Solar installations on a digital platform evaluated with a user-centered approach

Daniel Jönsson
Abstract

Solar installations on a digital platform evaluated with a user-centered approach

Daniel Jönsson

The main goal of the project and partnership between STUNS and Uppsala county council is to increase the use of renewable solar energy by helping potential investors get relevant and objective information from solar installations in use. This information is provided on a public web page with open data.

This thesis takes a user-centered approach to evaluate the web page developed by STUNS and Uppsala county council. It also describes the development of a prototype for comparing solar panels and other techniques used at the solar installations.

Information about the usability of the web page was gathered with semi-structured interviews with three people representing target groups for the web page. Two people represented public property owners and one represented researchers of renewable energy.

The results from the interviews showed a big need for improvements to the web page. Some improvements requested were a clearer purpose and a more attractive, understandable and user-friendly web page. All of the interviewees also requested more cost-related information on the web page. To summarize, a lot of improvements were needed before the web page could be seen as a valuable resource that fulfills its purpose.

The prototype help users compare solar panels used at the solar installations. It was evaluated and tested on users and the tests evaluated the usability and functionalities of the prototype by having the users perform different predefined tasks.

To summarize, the prototype was easy to use, had an understandable and clean design that could look more modern. Five out of seven users solved all the tasks in the user tests. Future developments of the prototype could be to integrate it with the rest of the web page, to make it possible to also compare other aspects of the installations such as inverters and whole solar installations.
Acknowledgements

I want to thank Thomas Lind for taking the time to have meetings with me, to discuss my progress and to come with valuable feedback. Thank you for helping me to decide on what next steps to take when working on the thesis. Thank you for taking time from your vacation to have meetings with me. Your contribution has helped me very much in the work of completing the thesis.

Fredrik Björklund, my contact at STUNS for allowing me to do this thesis in cooperation with STUNS and the county council of Uppsala. You have given me a lot of input and feedback throughout the thesis and have contributed to a lot of ideas and with positive energy.

Mikael Laaksoharju for taking on the role as my subject auditor.

I also want to thank all the people who supported me and a big thanks to all users and friends that were willing to participate in the user tests and interviews.
Contents

1 Introduction 6

1.1 A partnership is created 6

1.2 Purpose 7

1.3 Research Gap 7

1.3.1 A change of direction 7

1.4 Research Questions 8

1.4.1 Web page 8

1.4.2 Prototype 9

1.5 User Centered Approach 9

1.6 Project Specification 10

1.7 The start 10

2 Background 11

2.1 Overview 11

2.2 The solar park 11

2.3 Tools & Setup 12
## 4 Development of the Prototype

### 4.1 User-Centered Development Method

#### 4.1.1 The Concept Phase

#### 4.1.2 The Process Phase

#### 4.1.3 The Design Phase

### 4.2 Implementation of Prototype

### 4.3 Result

## 5 Evaluation

### 5.1 Method

#### 5.1.1 Tasks for the test

### 5.2 Result

#### 5.2.1 Positive Comments

#### 5.2.2 Suggestions

#### 5.2.3 Changes made after evaluation

## 6 Discussion

### 6.1 Challenges
7 Conclusions

7.1 Web page ................................. 44

7.2 Prototype ................................. 44

8 Future work ............................... 45

9 Appendix ................................. 47

HTML ........................................ 47

Questions for Contractors ............. 48

Structure for Interviews ............... 49

Användartester .............................. 52

Scenario .................................. 54
1 Introduction

1.1 A partnership is created

Uppsala County Council has increased its solar energy installations since 2015 and its efforts have resulted in Sweden’s most diversified solar park [1][2]. Uppsala county council wanted to put their installations to the test to see how their technologies perform in the real world and to share the results [1].

STUNS is a foundation that mainly focuses on the segments Energy, Innovation & Tech, Life Science and a sustainable society for Uppsala Region. STUNS tries to bring together leaders and decision-makers from the university, municipality and business world of Uppsala for issues that concern these sectors.

Together Uppsala County Council and STUNS realized that there are possibilities to meet some of society’s challenges when it comes to clean energy and the environment by sharing data from their solar installations. This could be accomplished by creating a web page where the information is open to the public. The project received means from the EU to promote research and innovation [2].

Uppsala County Council partnered with STUNS and they created a system that collects and handles data from the solar installations and a web page where some of the data is represented. The information on the web page is intended to increase the interest in solar energy and to help property owners to make decisions when investing in solar energy. The goal is to give useful and objective information about the different solar techniques used in Uppsala County, to gain experience and to further encourage investments in solar energy.
1.2 Purpose

The purpose of the partnership is to contribute and speed up the transition to a society with low carbon dioxide emissions by encouraging decentralized energy production and energy management. The primary target group for the project is public property owners, and the secondary target group is small and medium-sized companies.

The purpose of this thesis is to contribute to the project by doing a user-centered evaluation of the existing web page, and by developing a prototype to compare different techniques and solar installations.

1.3 Research Gap

Energiportalregionuppsala.se is the web page where it is possible to get information about the different solar installations in Uppsala County. It is possible to read about, see pictures from the different installations and to see some combined data from all the stations, such as the cumulative energy produced from all installations and the energy produced in the last 48 hours. It is also possible to see some individual data for every solar station such as the current energy production and the energy produced in the last 48 hours.

STUNS and Uppsala county council had not made any user-centered evaluation or user-centered development for the web page and therefore it was hard to know what users thought about the web page and if there was a need for the service provided.

1.3.1 A change of direction

The gap between the users and the contractors revealed the need for a user-centered evaluation of the web page. The initial idea of the thesis was to only create a prototype for the web page to compare different techniques used at the solar installations. However after a closer look at the web page and after talking to STUNS and realizing that there were no known users of the web
The new direction was to also include a user-centered evaluation of the existing web page to find out more about the users, their opinions about the web page, about the idea and design of the prototype and to find out if the web page was providing any value to them. Because of this new direction some parts of the thesis will have two sections. For example, there will be two methods and results in this thesis to separate the development of the prototype from the evaluation of the web page.

1.4 Research Questions

In user-centered development, it is necessary to gather information about the users to find out about their needs, conditions and possibilities for the context of use [3]. To decrease the gap between the users and suppliers information needs to be gathered about the users and their context of use. The design team needs to find out who the target groups are and prioritize them [4, p.43].

Important information about the users concerning the product or service is who, what, when, where, how and why [4, p.43]. To acquire this information it is important to talk to and ask questions to the considered users. The questions developed and used may vary from project to project with user-centered development. This report tries to answer some important questions about the web page developed by STUNS and Uppsala county council and about the prototype developed for this thesis.

1.4.1 Web page

1. Is the information provided on the web page fulfilling the users’ needs?

2. Does the web page fulfill its purpose to encourage and help people invest in solar energy?
1.4.2 Prototype

1. Could a prototype to compare techniques add value to the web page and its users?

2. If such a prototype is developed, will it be understandable, easy to use and provide value for the users?

By knowing the purpose of a project it is possible to investigate if the product or service is fulfilling its purpose towards its users. Questions for STUNS and Uppsala county council were also created and asked with the intent to find out more about the purpose of the project, see appendix 9.

1.5 User Centered Approach

To provide a software solution that meets a need, it is important to acquire information about the intended users. The foundation for user-centered development is the users’ needs, conditions and possibilities [3, p. 7-8].

A reason to apply user-centered development is that value is created when a product or service is used. A product or service then fulfills its purpose and becomes valuable for both the users and the stakeholders. If a developed product or service is not used it lacks value and all the money and time spent on development have been a waste [4, p. 9]. With a user-centered approach, the chance of developing a meaningful product or service for the context of use will increase.

At the beginning of the process, the design group and contractors should acquire insights about the users for the future design [4, p. 5]. In this project, the user-centered approach has decreased the gap between the users and the contractors.
1.6 Project Specification

STUNS had a specification to create a product that enables users to make various comparisons of solar installations and techniques on the web page. What to compare and what to show when making the comparisons was not clear but some ideas were discussed. STUNS wanted something similar to the compare functionality used at pricerunner (figure [1]) where a table is built dynamically and shows various information about the products side by side in columns.

STUNS did not have any specifications about user-centered evaluation or development. This was initiated in this project after realizing that there was a gap between the users and the contractors. For a product to be valuable, it needs to be used. Otherwise, the money and time spent on the product are a waste [4, p. 9]. After asking questions to the contractors and doing some research, it became clear that it was unknown if the web page was used at all. This revealed a big need for a user-centered approach to increase the knowledge about users and their needs.

After consulting with STUNS and Uppsala University, the project started to implement a user-centered approach to get a better understanding of the users, their needs and to increase the chances of developing something valuable.

1.7 The start

At the beginning of the development, no contact was established with the users, mainly because STUNS had no record of who the users were and because of the time limitation. For a big part of the development, STUNS represented the users and the development was directed by the their feedback and specifications in cooperation with the designer/developer. The design specifications for the project were similar to the design patterns used at pricerunner when comparing products, see figure [1].

Later in the development, contact was established with potential users and
interviews (see appendix 9) were made to start the user-centered approach. STUNS and Uppsala County Council did not know if the web page was used so it was important to ask potential users for their opinions about the web page to find out about their needs and what features could attract them to use the web page.

The idea of the user-centered development was to find out more about the users’ needs, their opinions about the web page in its current form and if the idea and design to compare techniques used at the solar installations was good. By doing this it was possible to evaluate if the project was in line with the users’ needs and to get a better understanding of what information the users want to see on the web page.

2 Background

2.1 Overview

In this section you will get some background information about the solar park, how data is collected from the solar installations, what tools that have been used to develop the prototype, about user-centered development, common concerns for property owners regarding solar energy and the specifications from the contractors.

2.2 The solar park

STUNS and Uppsala County Council are working to establish the region to be the leader in Sweden of providing knowledge about applied solar energy and innovative solar technologies [2]. The solar park has installations at nine different sites in Uppsala County where different techniques are tested. Some installations offer the opportunity of side-by-side tests since different techniques have been installed next to each other. These types of installations make it possible to make fair comparisons in a real environment.
2.3 Tools & Setup

The tools used to develop the prototype are listed below. The prototype enables users to compare solar-panels used at the different installations and can be seen more in detail here[9]

- Microsoft Azure
- HTML
- CSS
- JavaScript
- Node.js

2.3.1 Part of setup

Here follows a short description of how data from solar installations is collected and handled.

To collect data from every solar installation microprocessors are used at the installations. These microprocessors are connected to the internet and they post data in a queue to Microsoft Azure. Microsoft Azure is a cloud platform with products and cloud services where it is possible to build, run, and manage applications across multiple clouds, on-premises, and at the edge, with the tools and frameworks of your choice. [5]. Microsoft Azure functions handles the raw data that is sent from the solar installations. The methods written for Azure functions are coded in C# and .net and Azure functions handles when things should happen and what trigger certain events. Azure functions also collects, updates and stores data in a database. Microsoft Azure provides server-less computing for the web page.

Azure sql-database is where data that should be saved longer are stored. Azure storage is another tool used for storing data and it is scalable and secure cloud storage. The data in Azure storage can easily be accessed and
managed through a rest API [6]. Azure storage is faster than Azure sql-database and is used for many things in the project such as storing data queues before they are handled by Azure functions.

2.4 Property Owners and Solar Power

Solar power has become a better and better option for energy production over the last years since the cost has gone down and the efficiency has gone up [7]. When it comes to solar energy one advantage for property owners is that it is possible to put solar panels on the roof of the building/ buildings so there is no need for any extra land. Solar panels require minimal maintenance, have no moving parts, make no noise and usually come with a long warranty [8].

The research for this project revealed some frequently asked questions from people thinking about investing in solar energy. Some of the frequently asked questions that were found in previous research are listed below [9] [10].

1. What solar panels should I choose?
2. How much does it cost to invest in solar energy?
3. What maintenance is needed?
4. What is the expected lifetime of a solar installation?
5. Is it possible to sell or store the produced solar energy?
6. What solar systems have other people installed?

Private property owners are not the main target group for the project but their questions and concerns can give some indication of what is also important for public property owners. Maybe these questions should not be answered on the web page provided by STUNS and Uppsala County Council but it could refer to another web page that answers these questions.
The research into this topic helped to develop a deeper understanding of investors in solar energy. The common questions asked can be used to improve the information provided by STUNS and Uppsala County Council on their web page. Since they want to encourage people to invest in solar by providing information on the web page energiportalregionuppsala.se it is important to know what kind of information the users want to have.

2.5 User-Centered Development

User-centered development in the real world is often not as linear and clear as described in theory. It might be hard to get in contact with the users, some steps might be skipped and the approach might differ from project to project.

2.5.1 History

For the last decades, it has been recognized that we need to consider human capabilities and characteristics when designing technologies and systems. As Nickerson summarized in 1969, “the need for the future is not as much computer-oriented people as for people-oriented computers” [11].

That the users are in the center of development for a service or product may seem obvious but unfortunately, this is not always the case. Usable and suitable applications are not something that happens automatically. In order to create these qualities for a service or product, there is a need to understand the users, their social environment and tasks. The users should ideally be involved in all the steps of the development. The base of the user-driven development is the users’ needs, conditions and possibilities [3 p.7-8].

User-centered design is a fairly new way of working and in 1989 the book (User-Centered System Design) was released by Norman & Draper. This book introduced many new viewpoints on how to design systems with a focus on the users [3 p. 15-16].
2.5.2 Approach

In ISO 9241-210 (2010), human-centered design is defined as an iterative process. However, the ISO standard does not describe how many iterations the design group should do [4, p. 9].

The user-centered approach for this project is inspired by the iterative process described in ISO 9241-210 (2010) with four steps for every iteration. Depending on what phase the project is in the four steps may look a bit different but the main goals of the four steps remain similar for the different phases and are shown below.

1. The main goal of the first step is to create insights about the users.
2. For the second step, it is to create intentions and to specify requirements.
3. In the third step ideas, solutions, design solutions and prototypes are developed.
4. In the fourth step evaluation of the progress is made. Evaluation is a crucial step of development and gives critical feedback for the product or service.

[4, p. 10, 104, 141]

A design process can be divided into three phases where the iterative process described above should be used in all phases.

2.5.3 The Three Phases

The Concept Phase

In the initial phase, it is often unknown what to accomplish. A problem or a situation that needs to be handled is identified and the first step is to
Research, information gathering, observations and analysis are made to create insights and intentions. The concept phase should lead to ideas that are evaluated by the design group, stakeholders and users before the direction of any further development is chosen [4, p. 7].

Roughly the purpose of this phase is to understand and specify the context of use for the product or service, to specify requirements for usability, create design solutions and check if these solutions satisfy the requirements. In this phase, the team tries to figure out what to develop and why. They create a vision, goals and explore different concepts and ideas [4, p. 39].

Sometimes the contractors think they know what they want and sometimes the design group needs to create a new version of an existing service or product. This means that it could be possible to skip the concept phase but that might be a bad idea. Oftentimes when a developer or designer looks closer to why the product or service should be developed it is often discovered that something else is needed or that it is not known what effect the new product or service will have. This means that the developer/designer always must be critical to the initial brief [4, p. 40].

The Process Phase

When it is known what to develop, the project enters the second phase called the process phase where the design group creates sketches and prototypes based on the ideas from the concept phase. The prototypes and sketches are created to give physical form to the results from the concept phase so that they can be evaluated in the real world [4, p. 103]. A general concept of solutions is determined and developed during this phase [12]. The ideas are more adapted to the real world to ensure practical and technical operation with a good design [13]. In this phase, the ideas take physical shapes in the form of prototypes.

The design group should have an idea of what to develop and why. However,
the shape of the product or service is not yet fully specified [4, p. 103]. In the process phase, functions and content are created and structured. It is decided how the interaction with the product or service should work and how to shape the interface [4, p. 103].

The four steps of an iteration in the process phase is intended to give:

1. Insights about functions, content and shape of the product or service
2. Intents and demands for the product or service.
3. Ideas for interfaces, sketches and paper prototypes
4. Evaluation from formative testing of the product or service.

[4, p. 104]

The Design Phase

In the design phase when the overall formation of the service or product is finished the last refining is done to shape and form the product in detail. Detailed prototypes and specifications will be developed to specify the product or service further [4, p. 8].

The main purpose of this phase is to finalize the design and form of the product or service in detail. Digital prototypes and design specifications are created where the focus is on how it looks and feels to interact with the product or service. The results from the process phase can be further supplemented with information from the users about how much, how often and for how long they need to perform tasks on the service or product. This information is used to create specific quantitative and measurable user- and operative demands. To evaluate the product or service tests that measure the quantitative demands can be performed [4, p. 141]. See the intentions for the steps of one iteration below for the design phase.
1. Obtain insights about how much, how often, for how long, and how many?

2. Create intentions with specific demands.
   (To define some measurable user- and operation demands such as 100% of the users should solve the most important tasks, 90% of the users should be happy with the waiting time and 90% of the tasks should be accomplished without any errors.)

3. Create digital prototypes and design specifications.
   (Continue to work on the design, make it digital with a focus on how it looks and feels, the design patterns and the visual communication)

4. Evaluate product or service with summative testing.
   (Prepare the test, find out if the product has improved and fulfills the demands)

[4, p. 141-144]

3 Evaluation of the web page

A lot of research had to be done about solar energy and user-centered development. It was necessary to learn about solar energy to increase understanding about the topic, trade terms, common questions that people have when investing in solar energy and to get a better understanding of potential users and their needs. A lot of information was found on energimyndighetens web page about solar energy [9], on the web page solcellskollen [10] and from talking to people from STUNS with knowledge about solar energy.

Knowledge about user-centered development was mostly acquired from the book Interaktionsdesign och UX by Mattias Arvola and by talking to my supervisor at Uppsala University.
3.1 Method

The first step was getting to know more about STUNS, their solar installations and about the project between STUNS and Uppsala County Council. It was important to gather information about what had been done, what needs to be done, to set limits, get familiarized with the existing web page and understand the specifications of this project together with the contractors.

When contractors express that they know what they want it is still important to evaluate the design and purpose as a designer because sometimes contractors lack an understanding of what effects the product or service will have on users. This means that the designer must be critical to the initial assignment and has a responsibility to ask questions and try to find out more about the real world and the context where the product or service will be used [4, p. 39-40]. Because of this, a lot of questions were asked (appendix 9) at the beginning of the project to discuss and challenge the web page, purpose of the project and to further understand the purpose.

The method used to gather information about STUNS, the project and the purpose of the project has been to talk to the thesis supervisor at STUNS about the project and its purpose, to read the material provided by STUNS and to ask questions to developers involved in the project. This gave a better understanding of the current system, earlier work and of the specifications and purpose for the project. Some of these questions can be found in appendix 9 under "Questions for the contractors".

The user-centered approach for this project is described in section 2.5.2.

3.1.1 Scenarios

What was done for the initial phase was to create scenarios based on presumptions after doing some research into solar energy and to create interviews for the users. By imagining potential users and stakeholders it becomes easier to find a first focus for the design and for the information gathering. This helps to limit what participants to include when gathering information about the
users [4, p.43].

A scenario is when a fictive person that represents many users are put into a scenario/ story. By putting the fictive person into a story he or she becomes more real. A scenario can be in the form of a text, a storyboard or a [4, p. 69].

The scenarios created for this project are text-based and three different scenarios were created for different user groups. The scenario for the primary user group (public property owners) can be found in appendix 9. The scenarios for this project were made in an early step of the development from research and presumptions since no users were known or contacted at this point.

3.1.2 Interviews

Interviews were developed to acquire information about the users and to get their opinions and information about their user experience when using the web page developed by STUNS and Uppsala county council. See the questions for the users in appendix 9.

Three interviews were made with people that represented two target groups of the project, public property owners and researchers. One interview was with a researcher at Uppsala University and two with people working for public property owners (sportfastigheter and Akademiska Hus) in Uppsala. More people were contacted but they did not respond or could not participate for other reasons. The questions for the interviews can be found in appendix 9.

The interviews were semi-structured and the questions were a result from research into solar energy, presumptions, frequently asked questions by people who invest in solar and from discussions with the contractors. Potential users where interviewed since there were no known users. The interviews gave insights about what was missing and could be added to the web page for it to better fulfill its purpose. The results revealed that a lot of information and functionalities are missing for the web page to fulfill its purpose of helping
users to invest in solar energy.

3.2 Result

None of the contacted users knew about energiportalregionuppsala.se before they were contacted to participate in the interview.

3.2.1 First impression

The interviewees all thought that the web page was missing some information. They thought it would be good to have a menu with options like About us and Contact and that there could be a lot of improvements to the interface of the web page. They didn’t like the header picture and suggested that a graphical designer could be hired to make the web page more attractive.

They also thought that the numbers and graphs were hard to understand and that the purpose of the web page was not clear. They liked the possibilities to see the combined data for all the facilities.

3.2.2 Motives to visit the web page

The interviewees were asked what information that could attract them to visit the web page. Some of the answers were to get inspiration from the solar installations, find objective information about the performance of the installations, see if an offer from a supplier is reasonable compared to the installations on the web page, see a compilation of Uppsala County Councils solar installations, for educational purposes when teaching and to refer students to the web page.
3.2.3 Desired information for the web page

All of the interviewees especially wanted to get more cost related information about the installations. They were interested in knowing the cost, capacity and payback time of the installations. They also wanted to know more about the purpose of the web page, to find links to other web pages that give an introduction to solar energy, that helps people with the process of investing in solar and to similar solar projects in other regions. They also requested more information about the techniques used at the installations.

The interviewees were positive to the possibility of comparing the installations and the techniques used at the installations. The researcher at Uppsala University expressed that it would be more interesting to compare different solar panels at the same installation (side by side tests) since the conditions then would be the same for the solar panels. They were also positive to a functionality on the web page that shows how one installation has performed in comparison to the average of all the installations during different time intervals in a graph, (similarly to how a stock can be compared to an index in a graph to show performance over time).

When asked if it was important to see energy production over different time intervals and to see the difference in performance between the seasons all the interviewees said that this was information that they would like to see. The researcher at Uppsala University expressed that it is important to see how the installations have performed with the temperature and solar insulation at a certain time and to see the difference for one installation for one month to the same month another year in combination with climate data for those periods.

The researcher at Uppsala University said that it would be valuable to get basic climate data about Uppsala and to be able to compare the solar insolation in Uppsala to other places in Sweden like coastal cities. She also wanted better names for the installations on the web page, see the locations of the installations on a map, get more information about the installations such as angle of the solar panels, azimut, cardinal directions for the solar panels, size of installations and to know if there are problems with shade. She also wanted to know more about the installers used for the installations and to
get a list of local installers of solar energy in the region.

The person interviewed from Sportfastigheter wanted to find to information about the rebuilding process of the buildings to prepare them for solar energy, was it expensive? She also said that it is important to show things in a simple way to politicians when making orders so it would be good if information on the web page is visualized in a way that is easy to understand and to explain to people. She also wanted to find more information about energy storage solutions and if the installations on the web page have implemented any solutions for storing energy.

### 3.2.4 Positive Experience of Web Page

The interviewees thought that it was good to see pictures from the solar energy installations and that it was possible to get some information about them. They also thought that it was a good initiative with open data to learn from, that it was possible to see data over a couple of days and to zoom in and out in the graphs. They liked that it was possible to see the energy production and the current effect for the different installations.

The interviewee from Sportfastigheter thought it was nice that the web page can inspire people and show different ways to install solar energy like solar panels as sun-blinds over windows. She also thought that it is good that there are graphs on the web page but that they should not be on the starting page. The project has a good purpose and a lot of potentials to push sustainable development forward.

The researcher at Uppsala thought that it could be good to refer students to the web page when teaching. She also thought that the open unprocessed data is useful for educational purposes.
3.2.5 Negative Experience

All of the interviewees thought that the web page was a bit messy and that the graphs need to be visualized in a better way. The graphs were cluttered and the purpose was not very clear. They didn’t like the header picture or think that that the web page was very attractive. They didn’t like that different fonts were used on the web page.

3.2.6 Conclusions interviews

The web page is a good initiative and has a good purpose but the interviews showed that a lot of improvements are wanted to make it more valuable and user friendly. The purpose of the web page is not clear and the web page is not very attractive at the moment. It has some good content like the graphs, information and pictures from the solar installations but the content should be presented in a better and more understandable way.

Especially cost related information about the solar installations seemed to be important to find on the web page and this information should be added to the web page for it to be more valuable to its users. More information about the different techniques was also requested and the interviewees were positive to the idea of comparing the techniques from the different installations.

To see performance of different time intervals was important for all the interviewees. Links to other web pages and a menu was wanted and would be good to add to the web page.

The purpose of the web page is good, it can be an asset for educational purposes and it is good that it is possible to find open data about the solar installations on the web page.
4 Development of the Prototype

A lot of research had to be done to do user-centered development for the prototype. Knowledge about user-centered development was mostly acquired from the book *Interaktionsdesign och UX* by Mattias Arvola and by talking to my supervisor at Uppsala University. To develop a prototype similar to figure 1, it was necessary to learn a lot about web development and to practice coding in HTML, CSS, and JavaScript. The course *Dynamiska webapplikationer* given by Uppsala University provided the foundation for further development.

4.1 User-Centered Development Method

4.1.1 The Concept Phase

Because of limited time, knowledge about the users’ and because the design patterns for the prototype are widely used the initial phase was almost skipped even though it is not recommended. Looking back this was probably the best decision considering the factors mentioned above. The concept phase and the process phase were not strictly separated but instead, they overlapped.

4.1.2 The Process Phase

In the process phase of this project, a prototype-driven development was used. Prototype-driven development is when the design of a product or service is driven by sketches and prototypes. A prototype is an early draft of a future product or service that represents a design idea. It offers something to evaluate, learn from and continue to build on. A reason to work with prototypes is that it is very hard to specify the exact demands for a product or service before it exists in any form. [1 p. 11].

The shape of the product and what design patterns to use were more or less
decided from the beginning of the project. The product and design patterns were created step by step and were evaluated in every iteration.

In this project, no paper prototypes were created as described in the process phase by Arvola [4, p. 104] instead prototypes were created digitally from the beginning. This solution was a better fit for this project since the specification and design patterns were decided to a large extent and because the practice of working with the digital development step by step was needed to gain the knowledge of how to develop the final product.

Several iterations were made in this phase where new insights, prototypes and evaluations were made with every iteration. The contractors acted as the users for the most part. New insights were created by talking to the contractors and by evaluating ideas and prototypes. These insights were then made to intentions and demands for the product, implemented for the next prototype and finally evaluated with every iteration.

In the book Interaktionsdesign och UX by Mattias Arvola it is recommended to do formative testing in the process phase when evaluating the prototype for the final step of every iteration [4, p. 104]. This was only done with real users in the final iteration since contact with users and time was limited in the project.

Formative testing is a way to evaluate usability and should help to shape the design for a product or service. Formative evaluations should be made during the development often iteratively to help eliminate usability problems [14]. Formative testing is considered to be a good tool to figure out which design features are useful and which are not. Formative testing is done mainly to design a good user experience for the product [15]. Results can be less formal than in summative evaluation, as suits the needs of designers, developers, project managers, and other project participants [16].

The final testing of the product overlapped the process and design phase since the tests were made on a digital prototype and also gave some summative results like how many participants finished the tasks. Testing was first made on friends and family to ensure that no obvious mistakes were made in the setup or the formulation [4, p. 134]. The tests were made on four friends/family members and three users. The form and questions of the tests can be
found in appendix 9 and have been inspired by the book *Interaktionsdesign och UX* by Mattias Arvola [4, p. 134-137].

4.1.3 The Design Phase

In this project, the design phase and process phase were intertwined. The prototypes were digital throughout the project and the user tests overlapped both phases. Not more than one iteration was made in this phase and the steps described in the user-centered approach in the background (2.5.3) were not fully applied. The first step was skipped since there were no users of the product and since the questions were not very relevant for this project. Intentions were created for the second step such as 100% of the users should be able to finish the tasks and the interface should be easy to understand and to navigate in. The third and fourth steps were intertwined with the process phase where the prototype was created and user tests were made.

4.2 Implementation of Prototype

The idea was to create a prototype for comparing techniques used at the solar installations in a similar way to how it is possible to compare things at pricerunner, see figure 1 below.
The coding and implementation of the prototype developed for this project have been an iterative process. The tools used for the development of the project are listed in the background under Technical implementation.

At the beginning of the project STUNS was thinking about the possibility of using a framework such as React or Angular for the development of the prototype (see figure 9). However, since the skills of JavaScript were not very good at the beginning of the project it would take too much time to first learn JavaScript and then another framework such as React, Angular, or Vue so the decision to develop in JavaScript was made.

The first step of the prototype was to make a basic implementation to have a starting point, something to evaluate, to learn from and to continue to build on. The first focus was to make something that was working and then try to optimize and refactor the code from time to time. Bugs are a natural part when developing and therefore fixing bugs was done continuously.

The first iteration of the implementation was to create an HTML file that
imported JavaScript code that could create a dynamic table. This iteration was implemented by using pictures of cars and mock data since the knowledge and possibility to fetch and work with real data was not yet realized. The mock data consisted of a list of objects containing the name, height and place of various mountains. The design of the first iteration can be seen in figure 2, 3 and 4.

The development continuously moved forward step by step. Every iteration included consulting with the contractors and together deciding on the next step. As the project moved forward, interviews with users were made and the results were considered in further development. The questions for the interviews with users can be found in the appendix 9 under interviews.

As the development continued to the final iteration a lot of work had to be done to implement all the functionalities and design patterns. What was done to reach the final iteration from figure 7 and 8 is listed below.

- Added checkboxes to the pictures in the starting view so that users can choose what solar panels to compare by clicking on the pictures or in the checkboxes.
- Added another button that compares the solar panels with marked checkboxes.
- Added the information power, brand and model for every picture shown in the start view.
- Creating two views, one start view and one view when making comparisons.
- Added a side menu from where it is possible to add more solar panels to the table and where panels appear when removed from the table.
- Added an X-button to the pictures in the table that removes a panel from the table to the side menu.
- Fixed so that all the functionalities were working without bugs.
- Refactored the code to increase readability and to optimize the program.
• Implemented so that the size of the columns changes dynamically. See difference between figure 10 and 11

In figure 9, 10 and 11 you can see pictures from the final iteration of the prototype developed.

The HTML file (see appendix 9) is very simple with few lines of code. The file has not changed much during the project. The final HTML file is almost identical to the file from the first iteration of the implementation. Most of the code is JavaScript and implements all the functionalities. All styling for the product is made with CSS.

4.3 Result

In this project, a prototype was developed that works, has been tested for usability and fulfills the specifications from the contractors. In figure 9, 10 and 11 you can see pictures of the final prototype and in this section you can see the result from different stages during the development of the prototype.

Jämför Solceller

![Jämför Solceller](image)

Figure 2: This was the starting view of the developed web page for the first iteration
Figure 3: By clicking on a picture a new line will be added to the table. Here two pictures have been clicked so the pictures with information are added to the table.

<table>
<thead>
<tr>
<th>Picture</th>
<th>Name</th>
<th>Height</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Kilimanjaro" /></td>
<td>Kilimanjaro</td>
<td>5895</td>
<td>Tanzania</td>
</tr>
<tr>
<td><img src="image" alt="Everest" /></td>
<td>Everest</td>
<td>8848</td>
<td>Nepal</td>
</tr>
</tbody>
</table>
The functionalities of adding an object to the table by clicking on an image and removing an object similarly have been included in the project from start to finish.

For the second iteration functionalities were added to add and remove all pictures with corresponding data by clicking on buttons. Instead of data about mountains, the implementation fetched data from a database. This was done by using a REST API provided by STUNS.

In the beginning, the code fetched all the data for an object from the API and displayed it in a row when an object was added to the table. Later this data was filtered and only the wanted data was displayed. When fetching data the response from the API is a list of objects where every object holds
data about one solar installation. The response is converted to JSON format filtered and displayed in the table. Figure 5 shows one JSON-object that holds data about one solar installation.

```json
{"deviceId": 32,
"identity": "Regionbussdepa_lilla_rampen.V1",
"displayName": "Bussdepo - small ramp\\n",
"properties": [{"key": "RoofAngle", "value": "2" },
{ "key": "MountingAngle", "value": "0" },
{ "key": "Tilt", "value": "2" },
{ "key": "MountingSystem", "value": "Topfix 200" },
{ "key": "Brand", "value": "GCL" },
{ "key": "Model", "value": "P6_60" },
{ "key": "Power", "value": "275" },
{ "key": "Height", "value": "1640" },
{ "key": "Width", "value": "992" },
{ "key": "Thickness", "value": "35" },
{ "key": "CellType", "value": "poly" },
{ "key": "Celltech", "value": "std" },
{ "key": "Busbars", "value": "4" },
{ "key": "ModuleType", "value": "frame" },
{ "key": "Efficiency", "value": "0.169" },
{ "key": "kWP", "value": "35.75" }
]"}
```

Figure 5: This is one object containing data about one solar installations in JSON format

The first two iterations created new rows when adding objects to the table. The reason for this was that it was easier to get started since the default behavior of adding information to a table in HTML is row by row. After consulting with STUNS, looking at pricerunner and improving the skills of Javascript the next iteration added columns with data instead of rows when adding objects to the table.
Figure 6: Working with real data provided by STUNS and adding columns instead of rows

The next step changed the pictures of cars to pictures of the solar panels used at the solar installations. The data was also filtered according to what should be shown to the users in this step.

Figure 7: The first iteration with solar panels instead of cars
Figure 8: Here you see when panels are added to the table in the same iteration as for figure 7.

In figure 9, 10 and 11 below you can see pictures from the final iteration of the prototype.
Figure 9: This is the start view from the final iteration of this project. Back to Tools here 2.3
Figure 10: A zoomed out view that shows how it looks when the button "compare all" is pressed.

<table>
<thead>
<tr>
<th>Brand</th>
<th>POLY</th>
<th>SOLAR</th>
<th>PERFORMAX</th>
<th>Sunpower</th>
<th>Trina</th>
<th>TITAN</th>
<th>QCELERO</th>
<th>BIPV</th>
<th>JAMTHER</th>
<th>TNO</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Polycrystalline</td>
<td>Crystalline</td>
<td>PERFORMAX</td>
<td>Sunpower</td>
<td>Trina</td>
<td>TITAN</td>
<td>QCELERO</td>
<td>BIPV</td>
<td>JAMTHER</td>
<td>TNO</td>
<td>HIGH</td>
</tr>
<tr>
<td>Rating</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Color</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
</tr>
</tbody>
</table>

Figure 11: A zoomed out view of how it looks when comparing three panels. Notice the side menu to the right where it is possible to add more panels to the table by clicking on a picture.
5 Evaluation

5.1 Method

User tests were made on friends, family and potential users. The user tests were made on the prototype developed in this project with functionalities to compare solar panels and not on the web page that were evaluated in the interviews. The tests were inspired by Mattias Arvola and his book *Interaktionsdesign och UX*. The structure and references for the user test can be found in appendix [9]. The first tests were made on friends and family to discover more obvious mistakes and problems before testing on users. Seven user tests were made, four with friends/family and three with users. Six out of seven tests were made on computers, the seventh test was made on a smartphone.

5.1.1 Tasks for the test

1. Compare any two panels.
2. Add a third panel
3. Remove all panels from the table
4. Compare all panels
5. Remove the last panel from the table
6. Remove the rest in the fastest way.
7. Compare panel P6_60 with Paladium and tell which has the best effect
8. Find the panel with the highest efficiency
9. Return to the start page

After the tests, the users gave evaluations about the web page and their user experience.
5.2 Result

First impressions from users worth mentioning were that the prototype looked a bit old like it was developed in 1990 or 2000 and that it needs to look more modern, that there should be some kind of logo and some indication of who the prototype belongs to, there should be a unit for the "power" line displayed with the solar panels, that the design is simple and understandable and that the page will compare the solar panels.

- Five out of seven testers solved all the tasks without any problems.
- From friends/family two out of four solved all the tasks without any problems.
- All the potential users (three out of three) solved the tasks. Some changes were made to the prototype from the tests with friends and family that potentially had a positive effect.

The two users that encountered problems had the biggest problem with adding a third solar panel. They didn’t notice the side menu or understood that it was possible to press in the side menu to add another panel to the table.

To address this problem the headline of the side menu was changed. This change was a result of the feedback from the first user tests and the changes were applied for the next iteration of user tests. When the headline of the side menu was changed this problem didn’t occur anymore.

The other users solved all the tasks but the tests revealed some design patterns that were not always intuitive. For example, two out of seven users pressed on all the 'X' buttons to remove all the solar panels instead of the button remove all (task three). The test on the smartphone revealed that it could be hard to see the text on the buttons.

All the users thought that the design was easy to understand and to navigate after some practice. They all liked that it was a simple design with only the needed information and functionalities.
5.2.1 Positive Comments

The web page has a simple, clean and understandable design. It is easy to read from the table and it is good with a side menu. It is easy to understand the functionalities and good that it is possible to see the panels next to each other in a table. The web page does what it is supposed to do.

5.2.2 Suggestions

Improve the graphics to make the web page look more modern. Add a button that takes the users back to energiportalregionuppsala.se and offer some explanation for all the specifications in the table. Show information about the cost and the expected lifetime of the panels. Avoid mixing languages and a filter function could be implemented if more panels are added to the web page.

5.2.3 Changes made after evaluation

- Changed the headline of the side menu.
- Changed the text for the button that takes the user back to the first view. From "Ta bort alla" to "Till startsidan".

6 Discussion

The interviews gave a deeper understanding of the users’ needs and goals when visiting the web page and also revealed their perception of the web page at its current state. The interviews have only scratched the surface and it would be valuable to do a more extensive user evaluation and to continue to do user-centered development of the web page in the future.

The results from the interviews clearly show that a lot of work needs to be
done to the web page for it to fulfill its purpose. At the moment it is not very attractive, understandable and fulfilling to the users’ needs. It also seems that the web page is not used or that its existence is known amongst its targeted users. I don’t think that the web page at the moment is used at all in the way it was intended; to help people to invest in solar energy. I think that people who want to invest find information in more developed web pages like Energimyndigheten or from suppliers. Some of the results from the interviews were expected since my experience of the web page was similar to the users’ experiences.

The results from the interviews show the importance of user-centered development to create value and not to waste time, money and energy on developing something that will not be used. My experience of the development of the web page is that there are a lot of ideas and projects ongoing that have never been evaluated by users and sometimes they are too complicated. I think that it would be more valuable to create something simple that gives a value from start and continue to build more advanced functions from this. My experience is also that there has not been a clear goal of how the final product should look like and therefore it is harder to finish the project.

The interviews also revealed that there is an interest in the web page if it is developed and adjusted to the needs of the users which is very positive. There is a lot of potential and possibilities with the project, it can give inspiration, show alternative ways of installing solar energy and it is a good initiative with open data.

The goal of the user-centered development for the prototype was to test and evaluate the user experience of the design. The user tests revealed a lot of information about the prototype. The user tests showed that the interface of the prototype was quite understandable and easy to learn. It showed that the users could solve the tasks that the prototype was designed to help users with. What was not evaluated was the data in the prototype, instead the tests focused on the functionalities, interface and user experience of the prototype.

The user tests were very valuable and gave a lot of information about potential problems with the prototype; what was working well, where problems could arise and the user experience of the prototype. I think that user tests
are an important part of the development and that it is a good way to get input about a product or service from other people. Some information that came out of the user tests for the prototype is listed below.

- The users thought that it was easy and understandable to navigate the interface of the prototype.
- The title for the side menu was a bit confusing at the beginning and needed to change.
- Most of the users could solve all of the tasks quite easily.
- Problems could arise when adding a third solar panel before the side menu title was changed and when they needed to remove all the panels.
- The text was a bit small and could be hard to read on smartphones.
- The web page looked a bit old and it would be good for the user experience to make it look more modern.

The users all liked that the design was simple and contained only relevant information, that it was easy to read from the table and that there was a side menu with solar panels. They liked to see the panels and information in columns next to each other and they asked for some explanations for the specifications in the table.

I think that the development of the prototype went well and the final prototype seems to be valuable and understandable when looking at the results from the user tests. The results are from a small group of people and are not representative of all potential users.

### 6.1 Challenges

During the development and implementation of the product, there have been a lot of challenges to overcome. Some of the bigger challenges will be described here.
Maybe the biggest challenges have been the lack of experience with user-centered development in combination with no known user of the web page developed by STUNS and Uppsala county council. The lack of experience increased the workload because it meant having to learn how to do user-centered development and at the same time try to apply it for this project. Often work has been done to move the project forward without knowledge of how to do it in the best way according to user-centered development.

With no known users it has been a challenge to find out who the users are, how to get in contact with them and how to get useful feedback from them. During the project, no active users of the web page have been found instead interviews and tests have been made on potential future users. Another challenge has been to communicate the importance of user-centered development. There is still a tendency that the contractors want to implement ideas without checking the value of these ideas with the users.

Sometimes the contractors did not have an understanding of how long time something has taken or will take to develop. They often got ideas about new features when we were evaluating an iteration without having an understanding of the technical difficulties or time it would take to implement this for the developer. Therefore sometimes the feeling of a never-ending project aroused when developing the prototype. It was important to set limits to finish the project and to have time for writing this report.

Communication is important in most projects but can often be overlooked and insufficient. One example of insufficient communication in the project was when implementing the side menu. When developing this feature a lot of time was spent implementing it with similar design patterns that pricerunner implements. On pricerunner it is only possible to compare four items at the same time. The side menu disappears after the fourth item has been added to the table. When the same functionality was added to the project and shown to the contractors this was not what they wanted. Instead, they wanted that the side menu should be visible for every comparison except for when comparing all. This was much easier to implement and it would have saved the project a lot of time if the communication regarding the side-menu would have been clearer.

Because of the extraordinary circumstances of COVID-19 during 2020, a
challenge was also to work from home instead of having the possibility to work in closer contact with STUNS and to communicate in person with the university and the contractors.

7 Conclusions

7.1 Web page

1. Is the information provided on the web page fulfilling the users’ needs?

2. Does the web page fulfill its purpose to encourage and help people invest in solar energy?

A lot of work needs to be done before the web page will bring the desired value to its users. The information on the web page gave some value according to the interviewees but it was not fulfilling their needs.

From the interviews, the conclusion is that the web page does not yet fulfill its purpose to encourage and help people invest in solar energy. To educate and encourage people to invest in solar energy a more user-adapted web page with, more relevant information and added functionalities to compare various aspects of the solar installations are needed. See a summary of the interviews at the result section in Evaluation of the web page 3.2.

7.2 Prototype

1. Could a prototype to compare techniques add value to the web page for its users?

2. If such a prototype is developed, will it be understandable, easy to use and provide value for the users?

The interviews revealed that there was some interest to use a service to
compare techniques and solar installations on the web page and therefore the conclusion is that the prototype would add value for the users.

The prototype has good design patterns and people could easily learn how to navigate it. The results from the user tests show that the prototype is understandable, easy to use and that it would provide value to the web page. There are still improvements to be made to the prototype to increase its usability further, read more about the prototype and users tests in the Evaluation section 5.1.

It is important to do some kind of user-centered development when creating a service or product to increase its chances of being used and valuable. Close cooperation with users will potentially save a lot of resources and give insights about needs and problems earlier. It is good to start small and to develop something that brings some value to the users from the start and continue to build on this rather than making things too complicated before having a good and valuable foundation to build on.

8 Future work

There is a lot of work that can be done to make the web page and project between STUNS and Uppsala county council more attractive to users so that it will fulfill its purpose. The web page needs to be more understandable, and there needs to be an introduction to the project and the purpose of the web page.

It is important to continue with user-centered development and to have cooperation with users. The user-centered development in this thesis only scratched the surface and got a lot of useful information but deeper investigations into the users and their needs should be made.

Some examples of valuable things to add to the web page include links to other web pages with good information about solar energy, explanations and more understandable graphs, contact information, information about the cost of the installations, techniques and suppliers used. A lot of things that should
be done in the future were revealed from the user-centered development and are described in this thesis.

The prototype is not included on the web page yet and this needs to be done too. When the web page is further developed and gives value to the users it should be marketed so that more people can find and use it.
9 Appendix

HTML

<!DOCTYPE html>
<html lang="eng">
<head>
    <title>J m f r elser</title>
    <meta charset="UTF-8"/>
    <script src="js/index.js" type="module"></script>
    <link rel="stylesheet" type="text/css" href="css/style.css"/>
</head>
<body>
    <div id="wrapper">
        <header>
            <h1>J m f r Solpaneler</h1>
        </header>
        <main>
            <div id='buttonDiv'></div>
            <div id="pictureArea"></div>
            <div id="table-div">
                <div id="tableContainer">
                    <table id="table">
                    </table>
                </div>
                <aside id="aside"></aside>
            </div>
        </main>
        <footer/>
    </div>
</body>
</html>
Questions for Contractors

Vad är ert syfte med hemsidan energiportalen?

Vilka är er målgrupp?
Hur ska ni nå er målgrupp?

Vilket syfte uppfyller projektet?
Uppfylls syftet som hemsidan ser ut just nu?
Vad behövs för att uppfylla detta syfte?

Primär målgrupp (fastighetsägare):

Vilka fastighetsägare vill ni rikta er till i första hand?
Villaägare?
Lantbrukare?
Privata Fastighetsbolag?
Kommunala fastighetsbolag?
Fabriksägare?

Vad tror ni är relevant för dem att veta?
Vilket behov hoppas ni kunna uppfylla med hemsidan för denna målgrupp?
Vilket syfte uppfyller energiportalen just nu för denna målgrupp?
Vad behövs för att energiportalen ska uppnå sitt syfte för denna målgrupp?

Sekundär målgrupp (företag inom solkraft)

Vilka är er målgrupp här?
Större företag?
Lokala företag?
Vad tror ni är relevant för dem att veta?
Vilket behov hoppas ni kunna uppfylla med hemsidan för denna målgrupp?
Vilket syfte uppfyller energiportalen just nu för denna målgrupp?
Vad behövs för att energiportalen ska uppnå sitt syfte för denna målgrupp?
Allmänheten:
Vad tror ni är relevant för dem att veta?
Vilket behov hoppas ni kunna uppfylla med hemsidan för denna målgrupp?
Vilket syfte uppfyller energiportalen just nu för denna målgrupp?
Vad behövs för att energiportalen ska uppnå sitt syfte för denna målgrupp?

Diskussion: Går det att uppfylla målen för alla målgrupper?
Om inte väljer vi ni att prioritera innehållet till fastighetsägare?
Hur ska folk få reda på att energiportalen finns?

Structure for Interviews

Nuvarande hemsida

https://energiportalregionuppsala.se/


1. Känner ni/ du till energiportalregionuppsala.se?
   • Hur fick du reda på att den finns?
   • Har du funderat på att besöka hemsidan?
   • Vet du vad syftet med hemsidan är?
   • Har du använt hemsidan?
   • Vad var syftet med ditt besök?
   • Uppfylldes ditt syfte?
Var det något du saknade på hemsidan?

Berätta om energiportalen och målen med hemsidan:

Mer solel är ett nationellt mål i Sverige för att producera mer hållbar energi. För att solel ska öka och vi ska kunna byta från fossil produktion så det finns det massor att lära och i början så finns det kanske inte så mycket erfarenhetsdata att ta del av från verkliga solcellsanläggningar. Här vill region Uppsala driva på och hjälpa utvecklingen framåt genom att dela med sig av erfarenhetsdata från Sveriges mest diversifierade solcellspark där många olika tekniker testas på olika anläggningar men också sida vid sida. Att jämföra solcellstekniker på samma plats är sällsynt. Tanken är att detta ska hjälpa andra fastighetsägare att ta del av riktigt data och inte bara data från sälj och informationsblad för att lättare kunna ta ställning vid sin egen investering. Hemsidan ska vara:

- En opartisk plats med erfarenhetsdata från solel.
- Ett föredöme och något att lära av för andra intresserade av solenergi, för kommunala och offentliga verksamheter.
- Att fler ska förstå mer om solel och att det är ett bra alternativ för är att producera el.
- Att tillhandahålla opartiskt information och motverka fuffens inom industrin.

2. Vad skulle du vilja få för information på hemsidan?
3. Skulle du vilja veta kostnad för installationerna?
4. Hur mycket energi de olika anläggningarna har genererat under olika tidsintervall?
5. Kunna jämföra resultat mellan olika anläggningar?
   - Vad skulle du isf vilja kunna jämföra mellan olika anläggningar?
6. Skulle en graf liknande för fonder vara ett bra sätt att representera hur olika anläggningar har har presterat?

7. Om du går in på hemsidan vad är ditt första intryck?
   - Är det något du saknar?
   - Vad är bra information som finns?
   - Är information representerat på ett förståeligt sätt?

8. I vilken situation tror du att du skulle kunna besöka hemsidan?

9. Känner du till något om solenergi?

10. Skulle du vilja att hemsidan länkar till andra sidor som t.ex. ger en introduktion till hur solenergi fungerar?

11. Vad tycker du är relevant information att veta om solenergi för personer intresserade av att investera?
   - Tycker du att energiportalen tillhandahåller denna information?

12. Tror du att det skulle vara bra med funktionalitet på hemsidan för att kunna jämföra olika aspekter av anläggningarna t.ex. olika solpaneler, strömväxlar eller hela installationer med varandra på ett liknande sätt som det går att jämföra produkter på pricerunner med kolumner bredvid varandra?

13. Vad skulle vara viktigt att kunna se?
   - Vinkel?
   - Solpaneler som används?
   - Väderstreck?
   - W/(m)^2?
   - Kostnad för hela installationen?
   - Kostnad/(m)^2?
   - Tid för återbetalning av systemet

14. Tycker ni att det är viktigt att sidan uppdateras med nya anläggningar efterhand?
15. Skulle ni kunna tänka att dela data från er anläggning till hemsidan så att fler kan lära från er investering?

**Användartest**

**Informerat Samtycke:** [4, p. 135]

Jag har utvecklat en jämförelsefunktionalitet åt Region Uppsala och stiftelsen STUNS för att möjliggöra jämförelser av solenergiinstallationer. Jag undrar om du skulle vilja vara med i en kort användarstudie för att undersöka om gränssnittet är förståeligt och användarvänligt och för att ge mig en bättre förståelse för vad som kan förbättras och vad som redan är bra.

Går du med på att delta i studien? Om du känner obehag och vill avbryta är det bara att du säger till. Är det okej om interaktionen och samtalet spelas in? Detta kommer att användas i mitt exjobb samt i samarbetet med STUNS för att förbättra jämförelse tjänsten. Du kommer att vara anonym.

**Datainsamling om användaren:** [4, p. 135-136]

Ålder:
Utbildning:
Arbetstitel/-roll:
Domänkunskap 1-5:
Erfarenhet av jäm/teknik 1-5:

Kan du beskriva vad du tror att de olika synliga komponenterna i gränssnittet gör, till exempel knappar, bilder och checkboxar?

**Scenario / Introduktion:** Du är intresserad av att investera i solenergi och vet att STUNS och region Uppsala har en hemsida energiportalregionupp-sala.se där det är möjligt att få information om deras olika installationer av solenergi. Du har hört att det går att jämföra deras olika solpaneler med varandra, du vill veta mer om Regionens olika solpaneler och jämföra de med

**Uppgifter att utföra:**

1. Jämför två valfria solpaneler.
2. Lägg till en tredje
3. Ta bort alla
5. Ta bort den sista solpanelen från tabellen.
6. Ta bort resten av panelerna på snabbaste vis.
7. Jämför solpanel av model P6_60 med solpanel av model Paladium och besvara vilken som har bäst effektivitet.
8. Hitta solpanelen med högst effektivitet av alla solpaneler.
9. Återgå till startvyn

**Efter testet:**

**Övergripande intryck**

Vad var bra?
Vad var mindre bra/kan förbättras?
Vad saknas (innehåll funktioner)?
Avslutande kommentarer eller frågor

**Frågor om design och innehåll:**

Är det förståeligt vad de olika specifikationerna betyder eller skulle du vilja ha en förklaring för t.ex. kWp, cellTech, celltype, ModuleType och Busbars?
Finns det någon information som du saknar och skulle vilja ha med i tabellen?

Vad var svårast att förstå med designen?

Vilken uppgift upplevde du som svårast att lösa?

Skulle du kunna tänka dig att använda denna tjänsten för att jämföra och lära dig mer om regionens solinstallationer?

Vad

Denna funktionalitet kan användas för att jämföra mer än bara solpaneler. Man kan också använda samma kod för att t.ex. jämföra olika aspekter av hela solcellsisinstallationer. Vad mer än solpaneler skulle du vilja kunna jämföra från regionens installationer?

När och var

I vilket kontext skulle du kunna använda dig av denna funktionalitet och hemsidan? Vad skulle du då ha för förväntningar på tjänsten?

Hur

Hur skulle du använda tjänsten / hemsidan för att uppnå dina mål?

Varför

Vad skulle motivationen vara för att använda tjänsten?

Scenario

Offentlig Verksamhet:

Isabelle är 40 år och mitt i sin karriär. Hon bor med sin sambo Jakob i centrala Uppsala i en lägenhet. De har inga barn och förutom att jobba
tycker de om att resa, vara aktiva med olika sporter och att vara ute i naturen. De har en hund som de går promenader med varje dag och minst en gång om året så går de på en längre vandring då de bor i tält och vandrar i minst 5 dagar.

Isabelle jobbar på sportfastigheter som ägs av Uppsala kommun. Uppsala kommun har höga ambitionsmål när det kommer till hållbarhet och vill vara en ledande kommun i Sverige vad gäller hållbarhet och förnybar energi. Detta mål har gjort att Isabelle nu har krav på sig som ansvarig för Sportfastigheter att undersöka möjligheten med solenergi på fastigheterna som Sportfastigheter förvaltar.

Isabelle har inte direkt någon tidigare erfarenhet av solenergi och känner att det är mycket att sätta sig in i. Hon vet inte riktigt var hon ska börja innan hon kommer på att det finns ju andra offentliga verksamheter i Uppsala som har installerat solceller, hon kan kanske ta kontakt med någon av dem? Hon tänker också att det borde finnas någon hemsida som visar resultat från olika verkliga anläggningar så hon börjar söka efter det på nätet och hittar då energiportalenregionuppsala.se. Denna hemsida verkar ha som mål att dela med sig av data från befintliga solcellsanläggningar för att hjälpa andra offentliga fastighetsägare att förstå och investera i solenergi.

Isabelle går in på hemsidan med som mål att bl.a. ta reda på vad de olika anläggningarna har kostat att installera, vem hon kan kontakta för att ställa frågor och få veta mer, om det finns möjlighet att besöka någon av anläggningarna och hur de olika anläggningarna har presterat gentemot varandra. Vad för faktorer som skiljer sig mellan olika anläggningar som t.ex. vilka solceller används, vinkel på solcellerna, i vilket väderstreck de är riktade, men också mellan olika installationer på en och samma anläggning. Hon vill få så mycket information som möjligt för att kunna jämföra hur de olika anläggningarna har presterat gentemot varandra. För att få opartisk information om hur solceller faktiskt presterar i verkligheten och kunna jämföra det med produktbladen behövs en opartisk sida och hon hoppas att det är det hon har hittat. Hon vill också kunna se effektivitet relativt till kostnad för att se vilken anläggning producerar mest energi relativt till priset och en uppskattning av hur lång tid det tar för de olika anläggningarna att betala tillbaka investeringen.
References


