

Arbetsmiljöverket (2016). *Tillgänglig arbetsmiljö - Arbetsmiljöverket*. URL: https://www.av.se/arbetsmiljoarbete-och-inspektioner/en-tillganglig-arbetsmiljo/ (cited on page 13).

Berntsson Svensson, Richard (2011). *Supporting release planning of quality requirements: the Quality Performance Model*. Department of Computer Science, Lund University (cited on pages 16–18).

Corbin, Juliet M. and Anselm L. Strauss (2008). *Basics of qualitative research techniques and procedures for developing grounded theory*. SAGE (cited on page 21).

Diskrimineringsombudsmannen (2008). *Diskrimineringslagen*. URL: http://www.do.se/lag-och-ratt/diskrimineringslagen/ (cited on pages 33, 43, 47).

— (2015). *Lagändring bidrar till tillgänglighet*. URL: http://www.do.se/om-do/pressrum/aktuellt/aktuellt-under-2015/Lagandring-bidrar-till-tillganglighet/ (cited on page 32).

European Agency for Safety and Health at Work (2016). *Hantering av arbetsmiljön mot bakgrund av en åldrande arbetskraft*. URL: https://osha.europa.eu/sv/themes/osh-management-context-ageing-workforce (cited on page 49).

European Commission (2016). *Web Accessibility - Digital Agenda for Europe - European Commission*. URL: http://ec.europa.eu/digital-agenda/en/web-accessibility (cited on pages 15, 57).

Funka (2016). *Tillgänglighet*. URL: http://www.funka.com/design-for-alla/tillganglighet (cited on page 49).

Funka Nu AB (2012). "Guidelines for the development of accessible mobile interfaces". In: *Riktlinjer för mobilgränssnitt* (cited on page 50).

Höst, Martin, Björn Regnell, and Per Runeson (2006). *Att genomföra examensarbete*. Studentlitteratur (cited on page 21).

Lago, Patricia et al. (2015). “Framing Sustainability as a Property of Software Quality”. In: *Communications of the ACM Commun. ACM* 58.10, pages 70–78. DOI: 10.1145/2714560 (cited on page 13).

Lowe, Charles and Pavel Zemliansky (2011). *Writing spaces: readings on writing*. Parlor Press.

National Institutes of Health (2016). *Facts About Color Blindness*. URL: https://nei.nih.gov/health/color_blindness/facts_about (cited on page 36).

Nielsen, Jacob (2003). “Usability 101: Introduction to Usability”. In: *useit.com : Alertbox* (cited on pages 15, 47).

Regeringskansliet (2016). *Konvention om rättigheter för personer med funktionsnedsättning*. URL: http://www.regeringen.se/informationsmaterial/2015/03/2015.001/ (cited on page 33).

Regnell, Björn, Richard Berntsson Svensson, and Thomas Olsson (2008). “Supporting Roadmapping of Quality Requirements”. In: *IEEE Softw. IEEE Software* 25.2, pages 42–47. DOI: 10.1109/ms.2008.48 (cited on page 16).

Scania Group (2016a). *Core values*. URL: http://www.scania.com.au/about-scania/scania-group/core-values.aspx (cited on page 30).

— (2016b). *Scania Group*. URL: http://www.scania.com/group/en/ (cited on pages 30, 33).

Seal, Eric (2016). *Why Website Accessibility in 2016 is So Important - SEO Inc. Blog*. URL: https://www.seoinc.com/seo-blog/web-accessibility-in-2016/ (cited on pages 9, 15).

Statistics Sweden (2014). *The labour market situation for people with disabilities 2013*. SCB (cited on page 49).

— (2016). *Inom vården finns Sveriges vanligaste yrken*. URL: http://www.sverigeisiffror.scb.se/hitta-statistik/sverige-i-siffror/utbildning-jobb-och-pengar/sveriges-vanligaste-yrken/ (cited on page 40).

Studera Med Funktionshinder (2016). *Studera Med Funktionshinder - Statistik*. URL: http://www.studeramedfunktionshinder.nu/ (cited on page 35).

Unionen (2014). *Tjänstemännens IT-miljö 2013: ingen ljusning i sikte*. Unionen (cited on page 33).

United Nations (2014). “UN Convention on the Rights of Persons with Disabilities”. In: *Article 33 of the UN Convention on the Rights of Persons with Disabilities*, pages 213–245. DOI: 10.1163/9789004220829_010 (cited on page 33).

Web Accessibility Initiative (2010). *Web Accessibility and Usability Working Together*. URL: https://www.w3.org/wai/intro/usable (cited on pages 16, 47).

— (2016a). *Introduction to Web Accessibility*. URL: https://www.w3.org/wai/intro/accessibility.php (cited on pages 9, 14).

— (2016b). *Social Factors in Developing a Web Accessibility Business Case for Your Organization*. URL: https://www.w3.org/wai/bcase/soc.html (cited on page 14).

— (2016c). *Strategic Planning for Web AccessibilityGuidance for Developing a Plan for Your Organization or Project*. URL: https://www.w3.org/wai/impl/overview (cited on page 20).

— (2016d). *Web Content Accessibility Guidelines (WCAG) 2.0*. URL: https://www.w3.org/tr/wcag20/ (cited on pages 13, 15, 51).

Webbriktlinjer (2016). *Alla riktlinjer i prioritetsordning*. URL: http://webbriktlinjer.se/riktlinjer/alla-riktlinjer-i-prioritetsordning/ (cited on pages 33, 50).

World Health Organization. *World report on disability* (cited on page 13).

Yerkes, Kenneth J. (2016). *U.S. Department of Justice Further Delays ADA Title III Rulemaking on Website Accessibility*. URL: http://www.natlawreview.com/article/us-department-

justice - further - delays - ada - title - iii - rulemaking - website - accessibility (cited on page 47).