CHALMERS
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# An app compatible with a sewing and embroidery machine

***A concept developed under the Singer brand***

JOHAN BAGGE AND NANNY GILLSTRÖM

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Bachelor thesis within Industrial Design Engineering
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Title page

A visualization of the finished concept (page 74).

**Preface**

This project was created by SVP-group worldwide and was carried out by Johan Bagge and Nanny Gillström, students at Chalmers University of Technology.

Thank you Emma Widehäll, Niklas Widell, Sofia Rudstam and Linda Lindqvist from SVP-worldwide for the positive encounters and invaluable help throughout the project. We would also like to thank our supervisor and examiner from Chalmers University of Technology - Mikael Johansson for his fine support and guidance and Sanna Dahlman for her enthusiasm and sewing expertice.

We would also like to send a special thank you to everyone who inspired us by sharing their experiences throughout the surveys, interviews and usability tests.

**Abstract**

Modern sewing machines often have a built in screen where certain functions are accessible – such as embroidery placement. The aim of this project was to investigate the potential user benefits from placing functions on an external screen compatible with Singer sewing/embroidery machines.

In order to investigate the target user group, a user study was conducted with participants between the ages of 20-35 residing in Europe. Two surveys and several interviews resulted in a persona for a Singer user. The persona in combination with the responses from the surveys resulted in a specification of requirements.

A usability test was conducted to investigate the current use situation of a sewing/embroidery machine and to determine if any functionality could be moved from the physical machine to an external screen. The results were analysed and used as a general framework for how the interface could be designed for such a device and the placement of buttons on the physical machine.

This initial concept was evaluated with a validation test – conducted in the same manner as the usability test. In order to create a final concept, additions and changes were made based on the results from the validation test. The study resulted in a suggestion for the design of an interface on an external screen and the placement of buttons on the physical machine.

The study showed that all *active functionalities* – i.e functions that control the physical machine – should be placed on the physical machine, while *passive functions* – such as settings and embroidery placement – could be placed on an external screen. Further, users experience that using an app to controll the machine reduces the feeling of creating something by themselves – and would therefore be less proud of their work.

# Table of contents

# 1

# Introduction

You have probably heard the saying ”there’s an app for that” many times since the introduction of the iPhone in 2009. In many cases, this statement is valid - TED conferences even presented some apps to support the thesis (TED.com, 2018).

On the hardware side of innovation, automation is becoming increasingly common in areas such as automotive and manufacturing - but also in household products (Brennan, 2013). While an increased automation can lead to user benefits regarding efficiency, it can at the same time constrain a creative process by removing user participation.

Still, technology and automation can be used to augment the user experience and function as a creative vessel. Imagine drawing a motif with sharp edges, slowly drawing the edges to not colour outside the lines. Compare this to utilizing the innovation of the stencil. A stencil automates repetitive actions and creates consistent results. While the creative process of drawing is removed, it’s substituted with the creative process of designing and crafting stencils.

Automation does not mean the end of creativity.

It’s in this domain that higher end embroidery machines exist. Their built in screens can visualize patterns and enhance the precision of which settings can be adjusted. But being built in leads to the sensation of the content belonging to the machine instead of the user. Imagine instead if this content resided in an app, on your own phone - with all your personal content, ideas and friends.

## 1.1 Background

SVP worldwide has got a whole range of different machines that are suitable for different target groups - these machines has got the ability to sew basic stitches to complex embroidery. SVP worldwide has got a wide range of different sewing machines, specially designed for professional use. These machines have special features that contributes to a higher price range. To reach one target group in particular – the hobby sewer - the company are seeking to invest in a new competitive product which could increase the product value and decrease the manufacturing costs.

One of their high valued machines has an integrated computer-screen that opens the possibility to use several desired functions. Because of high manufacturing costs, these machines are expensive. The majority of hobby-sewers are price-sensitive which leads to being limited to the functions that are available on the physical sewing machines.

SVP worldwide is seeking to invest in a new sewing machine that opens up a whole range of possibilities – including embroidery and creating patterns. This project is going to investigate if it is possible to utilize an existing screen on a smartphone – instead of an integrated screen on the machine – and how this new machine could be developed in order to be desired by the users to make high end features affordable for the hobby sewer by decreasing the manufacturing costs.

## 1.2 Purpose

The aim is to investigate the possibility of creating an innovative solution that would open the possibilities for the hobby-sewer of using several functions usually limited to high-end machines and decrease the manufacturing costs that would make the product available for the hobby-sewer. This results in the project not focusing on creating a high-end machine where more expensive solutions might be acceptable. The solution will be based on connecting the physical product to an external screen (smartphone / tablet) on which desired functions will be placed.

The target group are a new generation of sewers in Europe, that are between the ages of 20-35. They are targeted by SVP worldwide due to the assumption that this group might be interested in a modern and unconventional product.

## 1.3 Research questions

Understanding the user and their preferences:

- What functions are desired and needed by the user in order to achieve their intended sewing/embroidery results and add value to the target group?

Usability and design:

- What placement of features results in the highest level of usability for the user regarding the exterior design of the physical product and the app layout?
- How can a design with an external screen facilitate and improve the functionality of a sewing machine?

## 1.4 Goal

A user study will be conducted in order to understand what the users expect of the sewing machine and what they use it for. Two usability tests will be conducted with a mock-up of the physical model. The first test aims to investigate which features are essential for the users and will result in a specification of requirements. New solutions based on the requirements will be explored through an ideation phase.

The second usability test will be used to validate the results from the ideation phase. After investigating the target group and completing the usability tests, a concept for the interface of the external screen will be delivered. The concept will consist of the layout of a smartphone app and the suggestion of button placements on the physical machine – neither will have actual functionality. Further, the user study will result in a *persona* for a Singer user.

## 1.5 Limitations

One of the limitations put on this thesis-project is the final testing restrictions. The physical product won't have a construction of an existing software. The result of the project will be a proposal for the physical product and an app – these will not be finished products. Buttons (appendix. 1) on the reference product (chapter 2.6) that control the machine while sewing will not be changed.

Due to difficulties in arranging usability tests in other countries, all tests will be conducted in Sweden with participants residing in Sweden.

The primary target is to investigate the interaction between an external screen and a machine. Many functions and additions on the external screen may therefore have the sole purpose of facilitating the usability tests.

## 1.6 Glossary

*Active:* When either a user or machine is engaged in particular activity.

*Active functions:* Functions that are operational when the sewing machine is engaged in sewing or embroidery. The *active functions* include, amongst others, the foot pedal and the buttons that control the machines running speed.

*Between test subject:* Test participants only conduct one of the usability tests - no one conducts both.

*Bobbin:* A cylindrical spool that is used for holding thread.

*Control*: The level of which the user interacts with the machine with clear intention and without the risk of injury or faulty usage.

*Embroidery with hoop:* When embroidery is made by an embroidery/sewing machine with belonging hoop (frame). During preparations the selected fabric is placed and stretched in a hoop, ready for embroidering.

*End:* When the sewing process is completed.

*Inches to mm conversion:* 1 inch is 25.4 millimetres.

*Machine control functions*: Functions which controls the machines actions.

*Pairing:* When connecting the app to the machine.

*Passive:* When either a user or machine is passive in a particular activity.

*Passive functions:* Functions that are operational when the sewing machine is NOT engaged in sewing or embroidery. The *passive functions* include, amongst others, changing settings and placing an embroidery pattern.

*Seam types*: Seams with different appearances and properties.

*Stitch length:* The vertical length of the stitch.

*Stitch width*: The horizontal size of the stitch.

*Tacking:* A stitch that is used to temporarily hold the fabric in place so that that the layers of fabric will hold together before being sewn with a permanent stitch.

*Thread tension:* A mechanism in the machine that put tension on the thread.

*Wizard-of-Oz:* A person who controls the feedback from a mock-up in response to the test participant's interactions with the mock-up.

# 2

# Theoretical Framework

This chapter aims to introduce relevant theories regarding human cognition and usability. These theories have been used to analyse user behaviour and to create and evaluate the final concept.

## 2.1 Human machine interaction

In order for a user to interact with a product, an interface is required (Boghard, 2011). To better visualize and understand how the user interacts with a product, the interaction can be illustrated with a graphical model (Boghard, 2011) (fig.1). It describes the process through which a user can interact with a machine, receive feedback on the interaction from the machine and react accordingly. The model can be used to evaluate use errors in order to improve the design of an interface. For instance, if a user presses a button and the machine executes the desired function, but the user does not perceive it to have worked, it could be due to a lack of feedback in the output-phase from the machine.

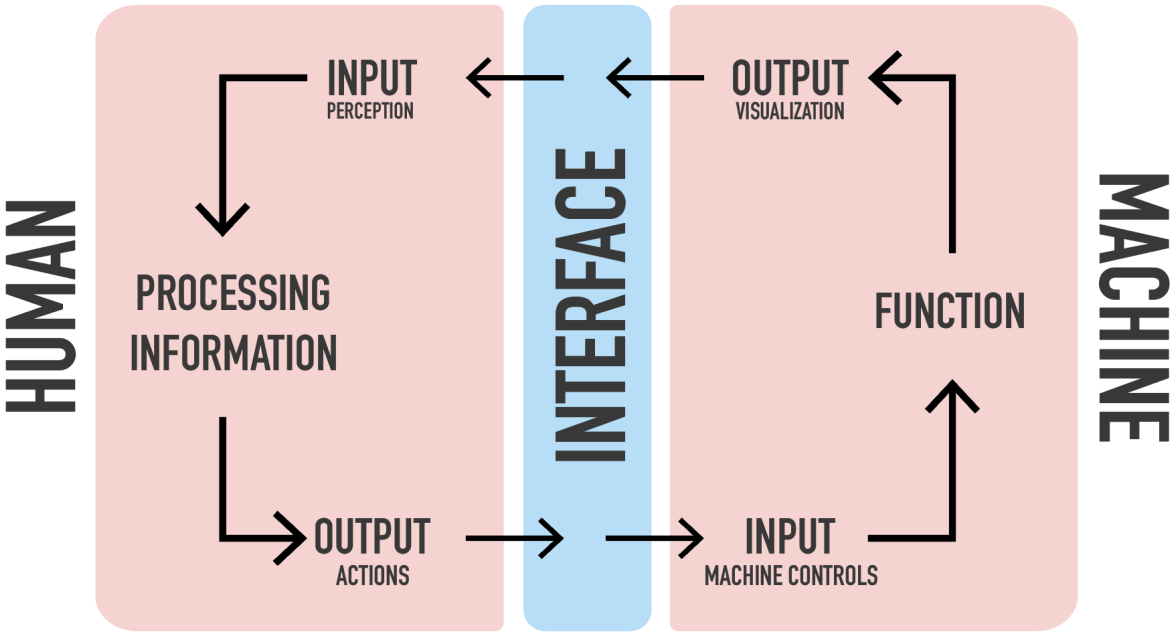



*Figure 1. Own illustration - Human machine interaction (Boghard, 2011).*

## 2.2 Cognition

Cognition affects how humans experience and interpret different sensory inputs. In his book *The Design of Everyday Things (2013, pp. 49-55)*, Norman divides the human cognition into three different levels: *Visceral, Behavioural and Reflective*.

The visceral level is responsible for primitive responses to stimuli - such as fight or flee reactions.

The behavioural level concerns actions that we are generally aware are going to be executed, but that our consciousness does not analyse until they occur. Norman exemplifies this with playing a sport and preparing oneself for action. When the action occurs, our behavioural level takes control much faster than any other level - executing the action without us having to consciously control it.

The reflective level is responsible for conscious analysis of situations and decision making. In this level, a person is regarded to have the highest degree of consciousness and control of their actions - resulting in it being a crucial factor to consider while designing a product.

Norman continues to explain that even though the behavioural level is regarded to be more or less subconscious, we still have expectations of what is going to be the result of an action. If a user repeatedly tries to execute an action which they believe to be (and is) the correct one in order to complete their task, but the interface doesn't respond accordingly due to a lack of feedback, they will eventually assume that they are executing the wrong action.

## 2.3 Experienced control

When a user executes a certain task, they experience different levels of control over the operation (Landau, M. J., Kay, A. C., & Whitson, J. A., 2015). The experienced control may differ from an observed, actual level of control. In instances when this discrepancy occurs, the user may be subjected to hazards. To illustrate this issue, a hypothetical scenario regarding the control of a vehicle could be used.

*The driver of a car is certain that the steering is controlled via the volume knob on the radio and when asked expresses that they experience control in this situation.*

*The car is controlled via the steering wheel, and the users actual control is low.*
The discrepancy between the experienced and the actual control could, in this scenario, arguably lead to severe consequences.

## 2.4 Mental model

A mental model consists of a person's expectations and schematics of how something works (Norman, 2013). When designing interfaces, layouts should be crafted in such a way that they match the users mental model. For instance, a study from 2015 suggested that people in cultures where text is written from left to right tend to assume that the left part of the screen should be read before the right part (Román, et al. 2015). Placing vital information on the right side of the layout might therefore lead to the users prioritizing the wrong information. Mental models can differ from person to person, between cultures and can also differ in one person over time (Holcombe. E and Kezar. A, 2017).

## 2.5 Usability

The concept of usability is often used to explain the different parameters that effect how easy a product is to use. One definition of usability is that it is *"... the extent to which a product can be used with effectiveness, efficiency and satisfaction by a specific user to achieve specific goals in a specific environment"* (ISO, 2018)

Two aspects of usability that are often mentioned is a system's *guessability* - the level of usability a user can achieve when using an interface for the first time - and *learnability* - the level of usability a user can achieve when reusing an interface.

### 2.5.1 Patrick Jordan's design principles

Patrick Jordan's ten principles are guidelines for how an interface should be designed in order to achieve a high level of usability for a product or service (Jordan, 1998).

*Consistency* - Is about solving data in a same manner in a product.

*Compatibility* - The product solves data in a way that resembles problem-solving techniques in the world. It is based on informed knowledge and standards about how certain products/services will work. This allows easy recognition and hence easier use.

*Consideration of user resources* - When designing, it is important to consider how the product affects the user's resources.

*Feedback* - How a product indicates and shows that it has registered a user's actions. It is important that this allows meaningful information about the outcome of one's actions. System Response Time, is an important factor for the impact of feedback.

*Error prevention and recovery* - A product should be designed to minimize usage errors. It is also important that it is easy to enable a fast recovery if the product/service is used incorrectly.

*User control* - Design a product so that the user experiences a high amount of control of the product's actions. When a user is denied control, there must be clear information about why and for how long they are denied it.

*Visual clarity* - Information should be simple to perceive and clarify.

*Prioritization of functionality and information* - Prioritize what information and features that need to be accessible to the user.

*Appropriate transfer of technology* - Use and utilize existing technology used in other applications in the product and with that- enhance its user-friendliness.

*Explicitness* - A product should have clear guidelines and clues about how to use it and what it can be used for.

## 2.6 Reference product

The reference product (fig, 2) was chosen by SVP-group and used throughout the thesis to achieve an overall understanding of a sewing and embroidery machine – a Singer Legacy (Singer, 2015).


*Figure 2. Reference product - Singer legacy (Singer, 2015).*

### 2.6.1 Machine and interface

The reference product was used to comprehend the machines functions and its' interface. To achieve this, the machine has been divided into three parts (fig. 3). The lcd-screen include functions that are operational when the sewing machine is NOT engaged in sewing or embroidery. These functions include, amongst others, changing settings and placing an embroidery pattern. The machine is *active* in the second part, when the functions placed on the machine are operational and the sewing machine is engaged in sewing or embroidery. The *active functions* include, amongst others, the foot pedal and the buttons that control the machines running speed. In the third part, the machine is *passive* and the user is *active*. In this part the user positions the emboridery with and *hoop* and prepares the machine for sewing or emboridery.


*Figure 3. The machine's interface divided into three parts.*

### 2.6.2 Sewing – and embroidery process

A simplified picture of sewing – and emboridery process (fig 4) has been used to create an understanding of the different stages and functions that are used throughout the process. The process has been divided into three stages. The first stage explaines the preparations that primarly are used before sewing. The functions that are used during the preparations are called *passive functions (appendix. 15)*. During the sewing process – the machine is active and controlled by the user by using the *active functions* (appendix.1) placed on the machine. After the sewing process the user will check the machine and evaluate the results.


*Figur 4. The sewing - and emboridery process divided into three parts.*

## 2.7 Sustainability

In 2017, almost 1,5 billion smartphones were shipped (idc.com, 2018) - each equipped with a touch display. In order to manufacture the necessary LCD panels the alloy indium tin oxide is used. The alloy requires the extraction of indium, which is considered to be a rare earth mineral. A study conducted at Yale in 2013 concluded that rare metals in smartphones doesn't have suitable replacements once they have been depleted (Graedel, Harper, Nassar, Reck. 2013). Further, the article describes this to be a real issue due to some rare earth minerals being responsible for functions that we expect smartphones to have - such as a touch screen.

Presuming that the user demand for owning a personal smartphone doesn't decline, utilizing the phone's display in combination with other products could minimize the need of manufacturing a separate display for that product.

Another aspect of sustainability is minimizing waste. According to the user study many people use scrap pieces of fabric to preview their seam settings and embroidery patterns before they commit to sewing on their intended piece of clothing or fabric. This results in fabric being discarded as waste. Arguably, this is preferable over previewing on your final piece and having to discard a larger piece of fabric - but as a general principle of sustainability, waste should be minimized (APEGBC, 2016)

If users aren't certain that the settings correspond to their expected results, they will need a preview of some sort. One function that could potentially be placed on an external - mobile (i.e. not stationary) - screen is a real size preview of stitches and settings. This would minimize the use of scrap pieces of fabric - resulting in less waste.

Further, sewing with the correct settings minimizes the risk of thread tangle and damaged fabric - which in turn leads to less waste.

# 3

# User study

The user study aims to create a better understanding of the issues that the target group encounters, and what functions they need. This chapter explains the methods used to investigate the target user group, the results collected and how the data was analysed.

## 3.1 Method

This section addresses the methods used during user study.

### 3.1.1 Benchmark

Three products that are already on the market were investigated in order to create a benchmark. Benchmarking is a great tool for understanding what kind of technical solutions and specifications there is on today's sewing machines. The benchmark contained existing sewing/embroidery machines that takes advantage of an external screen, an external app or both. The products that were chosen to be benchmarked (appendix. 2) were the main competitors Brother (Toptenreviews, 2018) and Spiegel. These products were compared in order to investigate their essential functions and stand out functions.

### 3.1.2 PNI

In order to evaluate the features and functions in the benchmark a PNI table was used. A PNI-table is a tool that was used structure the positive, negative and interesting features/functions of a sewing machine into a table. The method further helped to highlight aspects of meeting the users' needs and desires which otherwise would not be obvious. (Österlin, 2011).

### 3.1.3 Surveys

Two surveys were conducted - a primary survey and an extended survey. These were sent to fashion schools and sewing organisations in Europe - mainly from Sweden, Germany, France, Belgium, Italy and the UK. The primary survey aims to find general attributes concerning people who use sewing machines - how often they use their sewing machine, what their current occupation is and what they would like to work with in the future.

***Primary survey***

The primary survey consisted of 50 participants and aimed to create an understanding of sewing machine users. Questions regarding gender, age, country of residence, occupation, career, frequency of use (sewing machine) and the name/model of sewing/embroidery machine.

***Extended survey***

The follow up extended survey aim to investigate what functions that these users need on their sewing/embroidery machines and how often they use those functions. Further, the result of the data collected was used for the first usability test (chapter 4) to decide what functions should be placed on a basic model of the machine. The extended survey was conducted with 67 participants. 32 participants were from the target group – i.e in the ages between 20-35. Questions regarding sewing, embroidery, functions, and their opinions/perceptions of Singer Co were answered.

### 3.1.4 Interviews

In depth interviews was conducted with 6 participants from Sweden. The interviews took place in connection to the first usability test and contained questions regarding the target groups general values and perceptions about sewing machines. What features are necessary, and what features that are desirable? (appendix. 3).

### 3.1.5 Evaluating seam types

Answers regarding what seam types that the participants used were collected with the aim to determine which seam types that are needed by the user. These answers were later to be used in the first usability test.

Points were assigned to the seams based on votes from the survey. The columns were then graded so that the most used seams would get a higher score - 3 for everytime, 2 for often, 1 for rarely and 0 for never. With this method, a seam type that scores 1 point in the *everytime-column* is considered more necessary than a seam type that scores 1 point in the *often-column*. The scores were then summarized to establish what seam types that received the highest score.

The ten seam types that received the highest score was later used and tested in the usability test (Chapter 4).

### 3.1.6 KJ

A KJ-analysis was made to develop an overall picture of the collected data. The data was written down on paper notes and then arranged in categories according to their domain

(Karlsson I.C.M, 2007). Responses from the user study were categorized into four categories - necessary preparations, settings, sewing process and the result.

The data was analysed with the KJ-method and was divided in three groups based on their context (chapter 2.6.1). The differentiation between contexts was based on if the machine and user have a more or less active part in a task.

***Preparations***
During the preparations, the sewing machine is *passive*, while the different sewing type selections and settings are *active* and the user is *active*.

***Sewing process***
During the sewing process the *machine control functions* are *active*, the user is *active*, the sewing machine is *active* and the sewing type selections are *passive*.

***After sewing process***
After the sewing process the sewing machine is *passive* while the user is *active*.

### 3.1.7 HTA

To structure and understand the use of a sewing and embroidery machine a Hierarchical task analysis was used. This analysis involves structuring the basis of the overall main objectives and then subdividing it into subordinate goals (Boghard, 2011). The HTA-analysis is based on data collection from surveys, which later were used to arrange the different steps. When these different steps are completed, they together would result in two main objectives - one to embroider a pattern (fig. 3) and one to sew two pieces of fabric together (fig. 2).

### 3.1.8 Persona

The information collected through the user study was analysed and used to create a persona of a primary user for the target group.

A persona is a fictional character that is made to represent the target group (Boghart, 2011). The data from the surveys and interviews where then divided into how they behave, how they think, their expectation while sewing and their end goals

## 3.2 Current situation

Benchmarking was used to find the best possible technical qualities and features of today's sewing machines. The different products functions were compared to each other and later evaluated through a PNI-analysis.

Table 1 shows the positive, negative and interesting features/functions of the three benchmarked sewing machines (table. 1).

*Table 1. PNI analysis based on benchmark.*

| Product | Positive | Negative | Interesting |
|---|---|---|---|
| **Spiegel Model 60609** | - Computer connectivity with available updates<br><br>-Realistic preview<br><br>-Precision<br><br>-Automatic threader | -Stitch cam needs to be highly responsive if to be used. (Spiegel has got a bit of a lag)<br><br>- Difficult interface which is not easy to comprehend.<br><br>-Important to have regular updates on software so that the technical aspects works.<br><br>-Does not save custom settings.<br><br>- Device hook is not compatible to all smartphones. | -Buy embroiderys through app<br><br>-Sewing application for tablet/smartphone<br><br>-Local WiFi network<br><br>-Stitch cam<br><br>- The start/stop key functions only work when the foot control is not plugged in. Also the machine won't stop until the stop key has been pressed. |
| **Brother SE400** | -Computer Connectivity with available updates<br><br>- will detect if it runs out of thread<br><br>-Onscreen density adjustment<br><br>-Thread cutting (Automated upper & lower)<br><br>-Automatic threader | - Buttonholes (manual measure of button)<br><br>-Non-intuitive interface<br><br>-Low resolution previews | -Possible to buy embroideries<br><br>-Editing on the screen<br><br>-Print and Stitch (stitch printed figures) |

| | | | |
|---|---|---|---|
| **Singer Legacy C440Q** | -Thread cutting (Automated upper & lower)<br><br>-Back to Beginning Key<br><br>- Large embroidery hoop<br><br>-Automatic threader<br><br>-Can save stitch combinations in the machine. | -Expensive | -Realistic preview<br><br>-Editing on the screen<br><br>-Mirror image (stitch patterns can be mirrored |

### 3.2.1 What the users want

This section compiles the results from the user study in regards to what the users want.

***Easy to use***

The study participants thought that the most important factors when sewing was that the machine was user-friendly with functions that are intuitive. They thought that it was important that the machine gave nice results - such as straight stitches. They wanted a machine that would not tangle the thread and destroy the fabric. While sewing, they wanted a reliable machine that responds quickly and doesn't break. A few participants thought that it was very important that the sound from the machine is comfortable for the ear and that the machine has good lighting so that they could easily control the results of the sewing process. A crucial factor that determined if the sewing machine was worth using for a specific task was the time in which a task could be completed - some participants attributed the completion speed to the machines ease of use.

***Expectations***

The study participants who owned a Singer sewing machine wanted the machine to be able to sew everything that they needed. A majority in this group expect their sewing machine to be able sew through many layers of fabric. The general opinions of the target group were that the machine should be easy to use, have basic settings such as general seam types and make stitches without encountering problems (appendix. 4).

***Repair and alterations***

Questions regarding what the users usually sew was asked to understand what expectations they have on a sewing machine, but also if there was any remarkable difference between ages and/or what kind of machine that the user has. The data was divided and set up in three circular diagrams - one for the target group, all users of sewing machines and singer-users (appendix. 5). The result was very similar to each other. An interview was made with complementary questions which led to the conclusion that sewing machine users within the target group use their machine for the purpose of repairing clothes and accessories for themselves - and also for friends and family. A

commonly expressed sentiment on what benefits having a sewing machine brings you was that it gives the user the freedom to at any time alter clothes and accessories. This in turn leads to less consumption and empowers the user to change clothes after their liking.

***Pride in their accomplishment***

Many participants expressed that they take pride in their work and that they are eager to show off their accomplishments. Some participants expressed that a higher degree of automation in the machine took away their handcraft and that the end product was the machines accomplishment and not theirs.

***Most used seams***

The scores were summarized to determine what seam types that received the highest score (Table 2, 3 and 4). This resulted in ten different seam types that are essential for fulfilling the target groups need (fig. 5).

*Table 1. Ranking of seam types.*

| | Everytime (3X) | Often (2X) | Rarely (1X) | Never (0X) | Result Points |
|---|---|---|---|---|---|
|  | 27 | 5 | 1 | 0 | 92 |
|  | 14 | 15 | 5 | | 75 |
|  | | 5 | 12 | 16 | 22 |
|  | | 3 | 12 | 18 | 18 |
|  | | 4 | 10 | 19 | 18 |
|  | | | 9 | 24 | 9 |
|  | | 3 | 7 | 23 | 13 |
|  | | 8 | 9 | 16 | 25 |
|  | | | 7 | 26 | 7 |
|  | 1 | 5 | 3 | 24 | 16 |

*Table 2. Ranking of elastic seam types.*

| | Everytime (3X) | Often (2X) | Rarely (1X) | Never (0X) | Result Points |
|---|---|---|---|---|---|
|  | 4 | 3 | 11 | 15 | 39 |
|  | 1 | 2 | 7 | 23 | 14 |
|  | | 1 | 6 | 26 | 8 |
|  | 1 | 4 | 10 | 18 | 21 |
|  | | | 5 | 28 | 5 |
|  | | 1 | 7 | 25 | 9 |
|  | | | 6 | 27 | 6 |
|  | | | 4 | 29 | 4 |
|  | | 2 | 5 | 27 | 9 |
|  | | 1 | 5 | 27 | 7 |

*Table 3. Ranking of button hole styles.*

| | Everytime (3X) | Often (2X) | Rarely (1X) | Never (0X) | Result Points |
|---|---|---|---|---|---|
|  | 8 | 6 | 5 | 4 | 41 |
|  | | 2 | 6 | 15 | 10 |
|  | | | 3 | 19 | 3 |
|  | 1 | 4 | 5 | 13 | 16 |
|  | | 2 | 5 | 15 | 9 |
|  | | 1 | 4 | 17 | 6 |

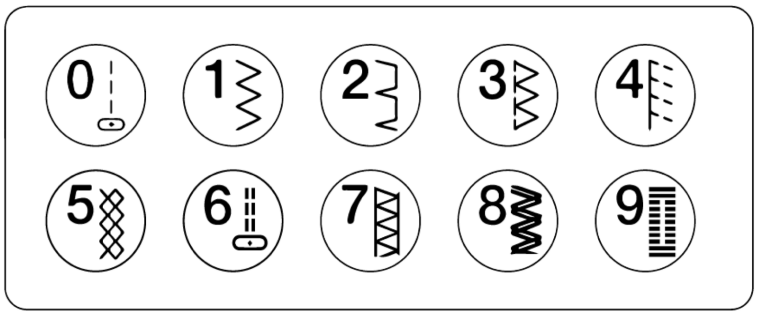



*Figure 5 . Most used seams.*

### 3.2.2 How they use it

This section  compiles the results from the user study in regards to how the participants use the sewing machine. The general procedure described in chapter 2.6 could be further developed with a HTA (fig. 6,7)

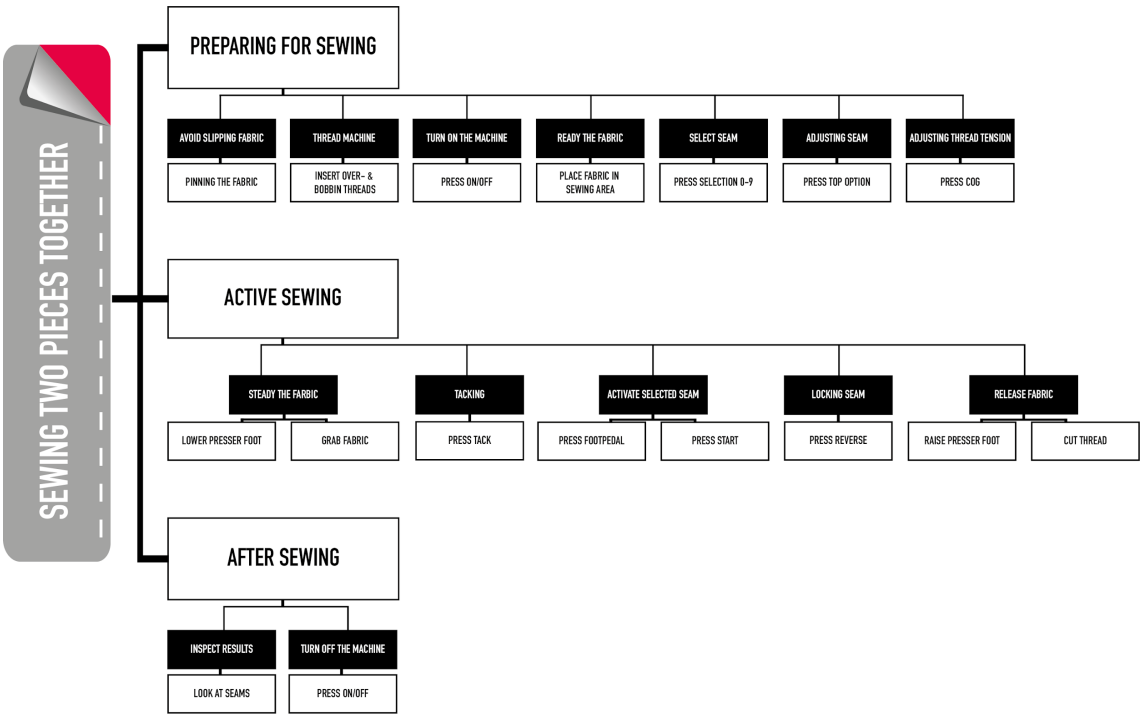



*Figure 6. Sewing two pieces of fabric together.*

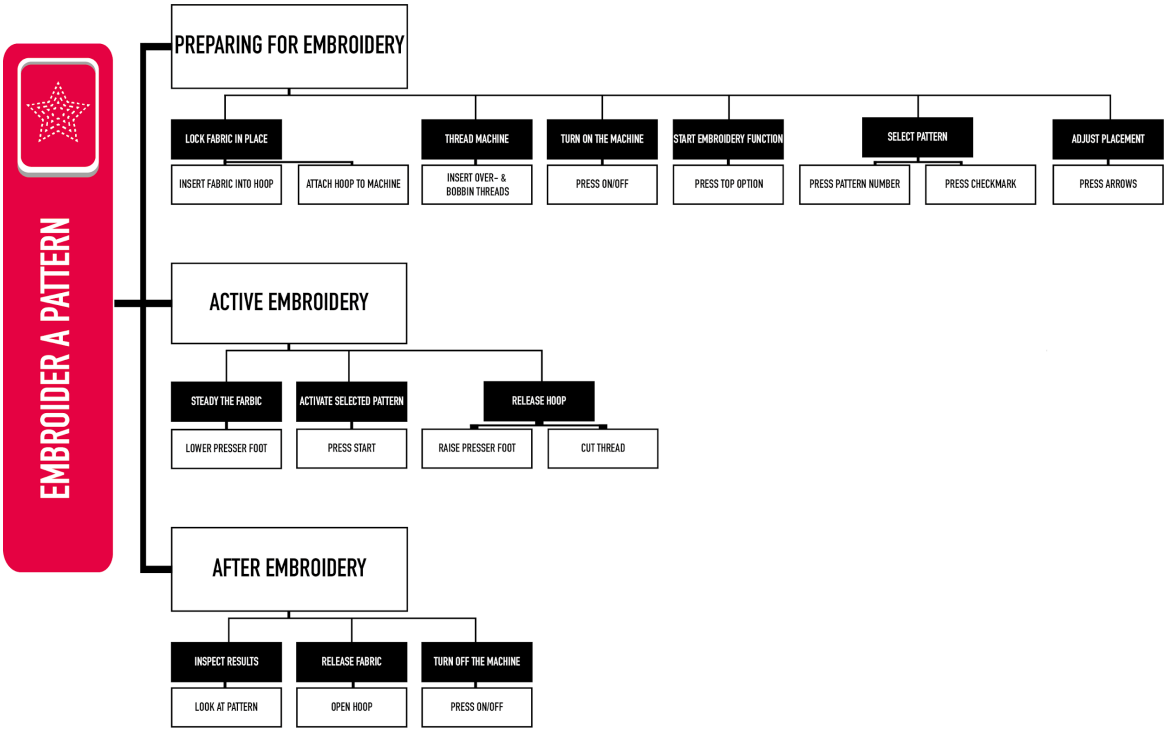



*Figure 7. Embroidering a pattern on fabric.*

***Express their creativitiy***

The participants generally considered themselves to be creative people. They craft and repair products of their own - sometimes using a sewing machine to aid this process. At the same time, none of the participants are using a sewing machine in their line of work and is therefore regarded as non-professional users. This separates them from more advanced users that are generally associated with the PFAFF persona (as describes by SVP group, internal memo).

***Potential and current Singer users***

By asking about the responders' age and what type of sewing machine they owned, it could be determined which of the responders who belong to the target user group and which of the responders who could potentially become Singer users. Two of the participants in the interview stated that they were aware of the type and model of their own sewing machine - while four participants only aknowlaged that they owned a basic model, but that they were not aware of the brand. None of the participants in the interview had bought the machine for themselves, but instead usead a machine given to them by a close relative.

***Frequency of use***

Questions regarding the frequency of use of sewing/embroidery machine were asked and 50 % of the study participants used their sewing machine a few times a year, most of these participants owned a basic sewing machine (appendix.4).

***Active buttons***

Most of the study participants used the foot pedal to control the machine (appendix. 4). Many participants used both start/stop button with pace control buttons. In this way the cables from the foot pedal is eliminated.

***Reading the manual***

Question regarding if the study participant read the manual or not was asked as a compliment question to the setting question stated above. The participant that rarely read the manual, usually used it when the machine was new, when using a new seam type and other special settings (appendix. 4).

***Focus during start/stop***

Participants thought it was most important to be focused when working on fine details such as corners, circular shapes, sewing multiple layers and hitting the marks on the pattern. Some also thought that it was important to be focused when starting and ending the sewing process. During the start/end of sewing process the participants must use *active functions* such as tack stitches and reverse button which are placed close to the needle.

***Difficulties***

Specific information about difficulties could be used to find functions that are needed and desired by the user. Changing settings on the sewing machine is one of the main difficulties for the users. Issues such as knowing what seam types that are best suitable for different fabrics, what thread tension and what sewing foot that are correct to use. Participants expressed that trial and error takes a lot of time and patience which "takes the fun out of sewing".

***Embroidery***

Only 20% of the participants who owned an embroidery machine did use it (appendix. 4). Participants wanted to be able to be creative and transfer their own designs to the machine. They wanted to have the ability to make big embroideries and complex shapes. During the interviews, participants stated that they didn't own an embroidery machine. The types of projects that could be created with an embroidery machine were - in their current form - not regarded as desirable.

***Settings***

A majority of participants thought that it was important to change settings due to the implication this has on the quality and result of the project (appendix. 4). Settings

mentioned were, width and length of the stitches (depending on the material), thread tension and needle selection. There was a noticeable difference between owners of Singer sewing machines with how important the settings were - many used standard settings instead of adjusting them themselves.

Most participants attributed thread breaks to using the wrong settings. While some participants were unsure of the purpose of individual settings, they were still aware of the impact that the settings have on the final results. To avoid problems with their final piece, they test the settings on a scrap piece of fabric.

### 3.2.3 Market related answers

This section compiles the results from the user study relating to costumers and their perceptions about Singer Co.

***Price range***

A question regarding how much the study participants would be willing to pay for a sewing and embroidery machine varied between the different ages of the participants. A majority of the target group was willing to pay around 200 euros for a sewing machine while an analysis of the total amount of participants was willing to pay around 300 euros (appendix. 5). This could be a result of the occupations of the younger target group - many are students and price sensitive.

***Buying additional seams***

52.2 % of the participants would be willing to pay for additional seams and they would want the price to range between 1-3 dollars (appendix. 6).

***Perceptions about Singer Co and their products***

The participants think that Singer Co is an established company, well known for their machines and their quality. Keywords: good machines, traditional, reliable, good price, trustworthy and classic. A few participants were not happy with Singer sewing machines - they believed that Singer sewing machines used to be good, became bad and now is on an upswing.

# 4

# Usability test

This chapter describes the planning and execution of the usability test. Further, it describes the gathered results and how it was analysed.

## 4.1 Method

The data collected from surveys and interviews were considered insufficient without an observation which were later to be done with a usability test where the buttons/functions were to be placed on either the physical sewing machine or in an app.

A usability test was conducted with six test study participants. During the usability test, participants were asked to perform certain tasks on a mockup of the physical product, and a prototype app created in Adobe XD. The usability test was divided into 3 parts (fig.8) that aimed to investigate how the user interacts with a sewing/embroidery machine if:

(part 1) all functionalities are placed on the physical machine.
(part 2) functionalities on both the physical machine and on an external screen.
(part 3) all functionalities are placed on an external screen.

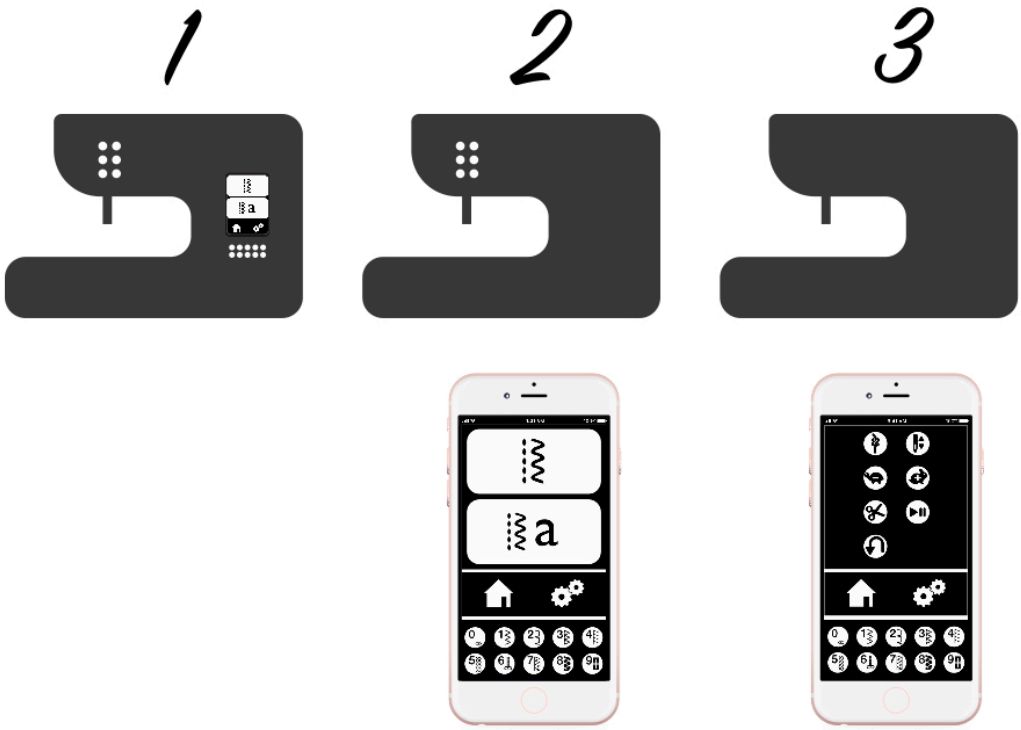



*Figure 8. Usability test divided into three parts.*

This aims to investigate which functions that are to be placed on the physical machine, and which functions that can be exported to the external screen.

A test leader and a *"wizard of Oz"* participated in the test. The participants' actions were filmed and later on compared.

### 4.1.1 Participants

The participants were part of the target group but Swedish residents due to limitations regarding arranging usability tests abroad. They were between the ages of 20-35 and all six participants were female. Users with different levels of experience regarding sewing/embroidery participated in order to investigate if there is any difference between how willing they are to accept a new solution. The participants were divided into two groups - A and B - according to the order in which they would conduct the test (Group A tasks 1,2,3 - Group B tasks 3,2,1)

### 4.1.2 Procedure

During the first usability-test, participants was asked by the test leader to perform certain tasks on a mockup of the physical product, and a prototype app created in Adobe XD. When the participants used any of the available functions, the "wizard of Oz" controlled the appropriate feedback from the mockup. During the intermission between the different

parts of the test the participants was asked questions regarding their performance. The results from the usability test was later divided into the participants opinion on their own performance and the observed performance in order to investigate any discrepancies.

During all three parts the participants had access to an instruction manual explaining the different functions of the mock-up.

### 4.1.3 Product representation - physical product

A mock-up was made due to the fact that a working machine makes comparisons with the new solution more difficult. If using the actual product instead of a representation, better usability might be expected due to the products higher level of refinement – compared to lower results for a less refined representation.

A mock-up was crafted in blue foam and used as a representation of the physical product. The mock-up needs to be the same size as an existing sewing machine - Singer Legacy SE300 (Singer, 2015) - in order to make the results valid. The mock-up had limited functionality with only the vertical movement of the needle, the horizontal travel of the fabric and a power switch that also controlled the machine lighting.

To control the needle, the participants used the designated start/stop interface (button or foot pedal) or rotate a wheel on the right side of the mock-up. While the start function is engaged, the fabric was reeled in by the mock-up operator - simulating the real travel of fabric. Both the needle and fabrics speed were adjustable. The moving needle and fabric was decided to be the minimum amount of functionality required in order for the users to receive feedback on their actions.

The physical buttons on the machine was represented by magnets. Covering the mock-up with magnetic paint facilitated the testing of different button layout by enabling the rearrangement of the buttons.

### 4.1.4 Product representation - Digital

Three prototype apps were created in Adobe XD. On the first test - where all functionalities are placed on the physical machine - the interface of the first app was a replica of Singer SE300 led-screen with its' functionalities. The second test where functionalities are both on the physical machine and on an external screen – functions such as seam types was added to the app. On the third test all functionalities are placed on an external screen.

### 4.1.5 Tasks

Several tasks were constructed in order to observe and investigate the user's interaction with the machine during specific assignments (appendix. 12).

The correct method of completing a task was visualized with an HTA (fig. 6 & 7). While this is close to a complete description of the task, a few of the tasks was not possible to execute due to limitations of the product representation. These include threading the machine, lowering the presser foot and attaching the hoop to the machine. The participants were able to complete the tasks with different levels of detail, depending on what level of quality they expected in their final results.

## 4.2 Results

The observations of the usability test were divided into different categories:

- Did the participant use the foot pedal or the button (on/off).
- What their actual *control* was compared to their experienced *control*.
- Whether or not they changed the settings and if they had control over them.
- If they tried before reading the manual or not and how much time the tests took to complete.

These pillars were observed (appendix. 7) through the three different tests with their different elements such as sewing, embroidery patterns and embroider letter combinations.

*Table 5. General results – Usability test*

*Part 1.*

| **Test sequence group** | **Group A: 1,2,3** | **Group B: 3,2,1** |
|---|---|---|
| **Foot pedal or button (P,B)** | They all used the foot pedal | Two used the buttons with speed control and one used the foot pedal |
| **Control (actual, 1-5)** | The overall control of the sewing process was high. Meaning the travel of fabric and straight stitches. | The overall control of the sewing process was high. Meaning the travel of fabric and straight stitches. |
| **Control settings (1-5)** | Average control - study participants did not seem secure or done with the assignment.<br><br>Participants did not get any feedback from the app saying the embroidery is programmed into | High amount of control.<br><br>One participant did reset the embroidery before starting the embroidery. |

| | | |
|---|---|---|
| | the sewing machine (no check mark). | |
| **Changing settings** | One participant believed that the default settings was on straight stitches. | Yes, everyone changed settings. |
| **Reading the manual** | Everyone read the manual when doing the embroidery<br>67% read the manual when sewing<br><br>Everyone read the manual when doing the letter combination. | Everyone read the manual when doing the embroidery<br><br>67% Did not read the manual when sewing<br>33% did not read the manual when doing the letter combination. |
| **Try before reading** | 67% did try before reading (embroidery figures)<br><br>No one tried to read before during the letter embroidery | 67% did try before reading (embroidery figures)<br><br>67% did try before reading (letter embroidery) |
| **Experienced success rate (1-5)** | Average (sewing) | High (sewing) |
| **Success rate** | High | High |

*Part 2*.

| **Test sequence group** | **Goup A: 1,2,3** | **Group B: 3,2,1** |
|---|---|---|
| **Placement of smartphone (passive)** | 67 % of the participants held the smartphone in their right hand | The participants placed the app on the left side of the table |
| **Placement of smartphone (active)** | 80 % of the participants put the smartphone on the right side of the table. | The participants placed the app on the left side of the table |
| **Control (actual, 1-5)** | Highest score | Highest score |
| **Foot pedal or button** | 80 % of the participants used the foot pedal to adjust the speed of the fabric feed. | 50% used the foot pedal |
| **Control settings (1-5)** | The control of settings was high | The control of settings was high |
| **Changing settings** | Yes, everyone changed settings. | Yes, everyone changed settings. |
| **Reading the manual** | Only one participant read the manual | Nobody read the manual in first part of the test |
| **Try before reading** | Only one participant did not try before reading | Everyone tried before reading. |
| **Experienced success rate (1-5)** | Believed that they had a very high success rate of the test | Believed that they had a very high success rate of the test |
| **Success rate** | High success rate. | High success rate. |
| **Time 1.1 (minutes:seconds)** | 2:05 | Similar to the first group. |

*Part 3*.

| **Test sequence group** | **Group A: 1,2,3** | **Group B: 3,2,1** |
|---|---|---|
| **Placement of smartphone (passive)** | 67% kept the smartphone on the right side of the table.<br><br>During the embroidery phase, 67% of the participants held the phone in their hand | Everyone kept the smartphone on the left side of the table. |
| **Placement of smartphone (active)** | Everyone kept the phone on the right side of the table. | 67% kept the phone on the left side of the table. |

| | | |
|---|---|---|
| | Had the phone on the table during embroidery | |
| **Embroidery placement check (paper, phone)** | 67% checked with the phone to see if the embroidery was correct on the fabric | 33% used the paper to check if the embroidery was placed correctly. |
| **Control (actual, 1-5)** | Very low with 46 % control. The feed of the fabric was not controlled<br><br>The control was high during the embroidery test | Low score. Most of the study participants was not prepared when the machine started. The feed of the fabric was not controlled<br><br>The control was high during the embroidery test |
| **Control settings (1-5)** | 80 % control over settings.<br><br>Embroidery - a high amount of control. | 67 % control over settings.<br><br>Embroidery - a high amount of control. |
| **Changing settings** | Yes, everyone changed settings | Yes, everyone changed settings |
| **Reading the manual** | 67% did not read the manual. | 67% read the manual. |
| **Try before reading** | 67% tried before reading the manual. | Everyone tried before reading the manual. |
| **Experienced success rate (1-5)** | Participants experienced that they had a very high success rate | Most of the participants believed that they had full control and full success rate of the test. |
| **Success rate** | The success rate was similar compared to the other group.<br><br>Embroidery- high success rate | Average success rate cause of the low quality of the sewing stitches.<br><br>Embroidery- high success rate |
| **Time 1.1 (minutes:seconds)** | 9:30 | 37:00 - one participant had a time on 17 minutes. |

The analysis of the observations has been made to compare the different groups (A and B) based on their differences during the test and to understand what factors that influenced these differences. Group A performed the test in a natural order (part 1, 2, 3) while group B performed the test in reverse order (part 3, 2 ,1).

### 4.2.1 Control

The participants believed their success rate to be high, rating it to be 9 out of 10 on average. This score was consistent throughout the different parts of the test.

Control was defined as *the level of which the user interacts with the machine with clear intention and without the risk of injury or faulty usage*.

The participants expressed that their perceived control varied between the different parts of the test. Further, they expressed a steep learning curve, resulting in them scoring their control lower in their first test then in their second and third. The participants who conducted the test in the same order consistently gave part three the lowest score. Regarding tasks that investigated the usability of the embroidery functions, the participants expressed that they had maximum control - regardless if the settings panel was placed on the physical machine or on the external screen.

Most of the participants believed that they had full control and a full success rate during the third part of the test. This was not the case. The feed of the fabric was not controlled and gave a low actual success rate due to the low quality of the sewn stitches. This occurred due to the participants activating the start button without having the control over the fabric. Some participants tried to grip the fabric with two hands when starting, which was not possible without a foot pedal.

### 4.2.2 Using the manual

The majority of the participants in group A read the manual when sewing. A majority of the participants in group B did not read the manual. This could have been due to the participants being more inclined to explore a mobile interface than a fixed display on a machine. All the participants were regular users of apps on their own phones and therefore might have been more and more comfortable to exploring the app.

Everyone read the manual when they embroidered patterns due to the fact that the numbers that corresponded to a specific pattern could only be found in the manual. During test 2 both group A and B had high control and success rate.

67% in group B did read the manual after choosing their settings. It appeared as if this was to double check if they had adjusted the settings in correctly.

### 4.2.3 Safety

The test participants explored different functions before reading the manual on a greater level when all the functionality was placed on the phone. This could be explained by the fact that pressing a button in an app generally don't have any implication in the physical world - the repercussions of a use error could therefore be considered to be less severe. While this may be true for many apps, by controlling a physical machine with the app, this could lead to possible safety hazard. If the user activates the START-button while exploring the app, the machine starts sewing and the user is at that point not in control.

Several of the participants expressed a desire to be able to hold the fabric with both hands when they begin to sew. This also affected their perceived control and could also be regarded as a safety issue.

### 4.2.4 Usability

After the first part of the test, one participant expressed a lack of control due to the distance between the settings panel (appendix. 15) and the sewing controls (appendix. 1). The participant later stated that this issue was resolved when the settings panel was placed on the external screen. In turn, this led to issues regarding where the external screen was to be placed in order to be accessible.

Group B performed the tasks in a shorter amount of time than group A. They had 40 percent shorter sewing time, 43 percent on combining letters and 86 percent less time on embroidering figures. Both groups were time efficient on executing the letter combination test. This could be due to learnability, that they read the manual before or another theory is that interface has a high level of external consistency.

One participant did exit the embroidery menu before restarting the task and completing it. During the test, the participant expressed that she didn't know if the pattern was ready to embroider. This could be due to the interface lacking in internal consistency. To select a pattern, the user must press the check mark - to start the embroidery, the user should instead use the start button.

### 4.2.5 Tack function

Many participants did not use the tack function, even though they described that they wanted to. This could be due to its symbol not being relatable enough - lacking in external consistency (Norman, 2013). The participants wanted to achieve a set task, could see the correct action, but did not associate it with the correct result (Section 7.4). While this is an issue related to usability, it could instead be analysed to distinguish user patterns. By acknowledging the participants request to use the tack function, it could be derived to be a function that the user requires in order to achieve satisfactory results. In turn, by using the tack function, the user is looking for an end result of a higher quality.

### 4.2.6 Settings

The level of control in which participants navigated through the app was high, while some participants used the default settings due to insufficient knowledge of what kind of settings that were the most appropriate to use for the different tasks. Some participants explained that they usually let someone else adjust the settings for them or that they only use the default settings. Factors that are in direct connection with settings are,the material and what the end product is going to be used for.

### 4.2.7 Possible user benefits

During the test, the participants had to read the instruction manual in order to find which embroidery pattern corresponded to what number (appendix. 11). The participants repeatedly suggested that the images from the instruction manual could be integrated directly into the app - minimizing the need to rely on external sources of information and tutorials.

The embroidery assignment had a high success rate for both groups. During the embroidery phase 67% checked with the phone to see if the embroidery was placed correctly on the fabric.
Some participants used the phone to navigate, they were rotating and moving the phone closer to the hoop when adjusting a difficult embroidery.

Some participants suggested that a greater level of automation and advanced technology (i.e. controlling the machine with an external app) could be beneficial when a task has to be completed within a short period of time. While the other participants shared this sentiment, they acknowledged that this could lead to a decrease in user satisfaction due to not experiencing the desired feeling of creating something yourself.

Group B had a total time of 37:00 - one participant had a time of 17 minutes. This was because she was confused whether or not the machine was turned on. This was a common mistake with the study participants. A confusing factor was that the app was turned *on* but the machine was not. All the buttons were placed on the app and only one on the right side of the machine, which might have led to that the participants not pressing the on/off button.

### 4.2.8 Expectations

Some participants expressed that they would expect the machine to be able to sew straight seams as a default setting - even while the machine was not connected to the app. Even though they use their phone frequently and often carry it with them, the participants expressed that it would be an issue if the machine had no functionality by itself.

## 4.3 Conclusion

By analysing and evaluation the actual level of control (table. 5) during the different parts of the test in combination with the issues that occurred, it was concluded that the concept of placing *active functionality* on the machine – while the app is used for *passive functions* – appeared to be the most promising.

# 5

# User requirements

This chapter describes the user requirements presented in a persona and a specificfaction of requirements based on the persona and observations collected during the usability test.

## 5.1 Persona

The information collected through the user study was analysed and used to create a persona of a primary user for the target group.

SINGER

"Sewing should be easy,fun and help me express myself!"

**Name:** Alice
**Age:** 20-35 years
**Nationality:** European
**Occupation:** Student in a creative field
**Career:** In a major company (creative field)
**Education:** Bachelor degree
**Financial status:** Thrifty economy
**Family status:** Domestic partnership.
**Hobbies:** Crafting, travelling and sewing.
**Types of sewing:** Alterations and repair on clothes, clothes for herself and interior.

### Alices story

Alice is a bachelor student in a creative field and enjoys spending her spare time crafting with friends. She learnt how to sew on her mother's old Singer sewing machine and for college present she was given a sewing machine. She finds sewing as a good way to express herself and creating things for herself.

Alice has always enjoyed crafting and consider herself to be a creative person with many ideas. Alice is inseparable from her smartphone and often browse the internet to get inspiration on interior and clothing design. She finds it difficult to find interior that suits her personality and instead likes to decorate her home with products that she has made herself - that way it reflects her personality.

### Expectations while sewing

Alice is not a regular sewer but she likes to sew minor projects such as alterations on clothes, accessories and interior. Alice would rather create many minor projects than a few big ones. She finds reward in making her own products with minor effort. When Alice gets the idea of a project, she feels eager to start off the project and begin sewing as soon as possible. Alice thinks that it's essential that the machine is easy to use. She doesn't have high expectations on the sewing process, she just wants the machine to be reliable.

Alice hasn't got an embroidery function on her machine. When an embroidery is needed she creates the pattern and sews it herself. Sometimes Alice finds it hard to know what kind of settings she is supposed to use for different fabrics. She often uses the default settings on the machine. She thinks that default settings are good enough to get proportional stitches.

"Most of the time zigzag and straight seams are the only thing that you need. And if they are not good enough - then I try the seams on a scrap piece of fabric to see if they're suitable."

### Which are their users goals?

**Experience**

Alice wants the sewing process to be fun and make her feels like her creative ideas are presented in the products that she makes.

She wants the functions on the machine to be easy to understand and use and that the machine does as she wishes.

"A machine that forces me to read the manual is not a good one"

**End**

Alice is happy to show her friends and family what she has created and find pride in succeededing with her project.

Alice wants the time she spent on a project should be visible in the final results, but not in detail. She rather wants to create minor projects with less effort than focusing on "perfect finish".

**Life**

A creative person is something that Alice prides herself to be. She wants to be acknowledged for her ideas and skills.

She feels that clothes are a great way to express her personality and uses the sewing machine to personalize the clothes that she buys.

## 5.2 Specification of requirements

Due to the safety issues observed when test participants controlled the *active functions* from the app – in combination with the observed benefits when *passive functions* were placed on the app – a decision was made to further investigate this placement of functions.

The specification of requirements (table. 6) was based on observations made during the user study and the persona and is divided into three domains – *App, Machine* and *Embroidery: Machine and App*.

*Table 6. Specifications of requirements.*

| **APP** | | **Requirements** | **Measurements** | **Desired/Necessary** |
|---|---|---|---|---|
| **USABILITY** | | | | |
| | *Cognitive ergonomics* | Haptic feedback | Vibrations for 0.5 seconds | D |
| | | Minimize strain on user memory | 7 +- 2 objects in working memory | N |
| | *Consistency* | Internal and external consistency must be used throughout the interface | Button functions are not allowed to change.<br>External semantic references must cohere with the user's mental model. | N |
| | *Visual Clarity* | Fonts must be readable | From 500 mm | N |
| | *Constraints* | Active phase | Settings can't be accessed while the machine is active. | N |
| | *Constraint* | Active app | Screen will not turn off. | |
| **FUNCTIONS (minimum)** | | | | |
| | *Passive* | Select seam type | Most used seams 0-9 | N |
| | | Change thread tension | 0-8 | N |
| | | Change stitch width | 0 - 7 mm | N |

| | | | | |
|---|---|---|---|---|
| | | Change stitch length | 0 - 5 mm | N |
| **SINGER ECO SYSTEM** | | | | |
| | *Integration with existing apps* | Sewing Assistant | | D |
| | | Creator Cue | | D |
| | *Semantic profile* | colour palette | Pantone 199C<br>Pantone CG7C<br>(White HS25-555) | N |

**Machine**

| | | | | |
|---|---|---|---|---|
| **USABILITY** | | | | |
| | *Cognitive ergonomics* | Machine control functions | Placed within users' field of view | N |
| **FUNCTIONS (minimum)** | | | | |
| | | Machine control functions. | Singer legacy SE300 (appendix. 1) | N |
| | | Foot pedal | | N |
| | | On/off button | | N |
| | | Device hook | Length > 12 cm (Apple, 2014)<br>Width > 1 cm (Apple,2014) | N |
| | *With or without the app connected* | Default setting - straight seam type | Length 2,5 mm | N |
| | *Restart of machine* | Resets settings | Resets to default straight seam | N |
| | *Pairing* | Start pairing mode button. | Bluetooth | N |
| **SAFETY** | *Machine control functions* | Tack, reverse, scissor, vertical needle adjustment. | Can't be accessed while sewing is engaged. | N |
| **SINGER ECO SYSTEM** | | | | |
| | *Semantic profile* | colour palette | Pantone 199C<br>Pantone CG7C<br>(White HS25-555) | N |
| | | Exterior design | Coherent with new Singer profile (SE 300) | N |

# Embroidery:
# MACHINE AND APP

| | | | | |
|---|---|---|---|---|
| **FUNCTIONS (minimum)** | | Inactive foot pedal | | N |
| | *Machine control functions* | Start/pause | | N |
| | *Embroidery unit* | Embroidery unit is connected. | Embroidery app is visible | N |
| | *App functions* | Rotate pattern | +-360° (10° increments) | N |
| | | Place pattern | Within hoop | N |
| | | Scale pattern | 5” × 7 in embroidery hoop | N |
| | | Create pattern | Convert image to pattern | N |
| | | Change thread colour | App alarms user to change thread colour | N |
| | *Restart of machine* | Backup settings in App | Resets to default straight seam | N |
| **SAFETY** | *Machine control functions* | Tack, reverse, scissor, vertical needle adjustment, speed control | Can’t be accessed during an active embroidery. | N |
| | *Settings* | Sewing settings | Can’t be accessed during an active embroidery. | |
| | | Embroidery settings | Can’t be accessed during an active embroidery. | |
| | *Speed control* | foot pedal | Inactive when settings have been programmed into machine | |

# 6

# Conceptualization

Different ideas that meet the specification of requirements was explored through the ideation phase by using a general design methodology (exploring, investigating, iterating) and theories regarding usability. During the exploration phase, a *brainwriting* was conducted in order to create large quantities of ideas. These ideas were then evaluated with a *Pugh matrix* to determine what – or which – ideas that were the most promising. The most promising ideas served as a baseline for the next iteration. The ideation phase resulted in a suggestion for placement of functionalities on the app and machine.

## 6.1 Ideation

This section describes the methods used to determine what functions the users want and the manner in which the ideation was conducted.

***Kano model***

A Kano model was used to identify and understand the users' needs and desires. The needs are divided into three different groups: basic needs, performance needs and excitement needs. Basic needs are the obvious needs that has to be satisfied or the user will be dissatisfied. Performance needs is important functions that makes the sewing machine more attractive for the user. Excitement needs are the needs that creates a high amount of satisfaction for the user (Lindstedt & Burenius, 2003). The Kano model was based on the persona of the hobby sewer and the specific requirements list (Chapter 5)

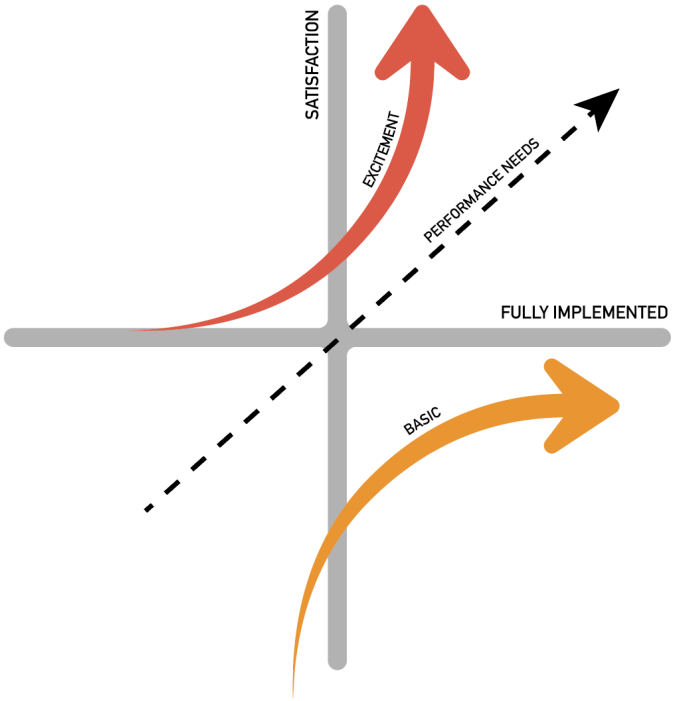



*Figure 9. Own illustration - Kano model (Lindstedt & Burenius, 2003).*

An ideation was conducted in order to explore functions that met the excitement needs investigated through the kano-model (fig. 9). The ideation was divided into five categories: *App Sewing / Embroidery*, *Machine Sewing / Embroidery* and *interconnection*. The latter referred to ideas regarding feedback from the machine and input from the user.

A *brainwriting* was conducted by writing ideas on Post IT notes for 3 minutes on each category. Brainwriting is a method used to quickly explore several ideas without constraining the creative process (Österlin, 2011).

### 6.1.1 Results

This section describes the ideas for different needs according to the Kano-model.

*Table 7. Kano model results*

| **Basic needs** | |
|---|---|
| **Sewing** | |
| | Seam selection<br>Seam settings |
| **Embroidery** | |
| | Select pattern (including letters)<br>Transform pattern<br>Create new and edit patterns |

## Performance needs

| | |
|---|---|
| **Sewing** | |
| | Stitch preview |
| | Instruction manual in app |
| | Save settings |
| **Embroidery** | |
| | Visual preview of embroideries |
| | Polychromatic patterns |
| | Alert when threads needs to be switched |
| | Pinch to scale and move pattern |

## Excitement

| | |
|---|---|
| **Sewing** | Scan seam-types |
| | "*Projects*" |
| | Interactive tutorials |
| | Measure sewing distance |
| | Visualize seam types and dimensions |
| | Show settings while machine is active |
| | Save projects and seams |
| | Combine different seams |
| | Default settings for different fabrics |
| | Buy seams |
| **Embroidery** | |
| | Virtual hoop |
| | Preview pattern |
| | Add photo to hoop preview |
| | Realistic preview on fabric without hoop |
| | Switch patterns when in preview mode |
| | Create an embroidery from an image and edit it |
| | Combine patterns and letters |
| | Live update of embroidery status |
| | Incorporate community apps |
| **Machine Excitement** | |
| | A laser indicates pattern placement on fabric |

***Excitement needs***

The ideas created during the ideation phase was collected and placed in their respective categories (fig. 10). To further summarize the results, similar ideas were distilled and compared to the persona and the specifications of requirements (Chapter 5).

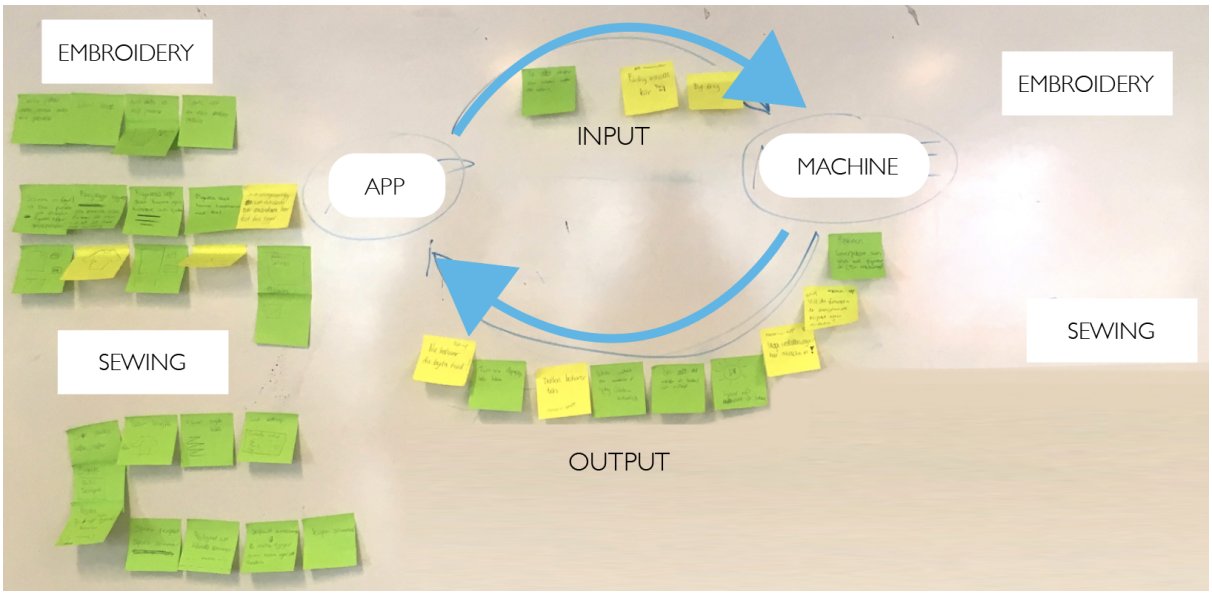



*Figure 10. Ideation phase.*

***Add photo to hoop - preview***

A real time preview of a pattern (fig.11) on a piece of fabric could be created by taking advantage of the camera on the phone, and the phones mobility. The user would take a photo of the fabric on a flat surface and then use that photo to preview patterns on.

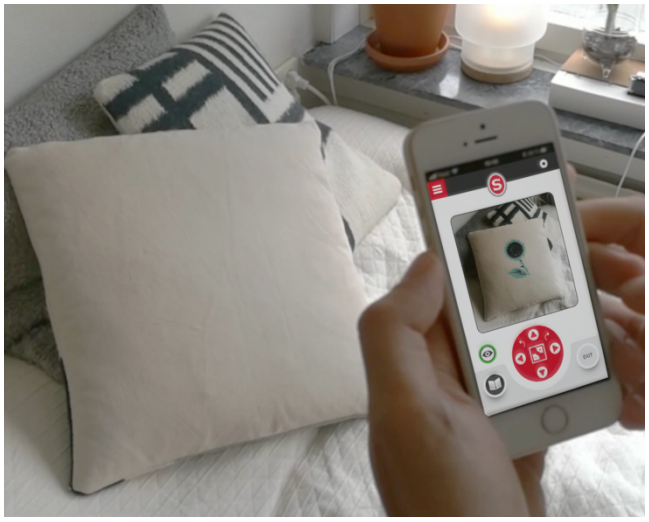


*Figure 11. Real time preview of pattern.*

***Real size preview - with reference***
By incorporating the "add photo to hoop" idea with a reference element - such as a bobbin or reference dots on the machine - the image could then be used to achieve a real size preview and placement of the pattern on the fabric. The bobbin was selected as a reference due to its fixed size and accessibility.

***Creating your own patterns***
By utilizing the camera on the phone, an embroidery pattern could be created from physical objects or images. This function was intended to work in same way as the Image Stitch app (Pfaff, 2016).

***Layout***
Several different layouts of the home screen were investigated. While the functions were not yet determined, their general placement could be explored.

***Projects***
In order to incorporate the instruction manual, help with ideas and automatic settings - an idea called *projects* was created. *Projects* would include content created by users or Singer, complete with instructions of a task and settings. A user would get a shopping list of what materials to buy before starting the project - and then receive step by step instructions during the project. The idea with *projects* was to meet the user need of a machine that is easy to use.

***Buy seams***
In a similar fashion to projects - where content and functionality is added after shipping the product - an idea was to allow the user to buy additional seams.

***Feedback regarding the interconnection between app and machine***
When an embroidery pattern is being transferred to the machine, the app could show a loading screen - and when the pattern has been successfully sent, the machine could indicate this with a green light around the play/pause button.

When the app is turned on for the first time, the app prompts the user to start the machine and press the Bluetooth button on the machine to begin pairing. Once pairing is activated, the user can press the connect button on the phone.

***Home-screen sewing and embroidery***
Several different layouts of the sewing and embroidery home screens were created in Adobe Illustrator. The placement of the basic and performance functions were prioritised in the layout of the app. The conceptual home-screens were visually different, but they all had the same functionalities (fig. 11,12 and 13).

- The ability to switch between the sewing and embroidery home-screen tabs.
- When entering the different tabs, the next one will lock itself and will not be accessible.
- There is a “slide-out” menu that has information such as manual, account and instructions.
- In the sewing tab the layout is divided into *projects* and seam types - only the relevant and most common seam types is shown. When activating a project or seam type a green circle will appear.
- New projects are created by tapping the plus symbol.

An idea generation between different layouts were made and resulted in three different layouts. These were later evaluated in a Pugh-matrix (Table. 8). Figure 11 acted as a reference to be compared with two other layouts (fig. 12 and fig. 13) .

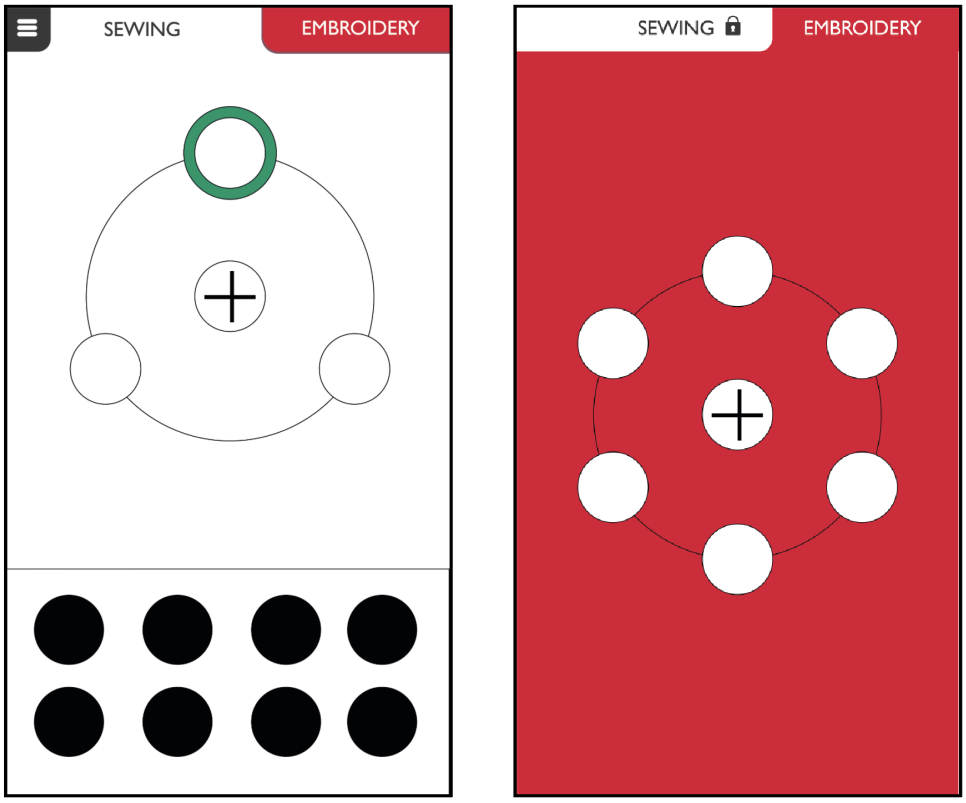



*Figure 11. Home screen reference of sewing and emboridery*

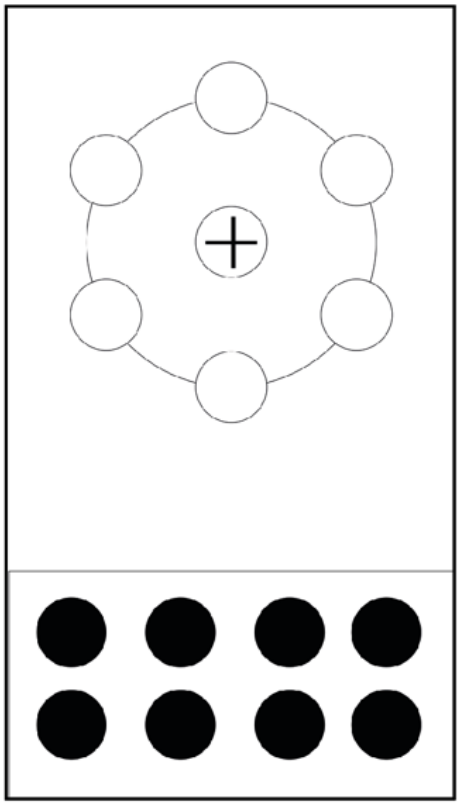


*Figure 12. Layout 1.*

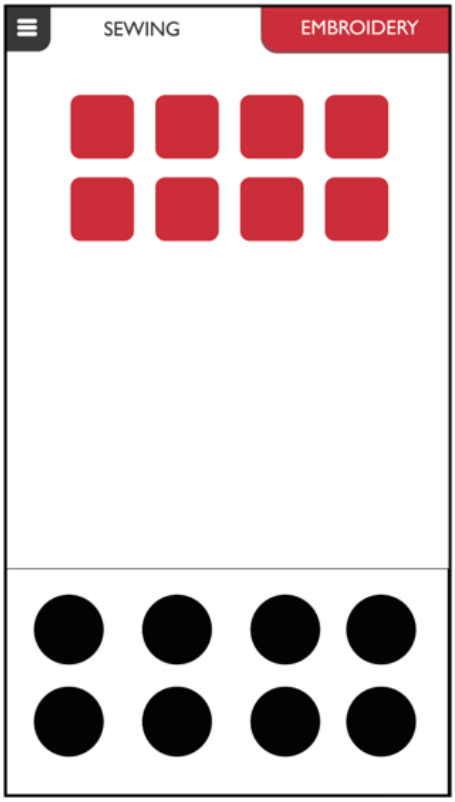



*Figure 13. Layout 2.*

## 6.2 Evaluation

This section describes the method used in evaluating the different home screen concepts. An evaluation of the three different layouts for home screens was conducted with a Pugh-matrix. The layout that received the highest score was selected to act as a framework for the construction of the app.

### 6.2.1 Method - Pugh matrix

The pugh matrix was used in the choosing for the most effective app concept which were later to be used in the validation test. A pugh matrix is a table where different functions/features are given points in a comparison to a reference (Johannesson, H. Persson, J-G. & Pettersson, D, 2013) relative to criteria extracted from Jordans ten design principles (Section 2.5.1). The goal was to achieve the most intuitive concept possible.

### 6.2.2 Results – pugh matrix

Layout 1 (fig. 12) scored most points for the sewing home-screen and layout 2 (fig. 13) scored most points for embroidery home-screen.

*Table 8. Pugh matrix.*

| **Criteria / value**<br>Sewing | | **Reference (fig.11)** | **Layout 1 (fig.12)** | **Layout 2 (fig.13)** |
|---|---|---|---|---|
| Prioritisation of information | **4** | | + | 0 |
| Compatibility | **5** | | 0 | + |
| Visual clarity | **5** | | + | - |
| Feedback | **5** | | - | - |
| Number of options potentially visible at any time | **3** | | + | + |
| **Σ + ** | | | 12 | 8 |
| **Σ 0** | | | 1 | 1 |
| **Σ -** | | | -5 | -10 |
| Value | | | +7 | -2 |
| Ranking | | 2 | 1 | 3 |
| | | | | |
| **Criteria/value**<br>Embroidery | | **Reference (fig.11)** | **Layout 1 (fig.12)** | **Layout 2 (fig.13)** |
| Prioritisation of information | **4** | | - | - |
| Compatibility | **5** | | - | + |
| Visual clarity | **4** | | 0 | + |
| Feedback | **5** | | 0 | 0 |
| Number of options potentially visible at any time | **5** | | 0 | + |
| **Σ + ** | | | 0 | 14 |
| **Σ 0** | | | 3 | 1 |
| **Σ -** | | | -9 | -4 |

| | | | | |
|---|---|---|---|---|
| **Value** | | | -9 | 10 |
| Ranking | | 2 | 3 | 1 |

## 6.3 Initial concept

This section describes the contruction of the app interface created in Adobe Illustrator and InVision. The general framework of the app, evaluated by the pugh matrix was expanded to incorporate all the required functions and needs using Jordans principles (Section 2.5.1) for designing an interface.

### *6.3.1 Sewing home screen*

The home screen for sewing (fig. 14) was selected due to it's prioritisation of functions and information. The most used seams are accessible at all times from the home screen, while more advanced functions could be accessed through the swipe up and swipe out menus.

To create a sense of home, the user's *projects* - both bought and created - were given the most amount of space on the home screen. When a new project is created, it adds itself to the circular menu - resulting in every user having a personalised experience.

Functionalities related to adding new content - such as creating or buying a project - was placed in a menu that was accessed through the red button with a white plus sign.

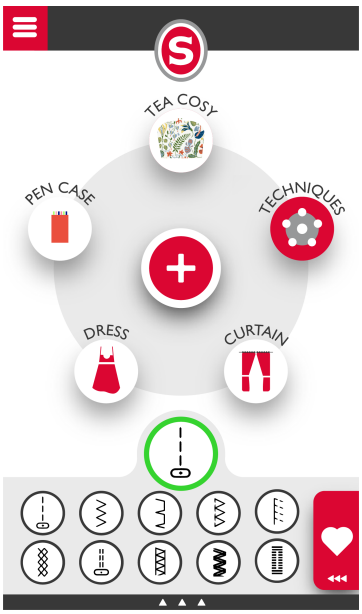



*Figure 14. Home screen - sewing*

### *6.3.2 Embroidery home screen*

The home screen for embroidery (fig. 15) was selected mainly due to the number of possible options that could be visible at any time. This is advantageous when browsing through multiple patterns. The participants in the first usability test expressed that the process of having to search through the instruction manual to find the numbers that corresponded to the embroidery patterns was unintuitive and time consuming.

The card symbol was selected to symbolize a store by referencing an actual credit card. To keep the interface consistent, a red button with a white plus sign represented the menu that contains functions that relate to creating new patterns.

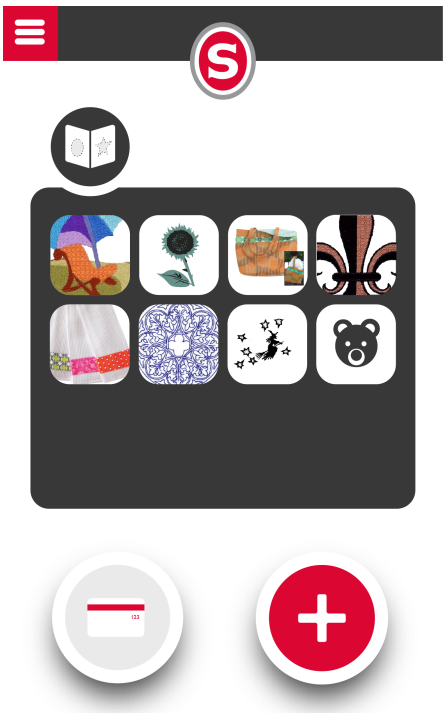


*Figure 15. Home screen - embroidery.*

### *6.3.3 Error prevention and recovery*

The backwards arrows represent the function to return to the previous page and is consistent throughout the app. Further, the addition of a *home* button enables the user to return to the respective home screen at any moment (fig. 16).

*Figure 16. Recovery.*

When the user selects a material that requires specific accessories, a warning is displayed to remind the user to switch presser foot and needle type (fig.17). This could in turn lead to the user being more aware of the impact that using the right accessories has on the results and may minimize the risk of use errors.


*Figure 17. Error prevention.*

### *6.3.4 Feedback*

During start up, the app prompts the user to start the machine and press the bluetooth button to set the machine into *pairing* mode. The user is then prompted to press the *connect* on the app. If the user completes this step, a loading screen will appear, revealing that the app and machine is establishing a connection. Once the *pairing* is completed, the app will prompt the user with a "Connected" (fig. 18).

Similarly, when a pattern is being sent to the machine, the app displays a loading screen that prompts the user that the pattern has been sent and instructs the user to press *play* on the machine to start the embroidery (fig. 19).

This feedback was thought to help the user understand the connection between the app and the physical machine.

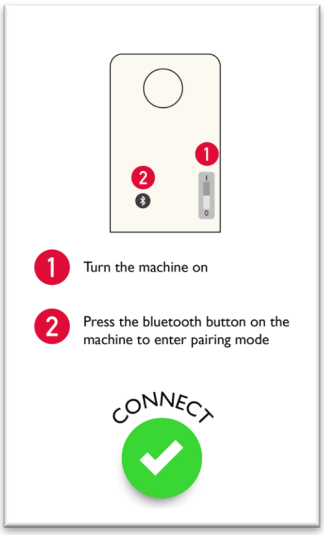



*Figure 18. Connecting the devices.*

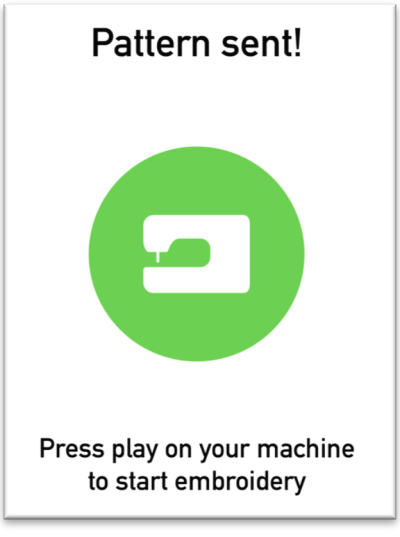



*Figure 19. Pattern sent to the machine.*

The chosen seam type was given a green ring to indicate that it was active (fig. 20). If a material had been selected, a symbol of the material was shown next to the active seam to give the user feedback on what settings had been chosen (fig. 21).

*Figure 20. Active seam type.*

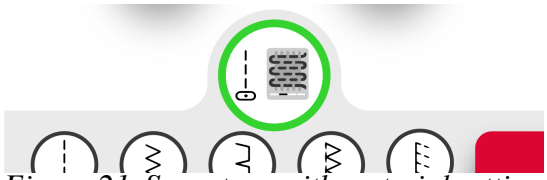


*Figure 21. Seam type with material settings.*

### *6.3.5 Affordances*

The checkmark is the symbol for "ok" and is represented in relation with a green colour which is consistent with other "ok" buttons in other products. The circular shape and shadow of the symbol creates the illusion of a button which indicates that it could be pressed. Other symbols such as erase is represented with an eraser, a colour palette represents changing colours and the black lines indicates change of contour density. (fig. 22).

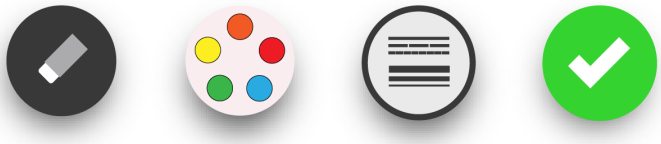


*Figure 22. Symbols: Eraser, colour palett, densitys and checkmark.*

Arrows (fig. 23) are used throughout the app to symbolise that the user could swipe for more information - it is possible to swipe down, up and to the side. A heart symbol corresponds to a *favorites* menu - in this case it represents the users' favorite seam types. Stars are used to symbolize the rankings on different projects (fig. 24).

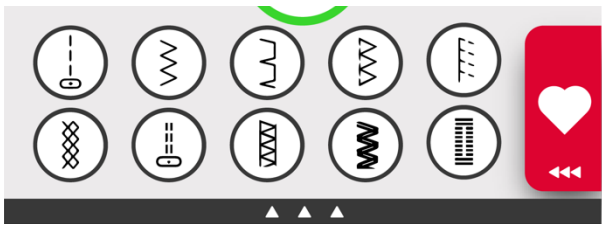


*Figure 23. Swipe for more information.*

*Figure 24. Project rankings.*

### *6.3.6 Brand identity*

To enhance the conception that the app belong to the Singer ecosystem of apps, the interface consists mainly of the colour profile (fig. 25) determined in the specification of requirements (table. 6).

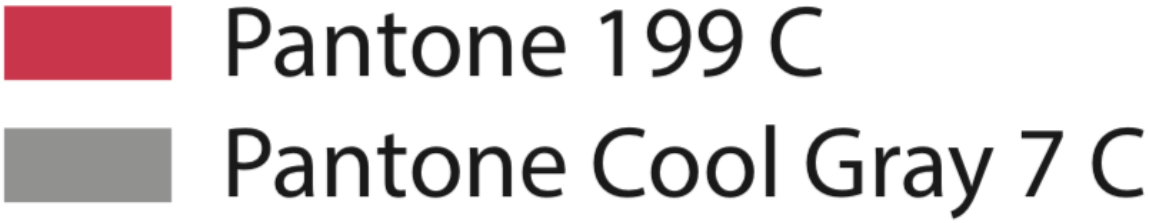



*Figure 25. Pantone colour profile.*

Negative actions - such as pressing STOP on a machine - is generally represented with the colour red. Using the swatch of Pantone 199C could therefore lead to the user to associate this colour with negative actions - creating an unfavourable impression of the Singer brand. Instead, grey colours and arrow symbols were used to create these affordances - and Pantone 199C were used for menus and options containing content *creation* and *projects*.

### *6.3.7 Visual clarity*

In order to achieve an interface with the optimal visual clarity, the distance between the user and the assumed position of the smartphone was measured. This distance was then used to determine what size the fonts had to be in order to be readable when using the app.

Due to a measured distance of ≈500 mm, the required font size had to be larger than 8 ppt (Design Resources, 2018). Therefore, by selecting a font size >12 ppt, text is readable at all times.

To further increase the visual clarity, a sans serif typeface was selected - Gill Sans (fig. 26 (left)) instead of a serif - Times New Roman (fig. 26 (right)). By selecting a sans serif, the text follows the general visual identity of the app.

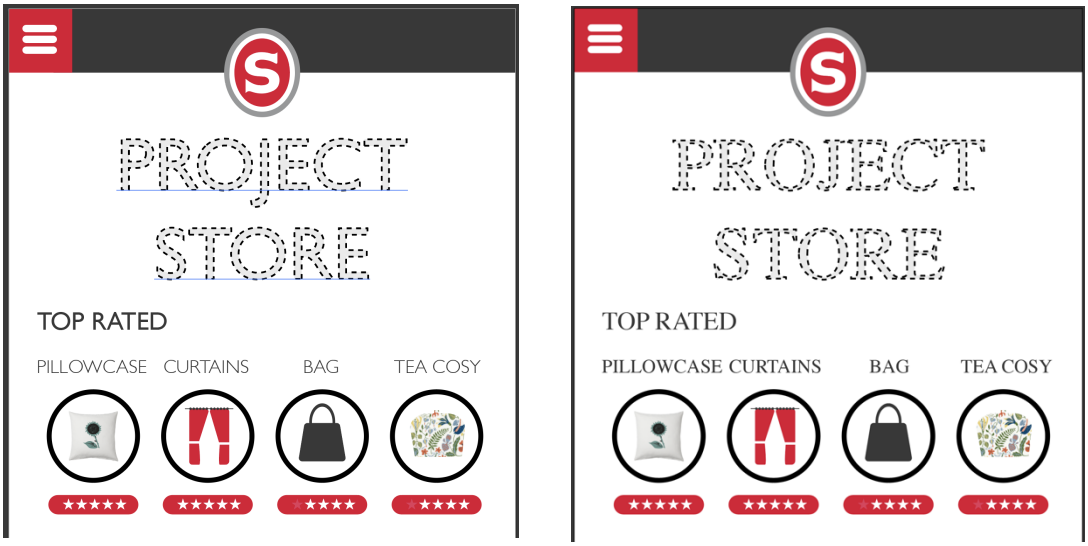



*Figure 26. Project store - Gill Sans (left) Project store – Time new roman (right).*

### *6.3.8 Communities*

The primary persona (Chapter 5) of the user group indicates the importance of sharing achievements and projects. Implementation of communities where the users could upload, share projects and communicate is regarded as a *excitement* feature which would increase the value of the product. The layout (fig. 27) is a suggestion on how the communities home-screen could look like. This layout contains the users most valued projects and favorite user-profiles (fig. 27).

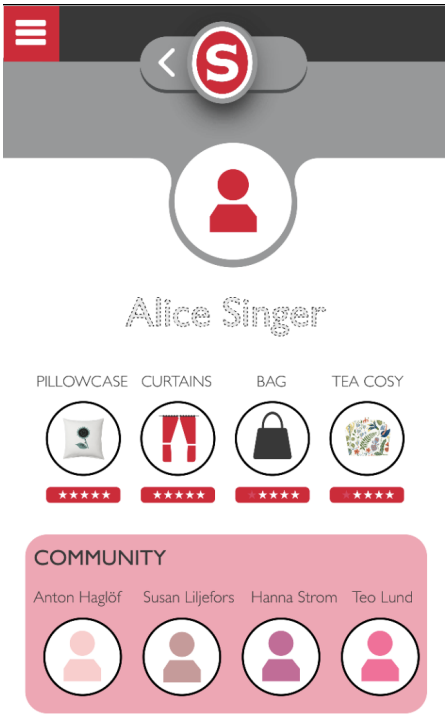



*Figure 27. Layout - User profile.*

# 7

# Validation

The concept - including both app and machine - was evaluated by conducting a validation test.

## 7.1 Validation test

The validation test – i.e second usability test - aimed to validate the concept created in the ideation phase. Six *between* tests participants – the participants were in the ages of 20-28 and had all tried sewing with sewing machines but would not be presented as highly experienced in sewing. Everyone had an high experience of using smartphones. The participants were asked to perform similar tasks as the participants in test one (appendix. 13), but with the new concept (chapter. 6.3). The first and second test was compared in order to determine if any user benefits, regarding usability, had been gained with the new concept.

### 7.1.1 Procedure

During the validation test, participants were asked to perform certain tasks: buying, creating and finding embroideries and seams (appendix.13) on a mockup of the physical product and with a prototype app made in InVision (Invision, 2018). After executing the different tasks the participants were asked questions about their experienced control and usability in using the app.

The test was divided into one sewing and one embroidery part. In order to investigate how the users interacts with the machine in combination to the app, the participants were asked to conduct specific tasks (appendix. 13).

The tasks aimed to answer the questions :

- How will the user find the correct functions?
- How will the user proceed to use the functions?
- How will the participant proceed to add additional functionality?
- Will the participant comprehend the connection between the machine and app?

### 7.1.2 Product and digital representation

Materials including the mockup, equipment and the active buttons were reused from the usability test (Chapter 4). Changes to the mock-up was made by enabling a phone-stand where the participant was able to place the smartphone while sewing (fig. 28). A bluetooth button was added to the mock-up in order to investigate how the users would connect the machine and app.

*Figure 28. Machine mockup with prototype app.*

## 7.2 Results

The observations from validation test were divided into different categories.

- Placement of phone.
- Connecting the app to the machine,
- Control.
- Success rate.
- If they tried before reading the manual.
- The time it took to complete the test.

These pillars were observed (appendix. 8) and analysed (appendix. 9) through the different tasks.

***Control***

Similairly to the analysed results from the first usability test, the validation test concluded that the placement of *active functions* on the machine and the *passive functions* in the app resulted in higher levels of percieved control than in part 1 and 3 of the first usability test (chapter 4).

When testing the added preview functionalities, the users experienced less control. This could partially have been due to the layout of the app and the users lack of understanding of what the function actually accomplishes.

Tasks regarding the basic functionality of the sewing machine – such as sewing and embroidering – resulted in a level of control that closely resembled the level of control from the second part of the first usability test (appendix. 9) (table. 5).

***Connecting app to machine***

The app prompted the user that it was necessary to press buttons – bluetooth and connect buttons - in order to connect the app to the machine. Still, only half of the participants pressed the on/off button and the bluetooth button on the machine. There could be many reasons as to why this happened. It could be due to the user not being familiar with sewing machines, and therefore not realizing the power switch needs to be turned ON before use. Another factor could be that the user's mental model of connecting bluetooth devices does not correspond to the process required in the test. It could also be due to the participants not expecting the mock-up to be capable of such functions, and therefore not attempting to connect the machine and app. Everyone pressed the *connect* button on the app.

While it was required to connect the machine and app in order to complete the first task, the process of connecting was not a task of its own. This could have resulted in the participants focusing on completing the actual task and ignoring the requisite process of connecting the device before starting.

***Settings***

During the sewing part of the validation test, some participants chose to use the default settings after they had selected the fabric, due to them believing that the result would still be good enough. One participant did not choose the material for the intended sewing task - which could have resulted in several problems if the sewing was proceeded. Problems that occurred often could be found in section 2.2.3.

One participant did not program the settings into the machine. The participant would then have sewn with the default seam type (Chapter 5).

Some participants did not know what the different settings meant by only looking at the symbols of the width, length and thread tension. This could be due to the participants' lack of sewing experience – the symbols used are common on almost every sewing machine.

***Buying seam types***
When attempting to buy a seam type, participants found it difficult to find the seam type store via the swipe up menu. The reason could have been that the arrows used for guiding the user to enter the seam type store was not big or clear enough for the user to see.

The plus symbol (section 6.1.1) has a higher level of guessability due to its compatibility with *add functions* on other interfaces. While many of the participants still experienced troubles finding the seam type store, they eventually used the plus symbol menu instead of the swipe up menu to access the seam type store.

***Finding embroidery home-screen***
When attempting to find the embroidery home-screen, two of the participants had very little *control*. The participants did not find the"switch to embroidery" button in the slide out menu, unless they accidentally had accessed it earlier in the test.

The reason why this issue occurred was explained by a participant to be due to their mental model not corresponding with placing such functionality in a slide out menu. Another reason could be that there was a lack of information from the app as to where the *switch to embroidery* button was placed.

***Finding pattern and starting embroidery***
The *control* was relatively high - compared to the other tasks - in finding the pattern and embroidering on the fabric. When sending the pattern to the machine two participants pressed the "completion of programming" button. This resulted in the participants having to redo the entire task. Why this problem occurred may have been due to the participants not expecting to use the app for *passive functions* only. While all *active functions* were placed on the machine, the participant may still have experienced the act of placing a pattern to be an *active function*, and therefore not realizing that this separation of functions existed. The user's mental model of what is an *active function,* and what is not, may differ between users.

One participant was unsure of the result of the embroiderys size on the fabric, which shows a lack of control. This could be due to the fact that the hoop in the app is shaped in a quadratic shape while the physical hoop is rectangular.

***Buying embroidery***
The success rate was high when buying an embroidery pattern, but two of the participants did not understand that the pattern had been bought. One reason could have been due to a lack of feedback from the app once the purchase was completed.

One participant seemed cautious about entering the pattern store because they thought that it could withdraw money straight away. The reason could have been that the symbol

for entering the pattern store was a credit card. Some participants expressed that this could refer to a store without any free content - something that they had come to expect from using similar marketplaces such as the App Store (App store, 2018). One participant tried to find the pattern store by clicking on the plus symbol, which is the symbol for creating a pattern. The participant was later asked why this happened and expressed the reason to be that they assumed the plus symbol to represent adding something new.

***Creating pattern***

The task of creating a pattern from an image was appreciated and the overall control of this task was very high. The symbols used for editing the pattern was considered easy to understand - except for one symbol that had the function of editing the thickness of the contours. The process in which this tasks was executed closely resembled tasks such as using the camera on the phone to take a picture. The high levels of control and rate of success could therefore be attributed to a high level of *compatibility*.

***Visualising pattern***

Many participants did not understand the purpose of the different steps of this task and the control of this task was low. The symbol used for previewing a pattern on the fabric was visualised with an eye combined with the scale 1:1. The participants thought that this implied that the fabric in hoop was in scale 1:1 and did not relate this to the intended function for visualising a pattern. To be able to visualize the pattern's correct size in a 1:1 scale on the fabric the participant had to use a bobbin as reference and place it on the fabric. Many participants did not understand the correlation between the bobbin and the size of the pattern. One of the reasons of the loss of control could have been the lack of information that was given from the app during this step.

***Device placement on machine***

Observations regarding placement of the device was made on the *passive* and *active* phases of the tasks. During the *passive* stage the participant either held the phone in their hands or had the phone laying on the right side of the machine. When in the *active* phase, most of the participant placed the phone on the table on the right side of the machine. After completed tasks, a question regarding placement of the device was asked and many of the participants expressed that they would have preferred the device to be placed and attached to the middle part of the machine - in order for the app to be visible at all times.

***Active buttons placement***

After the completion of the tasks - participants were asked to change the placement of the active buttons on the machine. Participants separated the play and reverse button from the remaining ones and the reason was that these two buttons was considered to be the most used ones and should have their own section.

## 7.3 Changes

This section explains in greater detail the changes and additions made after the validation test to the final concept.

***Visualisation***

To better match the users' mental model, the 1:1 symbol (fig. 29) was removed from the preview icon. Further, the functionality of being able to use a reference object to get a real size preview (fig. 31) was removed due to it not being a desired function. The users did not trust the placement tool in the app, and still opted to use traditional methods of placement - such as a chalkmark or practise on a scrap piece of fabric.

The preview function (fig. 30) is now accessible from the pattern placement window, but the user can no longer send the pattern to the machine from this stage due to the problems that were observed during the validation test (Section 7.2). An EXIT button was implemented as a *constraint* to avoid use error where the user tries to activate the embroidery at this stage (fig. 31).

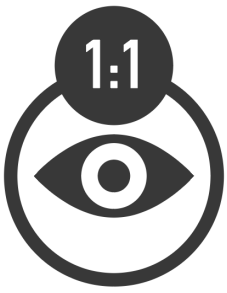



*Figure 29. Old Preview symbol.*

*Figure 30. New Preview symbol*


*Figure 31. Real size preview old (left) and new (right).*

***Pattern store***

The pattern store found on the final concept (fig.39) is entered through the emboridery home screen (fig. 32). The credit card used for accessing the pattern store (fig. 32 left) was changed due to the symbol creating the impression that the pattern store didn't contain any free content. Instead the user could access the pattern store by clicking on the white plus symbol - this symbol indicates adding something new, throughout the interface. A pop up (fig. 33 right) will then appear with four different alternatives - the shopping trolley was implemented to symbolise the pattern store.

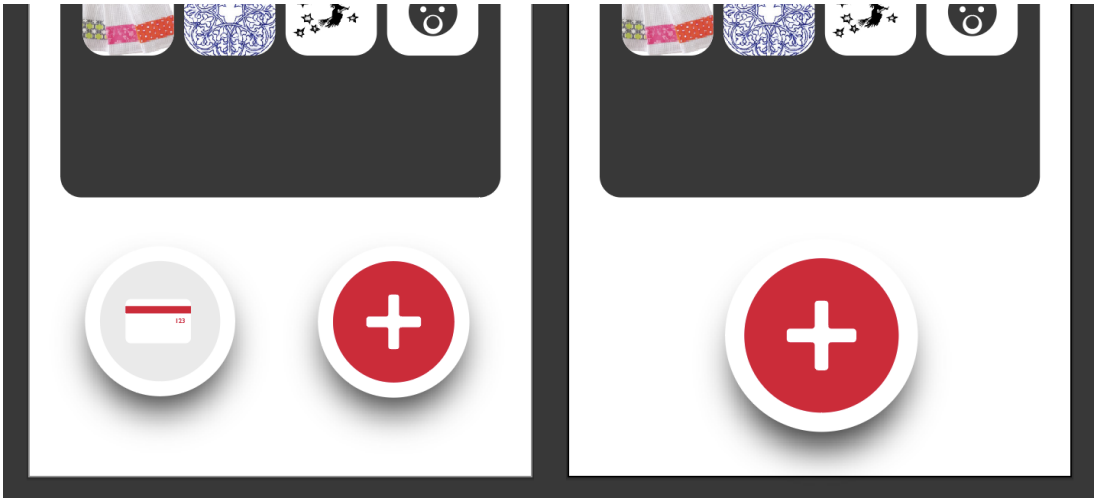


*Figure 32. Accessing pattern store - old (left) and new (right.*

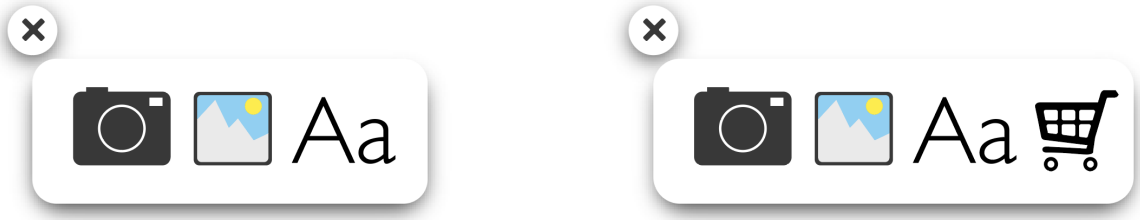



*Figure 33. Pop-up with alternatives of adding embroideries - old (left) and new (right.*

***Sending pattern to machine***

To avoid use errors where the user tries to activate the sent embroidery by pressing the green button on the app, a screen with clear instructions and no has been implemented (fig. 34 right). The green check mark symbolizes that the pattern has been sent, yet it is not clickable - contrary to the green machine button in the previous version. Instead, when an embroidery has been started on the machine, a real time update of the embroidery progress can be seen in the final concept (fig. 40).

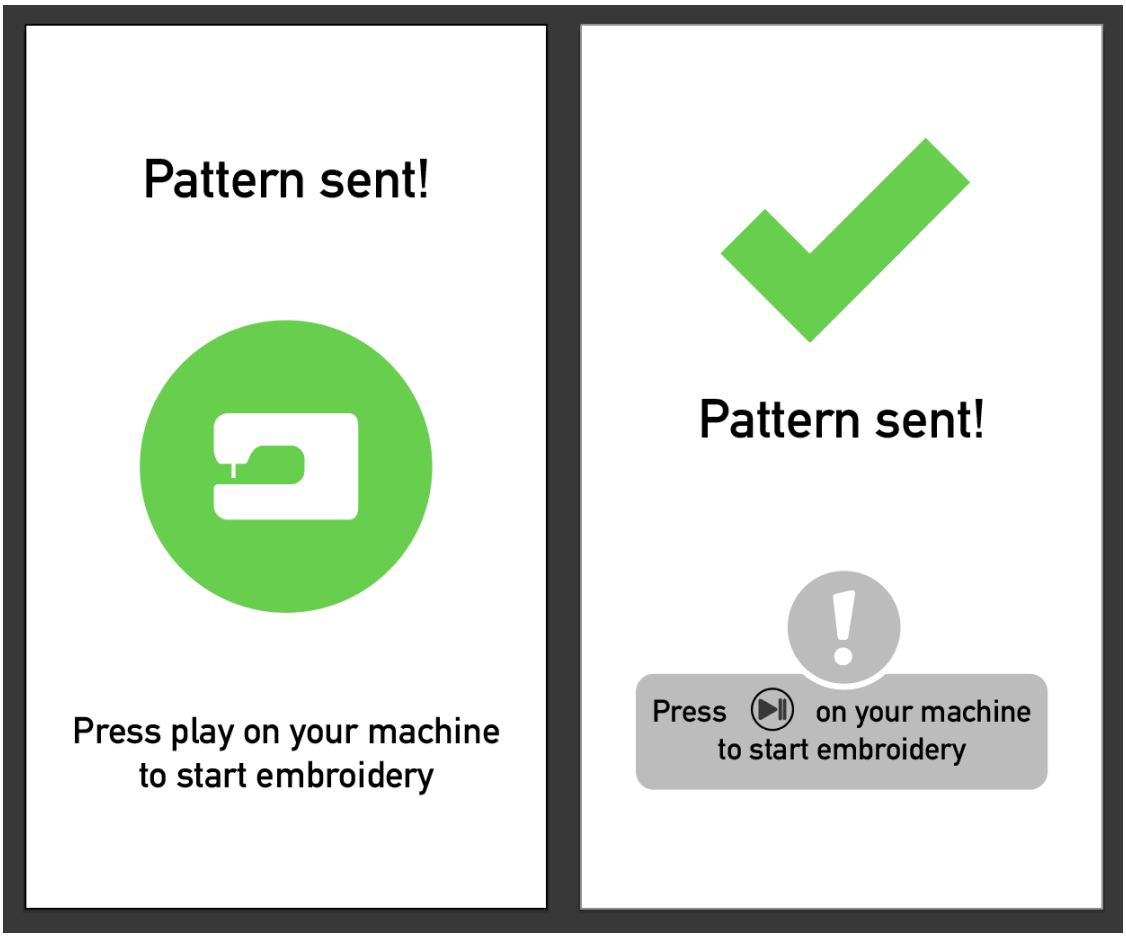



*Figure 34. Programming pattern- feedback screen - old (left) and new (right).*

***Seam type store***

The seam type store is accessed from the sewing home screen (fig. 35 & 36). The arrows that indicated that there was the user had the option to swipe up from the bottom of the screen to access extra content were not clear enough and only one participant noticed them. To resolve this issue, the arrows were given a position closer to the vertical center of the screen (fig. 35 right) - making them more visible. Further, the dark menu bar that the arrows are placed on is positioned behind the *active seam* symbol, creating the appearance of a menu "hiding" underneath (fig. 35 right). When the user swipes up from the middle of the screen, the *additional seams* menu now slides up from underneath the *active seam* symbol (fig. 36 right).

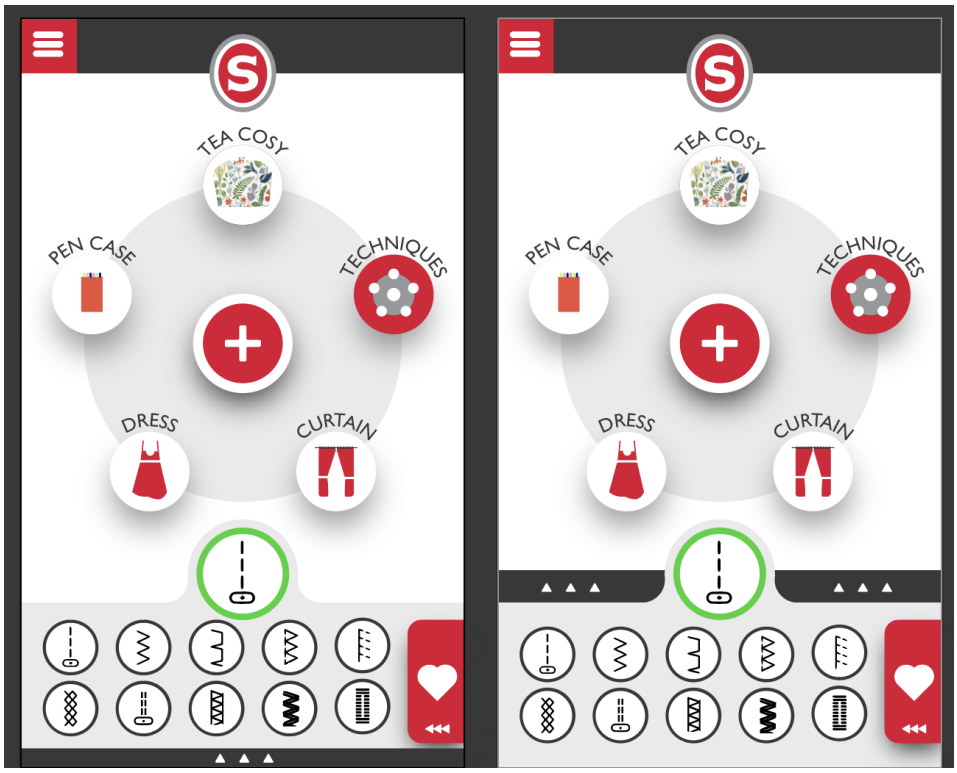



*Figure 35. Placement of arrows old (left) and new (right).*

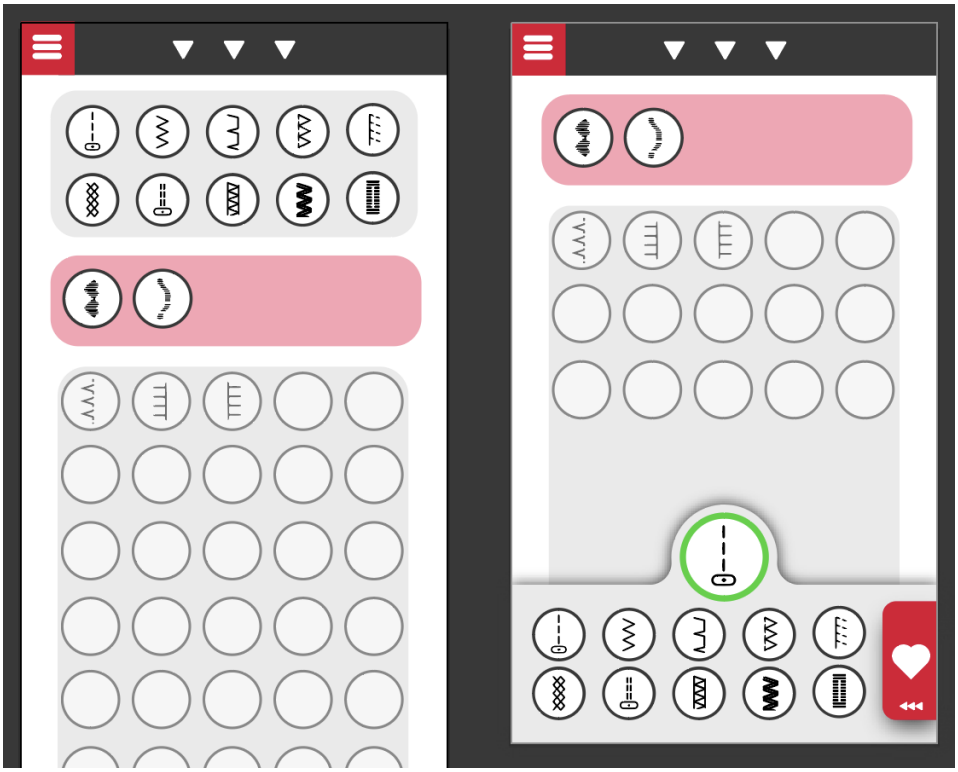


*Figure 36. Seam type slide-up bar - old (left) and new (right).*

***Slide out menu - layout***

The topography of the slide out menu (fig. 37) was edited to match the users' mental model. The *switch to embroidery* - button is placed on top of the menu, and is accessed by either swiping right or tapping. Functionalities regarding instructions and machine information was grouped together in the middle of the menu, while *Contact* and *Profile* remained grouped at the bottom of the menu. By doing so, the buttons are grouped according to their functionalities.

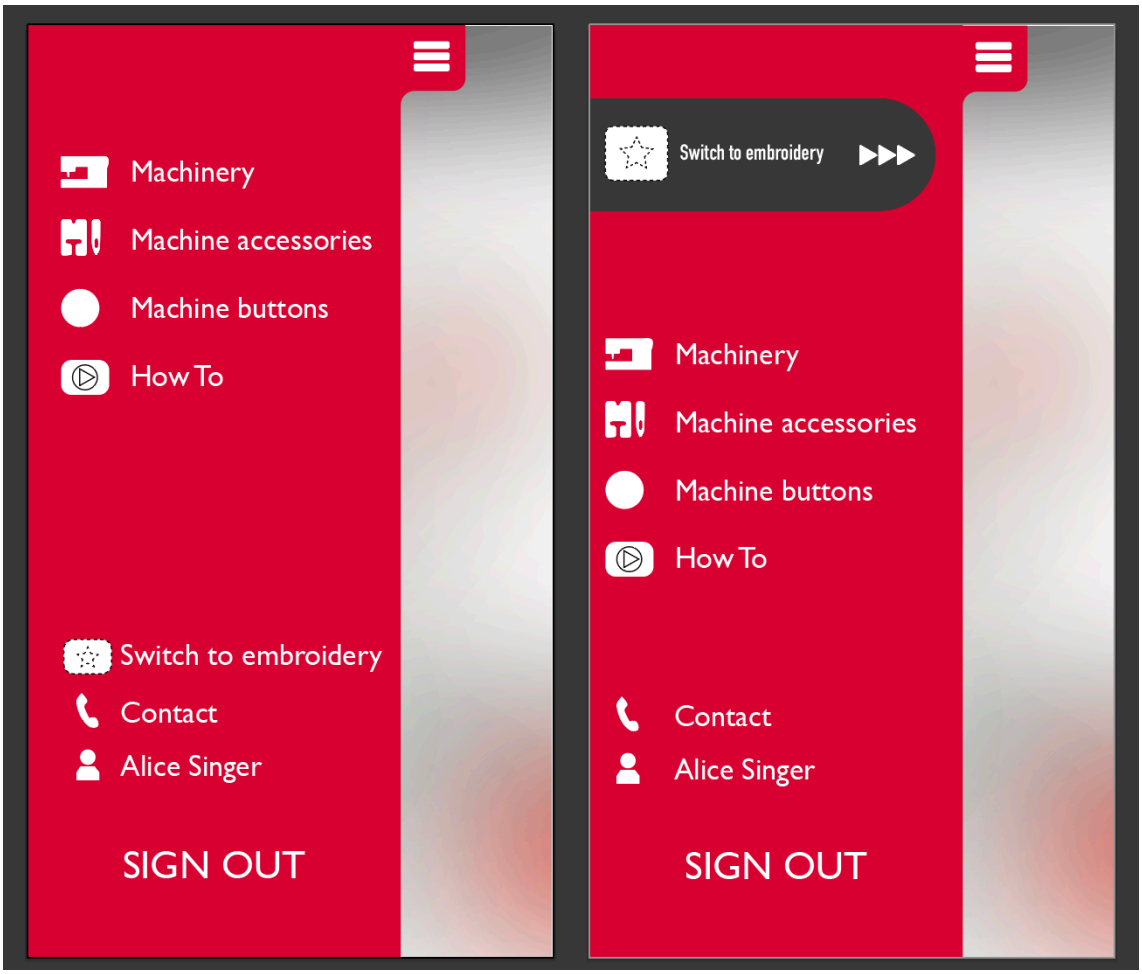



*Figure 37. Slide out menu - old (left) and new (right).*

## 7.4 Theoretical evaluation

This section describes the method used to conduct a theoretical evaluation of the additions made to the initial concept.

***CW***

A Cognitive Walkthrough is a method used to evaluate an interface in regard to explorative learning and to detect problematic areas of an interface (Lewis and Wharton, 1997).

Lewis and Wharton (1997) describe four questions to be asked during the method :

- Will the user try to achieve the right outcome?
- Will the user notice that the correct action is available?
- Will the user associate the correct action with the desired target?
- If the correct action is taken, does the user get feedback?

The Cognitive Walkthrough was conducted on the additions made to the final concept – after the validation test.

### 7.4.1 Results

The CW (appendix. 10) confirmed that most of the changes made to the app could work in practise. Two tasks were still considered to be areas of improvement.

***Finding the embroidery home screen***

To enter the embroidery home screen, the user must first tap the slide out menu to reveal this option. When the user is searching for the embroidery home screen (fig. 37 & 38), they expect embroidery functions to be accessible at all times. This could be due to the tasks given in the validation test focused heavily on embroidery functions - creating the impression of this being a functionality that was used in a greater extent than surveys describe.

This results in the user looking for a s*witch to embroidery* option in other places than a slide out menu (fig. 37).

***Finding additional seams***

The *affordances* created by the arrows (fig. 35 right) gives the user a clear indication that there is additional content to view. The user does not in this instance associate the correct action with the desired target - due to the slide up menu possibly containing other content.

# 8

# Final Concept


*Figure 38. Sewing home-screen.*

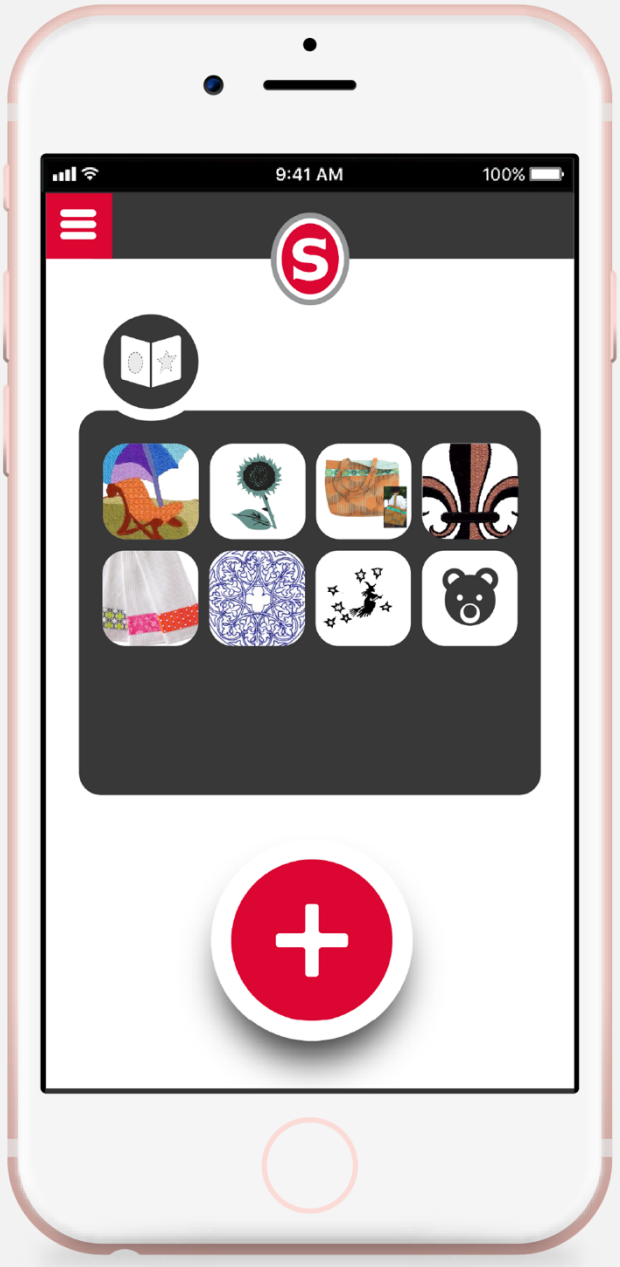



*Figure 39. Embroidery home-screen.*

## 8.1 Additions

This section adresses additions that has been incorporated into the final concept.

### 8.1.1 Ongoing embroidery process

When the pattern has been sent and activated by the user an embroidery screen will be displayed. This screen shows the ongoing embroidery process in real time which is carried out by the machine (fig. 40). To increase customer satisfaction, a timeline has been implemented which visualizes where in the process the machine is currently at. The timeline also advises the user to change the colour of the thread and displays the remaining time to the next action. The machine will pause when a change of thread is necessary and when the thread has been changed the user is prompt to press the play button on the machine. The symbols in the upper right corner indicate the process progression in percentage done and time remaining to completion.

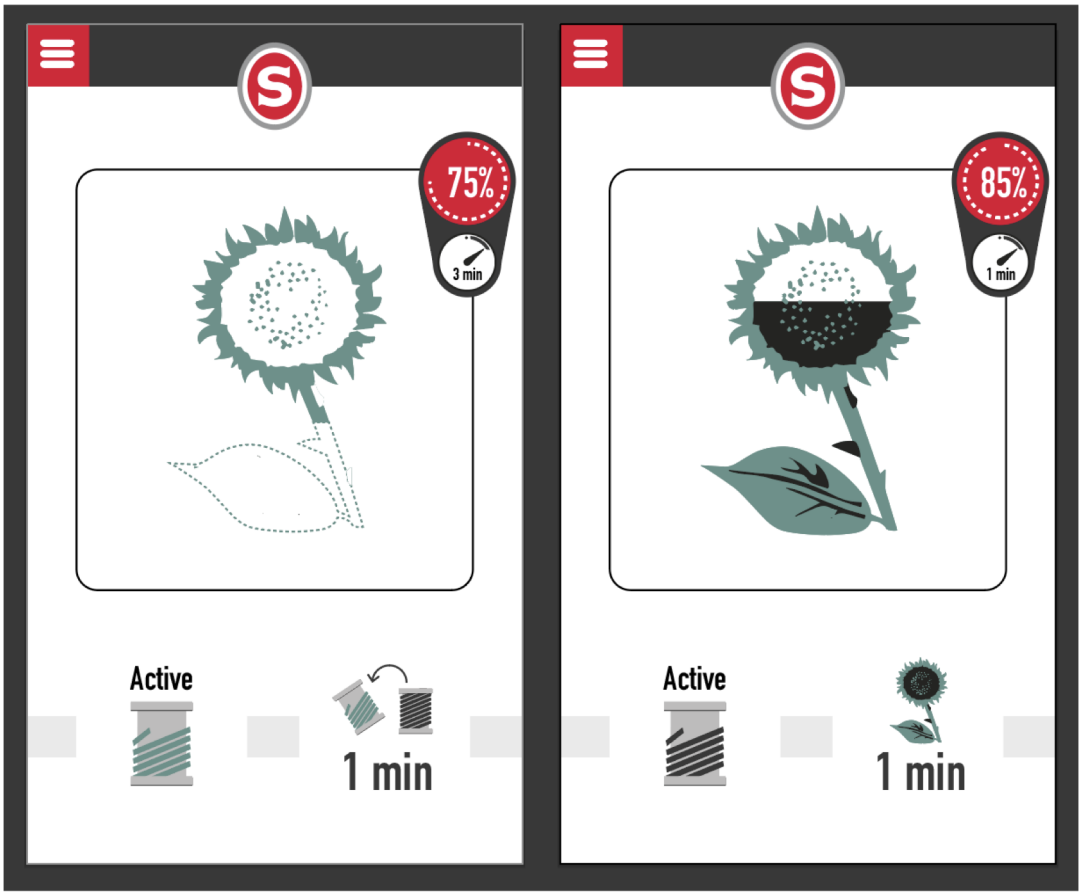



*Figure 40. Embroidery process in real time with belonging time-line.*

### 8.2.2 Integrating manual

To further adapt the app to users who are not familiar to sewing machines, an integrated manual was implemented throughout the app. Symbol explanations – for symbols such as thread tension, stitich width and length - was accessible by tapping the question mark symbol (fig. 41).

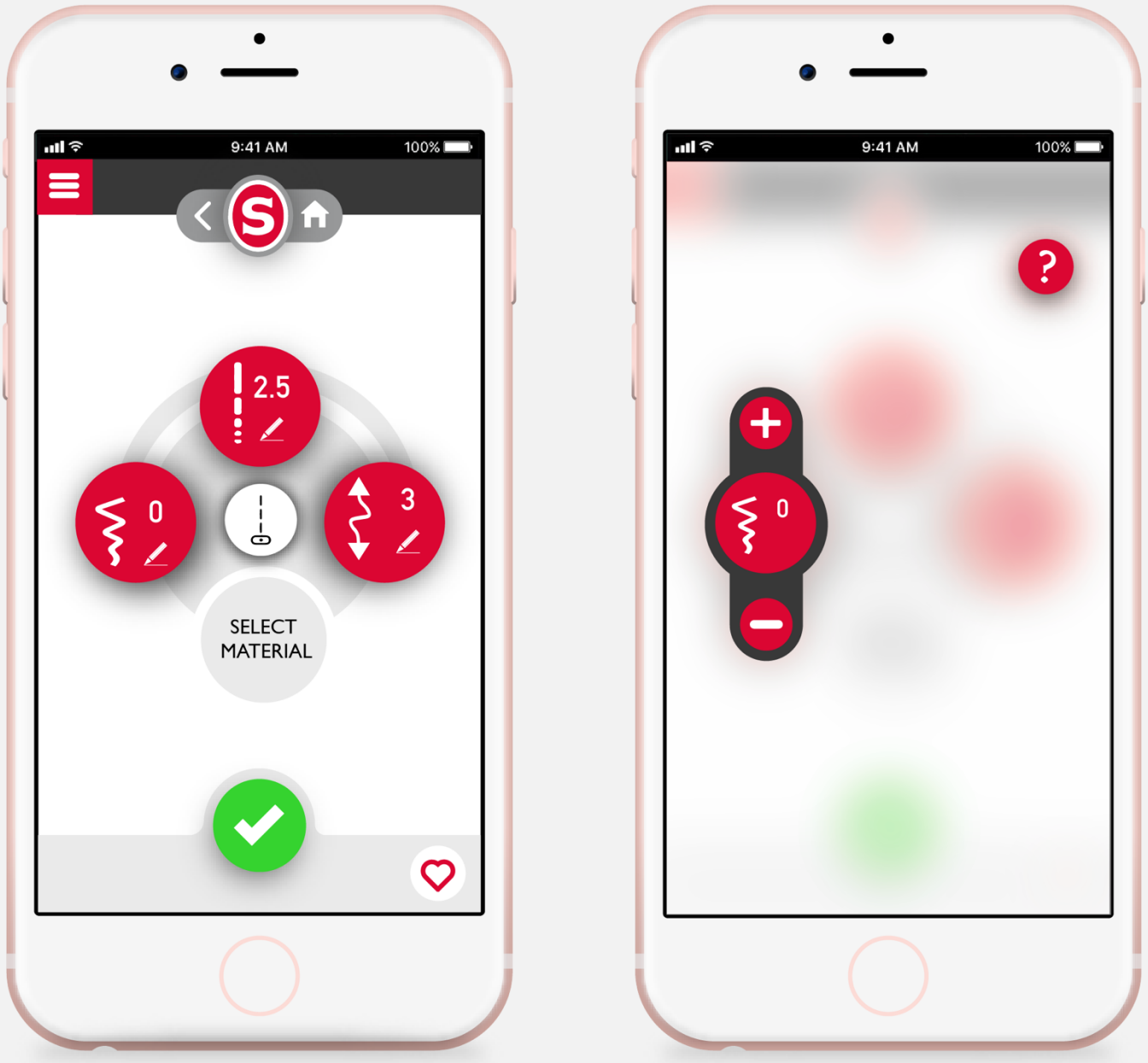



*Figure 41. Settings panel (left) with questionmark (right) - symbol containing information.*

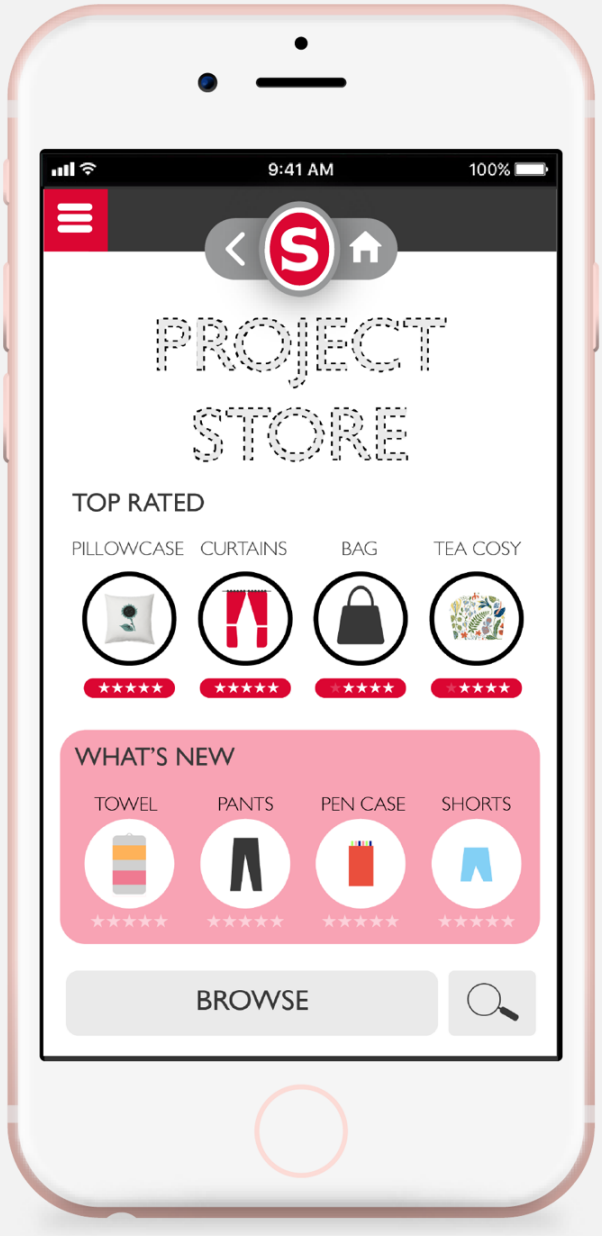



*Figure 42. Project store layout.*

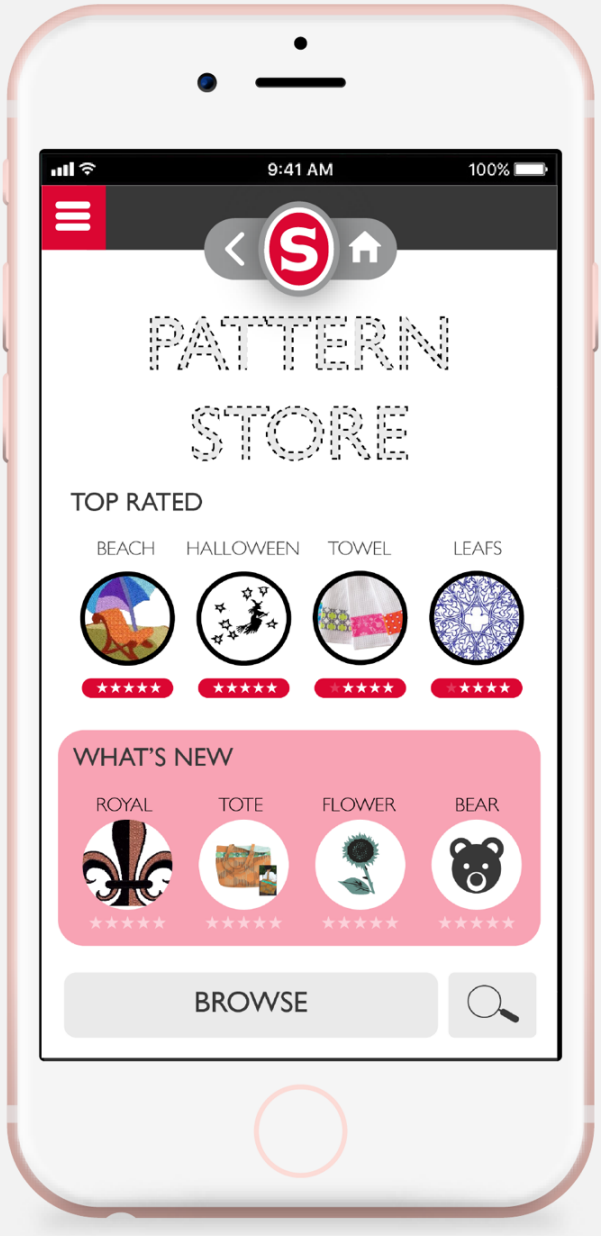



*Figure 43. Pattern store layout.*

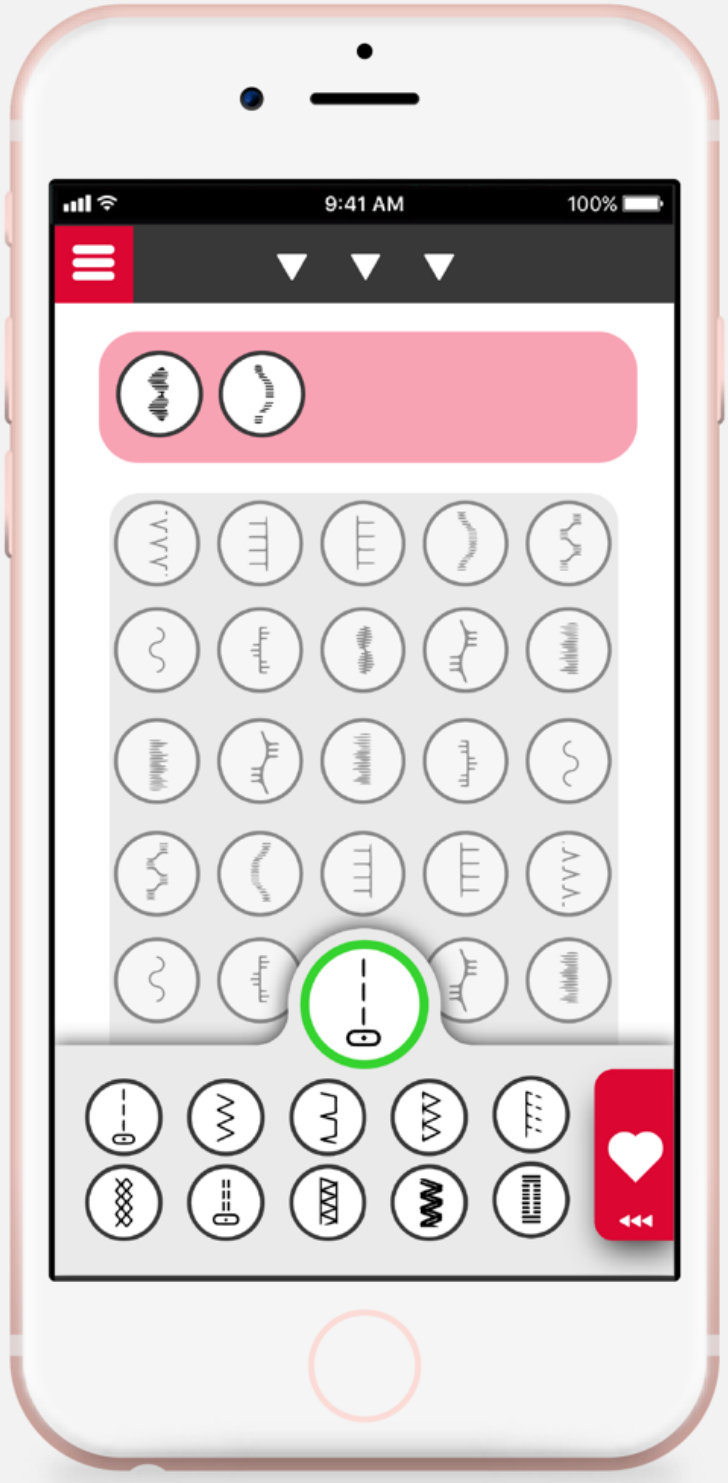



*Figure 44. Seam type store.*

## 8.2 Machine layout

The exterior design of the machine was not created in this project. Instead, existing photos and renderings of the reference product (singer,2015) were used to visualize the final concept.

***Buttons***

The *passive buttons* on the machine which were previously placed on the lcd-screen with belonging buttons (Singer, 2015) has been removed which leaves only the *active buttons* displayed on the machine. A bluetooth button has been added on the back of the machine and is situated above the on/off button (fig. 45).

When settings from the passive functions has been programmed into the machine a flashing light will appear on the physical machines play button - encouraging the user to press start (fig. 48).

***Embroidering machine***

When embroidery is active the embroidery unit will be attached to the machine and the hoop will be placed and attached on top of the embroidery unit (appendix. 14).

***Pairing***

When connecting the app to the machine the bluetooth transmitter in the machine will send out a signal. When pressing the bluetooth button on the machine, a blue led light will start to flash and search for bluetooth devices (fig. 46). The user could then discover and connect their device with the sewing machine. When the two devices are connected a white light will appear from the bluetooth button (fig. 47). When devices has been connected a homescreen will appear on the smartphone (fig.50).

***Device placement on machine***

Due to interview questions investigating the placement of device - a suggestion of where the phone could potentially be attached to the machine has been visualised (fig. 49). While the tests showed that the users tend to place the phone in front of the machine, the manufacturer may still want to include this feature. The suggestion (fig. 49) does not describe a technical solution for attaching the phone to the machine, it only describes where the users would like the phone to be attached.


*Figure 45. Reference product – Singer legacy (singer, 2015) with final changes.*

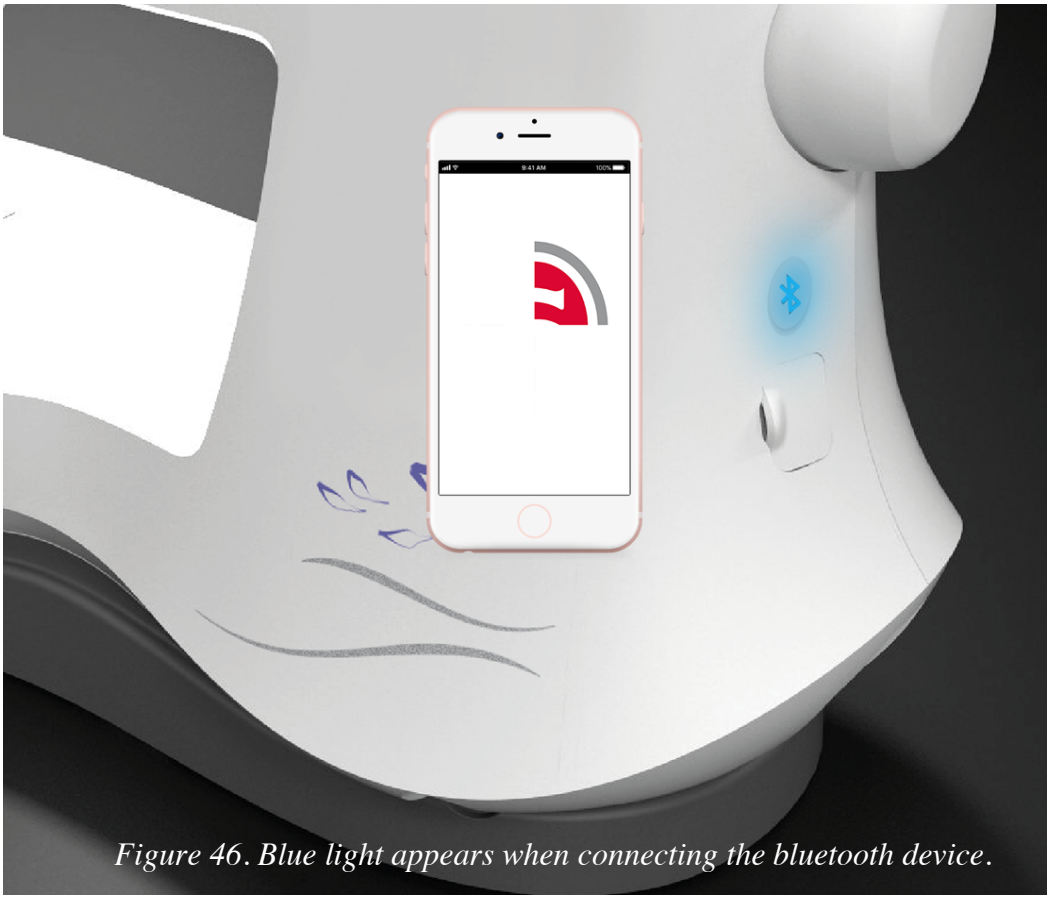


*Figure 46. Blue light appears when connecting the bluetooth device.*


*Figure 47. White light appears when devices are connected.*


*Figure 48. A green light appears around the play button when programmed.*

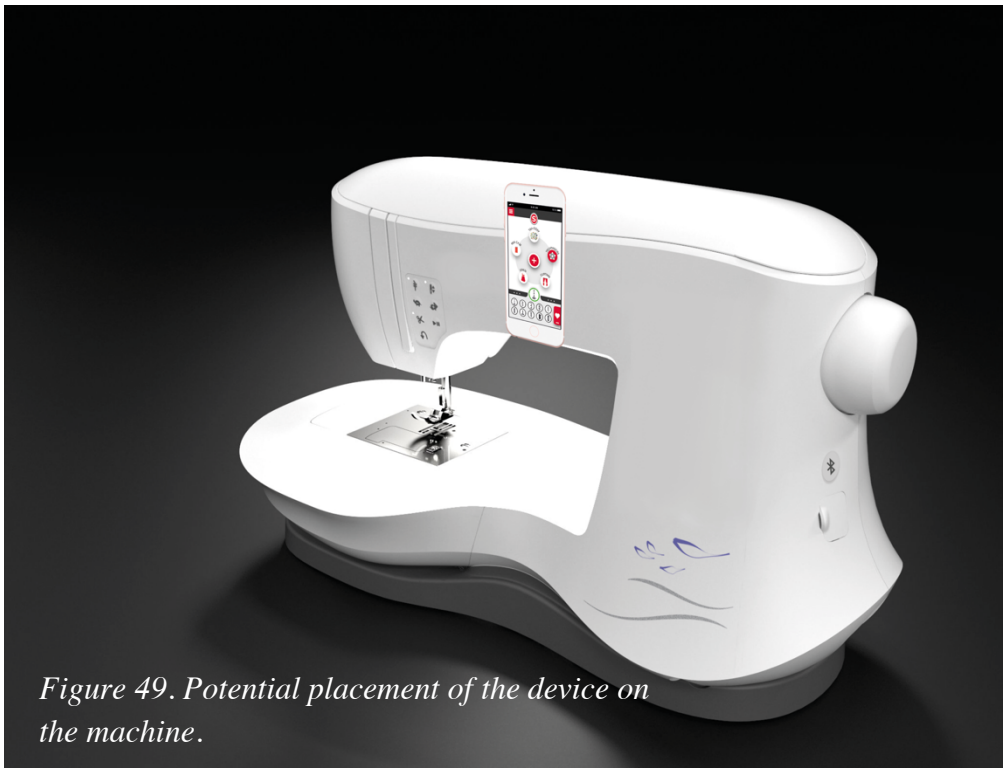


*Figure 49. Potential placement of the device on the machine.*

*Figure 50. User with the final concept.*

### 8.1.4 Quality of service

In order to achieve a great customer value the quality of the connections between the app and machine has to be efficient and reliable. A comparison between a Bluetooth and wifi connection has been conducted and resulted in using a bluetooth connection. The wifi connection is connected through a router (Autodesk, 2016) which would put a demand on the users to have an extra device in order to use the machine. Although the wifi connection has got a higher frequency than bluetooth connections (Autodesk, 2016) - the functions that would be affected by possible delays are the *passive* functions, which are displayed on the app. Latency when activating the *passive functions* does not lead to potential user hazards – which delays for *active functions* most certainly could.

During both usability tests, the participants waited at least a few seconds after adjusting the settings before beginning to sew. The delay on a Bluetooth connection has an avarage latency of 200 ms (Diffen, 2018) which would therefore be acceptable by the user.

The results of the first usability test indicated that the *active* buttons should be easily accessed and therefore these buttons have been placed on the physical machine. This allows the possibility of controlling the machine when the network is down. When SVP servers are down the embroidery and seamtype store will not be accessible - while all other functions will be accessible.

When the machine and the device's distance is further than 30 meters apart (Diffen, 2018) the connection will be lost between the devices which would interfere with programming the settings into the machine. For safety reasons it is important that the machine is monitored - the limited signal range of an bluetooth transmitter will therefore not be an issue.

The app allows the user to get access to a project and seam type store. These stores has to be updated regularly to achieve a customer satisfaction. The persona of the user group indicates on the importance of sharing achievements and projects - this should be maintained regularly if possible.

### 8.1.5 Sustainability

Due to *sustainability* and functionality the lcd-panel has been eliminated from the concept. Instead of manufacturing a separate display the concepect utilizes the display on an external device – the smartphone. By having functions that provide the user with necessary information - such as real size preview of stitches and settings - the new concept encourages the user to not use scrap pieces of fabric. Further, sewing with the correct settings minimizes the risk of thread tangle and damaged fabric - which in turn leads to less waste.

# 9

# Discussion

This chapters discusses general sources of errors that may have reduced the validity of the results.

## 9.1 Usability test

***Participants***

Due to limitations, test participants were only swedish residents. The extent to which this may have effected the validity of the usability tests is not determined by this study. Differences could have occurred to the usability test if the participants had different perceptions made by different backgrounds and cultures.

The participants were selected on the criteria that they belonged to the target age group of 20-35 year olds. Participants applied to participate until all twelve spots were filled. Due to time limitations, no further selection was made. The participants who conducted the test consisted of 11 women and 1 man. This sample was too small to conclude any meaningful observations regarding whether gender differences had any effect on the validity of the results.

Further, the sample size - 6 participants in each usability test - could be considered small. Still, research show (Nielsen, 2000) that a sample of 5 people is often enough the collect the majority of issues that users experience in a usability test.

The choice to use *between* test subjects was motivated by reducing the possibility of errors induced by learnability in the results. By not using any *within* test subjects, results regarding which alternative that a specific user prefer were not investigated.

***Order***

The results from different tasks were compared between participants that conducted the test in the same order (1,2,3 or 3,2,1). This is due to the groups being subjected to *learnability* in a different order. Group A that conducted the tests in order 1,2,3 was exposed to *learnability* regarding the active, passive functions and foot control on the machine - while group B that conducted test in order 3,2,1 started the test with only controlling the machine through an app.

The task of embroidering a letter combination may also have been exposed to an error due to the setup of the usability test. The tasks was conducted directly after the participant had completed a task to embroider a figure. Many of the participant had therefore read the manual - in full - before attempting the task, which may have had an impact on their success rate.

***Observation***
The participants may have acted differently due to the fact that they were being observed. This issue regarding the validity of the test is suggested by the *Hawthorne effect* (Colman, 2015).

During the test, some of the participants actively tried to angle their display towards the camera, expressing that they were trying to convey where they were pressing. This may have created errors in the results regarding where the user place the phone during the *active* and *passive phase*.

***Feedback***
During the sewing part of the test, the participants felt a lack of control when maneuvering the machine. This resulted in a lower experienced success rate compared to the actual success rate. A source of error could be the lack of functions on the mock-up, such as no threads. Another reason for the experienced loss of control could be the result of feedback latency due to the the reaction time of the *Wizard of oz*.

## 9.2 Survey

***Participants***
The participants who responded to the primary and secondary survey were mainly swedish residents. While no differences between the responses by swedish and non-swedish residents were found, this may have resulted in a lower validity for the Singer Persona - which was partially based on the results from the primary and secondary survey.

## 9.3 Safety and control

Observations conducted during the first usability test showed that the users tend to explore the app by trial and error. This resulted in several situations where the machine was unintentionally started while the user wasn't in control. While no injuries could occur during the tests - due to the mock-up not having complete functionality - this issue could in a real use scenario result in the user being subjected to hazards. The decision was therefore made to prioritize user safety over user control - i.e minimizing the user control

in hazardous situations, and maximizing it during situations with limited hazards. To aid this issue, several constraints where implemented - such as placing all *active buttons* on the machine, making it impossible to start the machine without being in close proximity to it. This could in turn lead to the loss of some user benefits - such as being able to pause and resume and embroidery from a distance.

Implementing constraints to minimize user problems could cause an issue of a lower experienced control. If making it mandatory to select intended material before sewing, the settings are automatically adjusted to improve the finished results. This could eliminate the problem of sewing low quality stitches, but could also result in restricting the users of their own customized settings.

# 10

# Conclusion

This chapter discribes in detail what this thesis concludes in regard to the research questions and additional findings. Finally, it describes potential further improvements to the final concept.

## 10.1 Answering the research questions

This section concludes the results in a manner that answers the research questions.

### 10.1.1 Investigate the target user group

The key attributes that the target group require from a sewing machine are :

***Ease of use***
They don't use the machine frequently, but when they do, there should be no obstructions.

***Creating your own patterns***
Few users in the target group own a embroidery machine, and those who do almost never use it. They express this to be due to not finding appealing patterns. Utilizing the mobility of a smartphone combined with its camera, quick image-to-pattern conversions can be created on the go. Using the smartphone for this functionality does not constrain creative episodes to the proximity of the sewing machine.

***Expectations on the result***
The general consensus within the target group regarding their expectations while sewing were that the results does not matter as much as the ease of use. They use scrap pieces of fabric instead of using the instruction manual to set the correct thread tension and settings.

***Pride in their work***
Many participants expressed that they take pride in their work. Controlling the machine with an app proved to counteract this sentiment. Even though the participants were conducting the same tasks with the same number of settings available to them, they still felt as if the machine now did all the work for them. While they acknowledged that this could have its benefits, it at the same time led to them not feeling a sense of pride in their work.

***Persona***
The general priorities and values collected through the user study resulted in a persona named Alice (Chapter 5).

### 10.1.2 Functions placed on machine

The finished concept consists of a machine with and external app where the basic functions have been arranged into two groups: *active functions* and *passive functions*. The *active functions* are the functions that are in direct control of the machine - these have been placed on the machine because of control, usability and safety reasons. The order and arrangement of the buttons has not been changed due to insufficient data collected. A bluetooth button has been added to the machine to enable the bluetooth connection between the app and machine. The button has been placed in proximity to the on/off button due to the relation between connecting the app and starting the machine.

The device placement while machine is active has been observed through usability tests. The results from the observations were not considered valid enough to decide if the option to attach the device to the machine would increase the machines value. Through interviews, it was determined that it was – if included – desireable to place such an option on the middle part of the machine.

### 10.1.3 Functions placed on App

The functions placed on the app are the *passive functions*. These functions contribute to minimizing the amount of problems that could occur while sewing - by allowing the use of default settings specifically customized for certain fabrics. Throughout the app it engages and guides the user by displaying symbols with explaining text.

To add value to the user - extra functions have been implemented into the concept. The added functions (Chapter 7) improves the functionality and usability of embroidering. Existing functions and features from Singers website (Singer. 2018) and the app Image stitch (Pfaff, 2018) owned by SVP-group has been implemented into the new concept to use already existing and working functions. Functions regarding the users basic and performance needs has been prioritised in the layout of the two home screens - sewing and embroidery. Excitement functions has later been added to achieve a higher level of user benefits.

Using the smartphone as an external screen improves the visual clarity and response from machine. The smartphone's touch screen has got a more advanced sensor than the original one and the size of the display is larger.

Additional seam types, projects and embroideries can be downloaded or bought inside the app. The pricing for these should be between 1 to 3 euros (appendix. 6).

## 10.2 Key conclusions

This section describes key findings and conclusions.

### 10.2.1 User benefits

- Embroidery works really well, utilizing the phones multi touch screen to rotate and scale patterns has large upsides.

- Creating an embroidery pattern from an image - incorporating the Image Stitch app - is the stand out function. Utilizing the mobility of a smartphone makes it accessible whenever a creative episode occurs.

- Sewing benefits from incorporating the Sewing assistant to aid the user in seam selection and minimizing use errors.

- The technology used to establish a connection between the machine and app was decided to be bluetooth, due to it being a reliable technique where no third device - such as a router - is necessary.

### 10.2.2 Challenges

- Controlling the machine with an app can prove to reduce the sense of pride the users experience. Even though the same number of settings where still available, the mere act of controlling that setting on a phone - instead of on a dial on the machine - reduced the sense of accomplishment.

- To optimize the user's experienced control, clear feedback must be implemented when connecting the app to the machine and sending patterns to the machine to the machine.

- The possibility of buying additional projects and seams may prove to be a good concept. While most sewers within the target group don't use more than a few seam types, they still expect the machine to be able to sew them all, without having to buy them.

- Some constraints are necessary in order to minimize the risk of use errors. All *active functions* must be placed on the machine, while *passive functions* can be placed on the external app. By doing so, the user cannot start the machine unintentionally while exploring the app.

## 10.3 Further improvements

Visualizing pattern on fabric and saving settings was one idea that would need further improvements. It is now possible for the user to visualize the pattern but not programming the machine with the correct size and placement of pattern. The function relies on references to work properly which put a demand on the references to be easy to use and understand.

Further improvement could be made on the communities layout in app. Communities could help to monitor the users needs and also help to send feedback to SVP-group which would facilitate the maintenance of the app.

A technical solution for attaching the phone to the machine could be constructed and placed on the middle part of the machine (Section 8.2).

# 11

## References


Autodesk. (2016).*WiFi vs. Bluetooth: Wireless Electronics Basics retrieved 2018-05-08* from: https://www.autodesk.com/products/eagle/blog/wifi-vs-bluetooth-wireless-electronics-basics/

APEGBC (2016). *Sustainability guidelines*. Retrieved 2018-05-15, from https://www.egbc.ca/getmedia/91beda29-ad6f-4a6f-b302-ac60de0bab40/APEGBC

Apple. (2014). Retrieved 2018-04-17, from https://support.apple.com/kb/sp587?locale=sv_SE

Appstore. (2018) Retrieved 2018-05-15, from https://www.apple.com/se/ios/app-store

Boghard, M. (2011). *Arbete och teknik på människans villkor*. Stockholm: Prevent.

Brennan, M. (2013). *House of the future: How auotomation tech is transforming the home*. Retrieved 2018-05-16, from https://www.forbes.com/sites/morganbrennan/2013/10/10/house-of-the-future-how-automation-tech-is-transforming-the-home/#2af74e2d5b98)

Colman, A.M. (2015). *Oxford dictionary of psychology (4ed)*. Oxford university press.

Design Resources (2018). Retrieved 2018-05-17, from http://resources.printhandbook.com/pages/viewing-distance-font-size.php

Diffen. (2018). *Bluetooth vs wifi*. retrieved 2018-05-15 from: https://www.diffen.com/difference/Bluetooth_vs_Wifi

Graedel T.E , Harper E.M, Nassar N.T, ReckB.K. *On the materials basis of modern society*. PNAS May 19, 2015. 112 (20) 6295-6300; published ahead of print December 2, 2013. https://doi.org/10.1073/pnas.1312752110

Holcombe.E and Kezar.A. (2017). *Mental Models and Implementing New Faculty Roles*. University of Southern California.

IDC. (2018). *Statistics on smartphone shipments*. Retrieved 2018-05-15, from https://www.idc.com/getdoc.jsp?containerId=prUS43591418

Invision. (2018). App prototyping tool. retrieved 2018-05-15 from: https://www.invisionapp.com

ISO. (2018). *Ergonomics of human-system interaction* (Standard no. 9241-11:2018. Retrieved 2018-05-15, from https://www.iso.org/standard/63500.html

Johannesson, H., Persson, J-G. & Pettersson, D. (2013) *Produktutveckling: Effektiva metoder för konstruktion och design*. Stockholm: Liber AB

Jordan, P.W. (1998). *An introduction to usability*. London: Taylor and francis

Karlsson I.C.M. (2007). Att lyssna till kundens röst, kurskompendium. Produkt och produktionsutveckling, Chalmers Tekniska Högskola.

Kaulio M., Karlsson M A, Rydebrink P. & Klemets M. (1996): *PRE - Att skapa ett företagsspecifikt arbetssätt för att hantera kundkrav*. Chalmers tekniska högskola och Institutet för verkstadsteknisk forskning, Göteborg.

Landau, M. J., Kay, A. C., & Whitson, J. A. (2015). Compensatory control and the appeal of a structured world. *Psychological Bulletin, 141*(3), 694-722.

Lewis, C., & Wharton, C. (1997). *Cognitive walkthroughs*. In M. Helander, T. K. Landauer, & P. Prabhu (Eds.), *Handbook of human-computer interaction* (2nd ed., pp. 1123 ). Amsterdam: Elsevier Science.

Lindstedt, P. & Burenius, J. (2003). *The value model: how to master product development and create unrivalled customer value*. Ödesborg: Nimba.

Nielsen, J. (2000). *Why you only need to test with 5 users*. Retrieved 2018-05-18, from https://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/

Norman, D. (2013). *The design of everyday things*. Cambridge, Massachusetts: MIT Press

Román, A. et al. *Reading direction causes spatial biases in mental model construction in language understanding*. Sci. Rep. 5, 18248; doi: 10.1038/srep18248 (2015).

Toptenreviews. (2018). *Best sewing machines 2018*. retrieved 2018-03-05 from: http://www.toptenreviews.com/home/crafts-sewing/best-sewing-machines/

Österlin, K. (2010). *Design i fokus för produktutveckling: varför ser saker ut som de gör*. Malmö: Liber.

**Material by Singer**

PFAFF. 2016. retrieved 2018-05-15 retrieved from. http://www.pfaff.com/en-US/Software/ImageStitch).

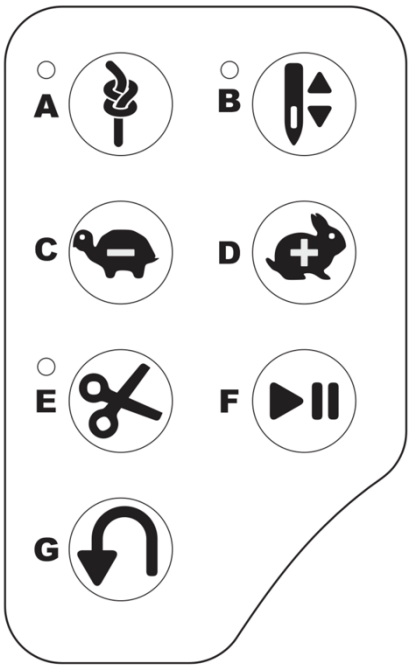
Singer. (2015). *Singer legacy SE300 product details*. retrieved 2018-01-25 from: http://www.singer.se/Produkter_details_legacy_SE300.htm

Singer. (2018). *Singer company home page*. retreived 2018-05-15 from: https://www.singer.com/

# 12

## Attachments

### 12.1 Machine control functions



## 12.2 Benchmark

| **Sewing + basic functions** | **Brother SE400** | **Singer SE300** | **Spiegel Model 60609** |
|---|---|---|---|
| LCD-screen | Yes - 2.7 x 1.4 | Yes | Yes |
| Product size (length * height * width inches) | 20.3 x 15 x 15.2 | 20.16 x 9.49 x 12.10 | 20.67 x 7.48 x 12.00 |
| Product weight (kg) | 6,7 | 8,4 | 7,8 |
| Sewing application for tablet/smartphone | No | No | Yes |
| WiFi network (connects through router) | No | No | Yes |
| Adjustable brightness on screen | Yes | Yes | - |
| Smart device holder | No | No | Yes |
| Select stitch | Touch Panel | Buttons + LCDscreen | Buttons |
| Help (on screen) | Yes | No | No |
| Built-in languages | Yes | Yes | No |
| Zoom function on screen | Yes | No | No |
| Automated thread cutting (upper and lower) | Yes | Yes | No |
| Thread cutter | Yes | Yes | Yes |
| Computer connectivity with available updates | Yes | No | Yes |
| Back to beginning | No | Yes | No |
| Editing on-screen | No | Yes | No |
| Realistic preview | No | Yes on LCD-screen | Yes - through stitch cam |
| Sewing stitches (includes buttonhole styles) | 67 | 200 | 350 |
| Buttonhole styles | 10. One-step | 13. One-step with underplate - adapts to size | 7.One-step with underplate - adapts to size |
| Sewing lettering fonts | No | Yes | Yes |
| Mirror image (stitch patterns can be mirrored side to side or top to bottom) | No | Yes | No |

| | | | |
|---|---|---|---|
| Stitch selection (Most basic stitch patterns are selected with a button) | No | Yes | Yes |
| Stitch width (mm) | 7 | 7 | 7 |
| Stitch length (mm) | 5 | 5 | 5 |
| Start/Stop Button | Yes | Yes | Yes |
| Reverse button | Yes | Yes | Yes |
| Thread tension | Yes | Yes | Yes |
| Tack button with led indicator | No | Yes | No |
| Presser-foot pressure adjustment (automatic) | No | Yes | No |
| Combine lettering and decorative stitches to create custom stitch sequences. | No | Yes | No |
| Speed control (adjust stitches/minute) | Yes | Yes | Yes |
| Needle position button (Up/Down) | Yes | Yes | Yes |
| Create stitch - feature that lets you create your own stitch pattern and save it to your machine | No | No | No |
| Lighting | 1 LED | 3 LED | Yes |
| Camera | No | No | Yes |
| System for needle threading | Yes | Yes | Yes |
| Automatic needle threader | Yes | Yes | Yes |
| Independent winding motor (bobbin) | Yes | Yes | Yes |
| Thread sensor (Upper and Bobbin) | Yes | Yes | - |
| Thread sensor On/Off | No | No | - |
| USB | No | Yes – transferring patterns | Yes - charging mobile device |
| Memory card | No | No | No |
| Cable | Yes | Yes | Yes |
| Power switch | Yes | Yes | Yes |
| Work space (inches) | 3.9 x 5.3 | 7⅞ | - |

| | | | |
|---|---|---|---|
| Sewing speed (maximum Stitches/ Minute) | 710 | 800 | 950 |
| Footcontrol | Yes | Yes | Yes |
| Feed dog | Yes - 7 | Yes | Yes |
| Sideways Sewing | No | No | No |
| Twin needle | No | Yes | Yes |
| Needle Threader (Easily thread the eye of the needle) | No | Yes | Yes |
| Presser foot leveling | Yes | Yes | Yes |
| Pivot function | No | Yes | No |
| Free motion | Yes | Yes | Yes |
| Hook for device | No | No | Yes (phone) |
| Quilting foot (free motion) | No | Yes | Yes |
| Quilting Stitches | No | Yes - 2 | No |
| Included Quilting Feet | No | Yes | No |
| Specialty Feet Included | Yes | Yes | Yes |

| **Embroidery functions** | **Brother SE400** | **Singer Legacy SE300** | **Spiegel Model 60609** |
|---|---|---|---|
| Embroidery area (maximum X x Y) | 4" x 4" | 10" x 6" | 4" x 4" |
| Embroidery speed (maximum stitches/minute) | 400 | 700 | 500 |
| Speed adjustment | Yes | | Yes |
| Adjust size on design | No | | No |
| Embroidery designs | 70 | 200 | 55 |
| Alphabet fonts | Yes | | Yes |
| Alphabet designs | Yes | Yes - 6 | Yes |

| | | | |
|---|---|---|---|
| Monogramming font styles | Yes | - | Yes |
| Camera | No | No | Yes |
| Pattern rotating | 1, 10, or 90 Degrees | - | - |
| On screen density adjustment | Yes | . | Yes |

## 12.3 Interviews

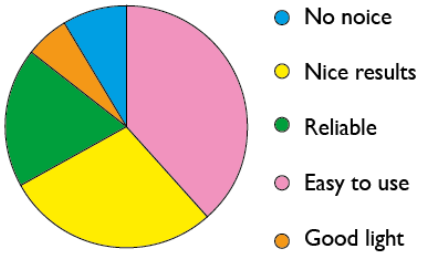
NAMN , ÅLDER

- Vem är du? Intressen och jobb
- Vad förde dig hit?
- Har du använt en symaskin någon gång?
- Vad har du för symaskin?
- Vad fyller symaskinen för syfte för dig?
- Varför köpte du just denna symaskin? (vilka faktorer var då viktiga för dig?)
- Vad är det bästa med att ha en symaskin?
- Har den broderi funktion? (tillhörande bågar till denna)
- Har du använt den någon gång?
- Har du hastighetskontroll? – använder du denna något?
- Läser du manualen? (hur ofta)
- Varför läser du manualen?
- Brukar du ha några problem när du syr?
- Vad tror du orsakar problemen?
- Hur brukar du lösa dessa problem?
- Vad brukar dina förberedelser innehålla?
- Märker du av att resultatet ändras beroende på dina förberedelser eller inställningar?
- Gör inställningarna någon skillnad? (vilka gör någon skillnad)
- Vad brukar dina inställningar vara?
- Vad skulle du vilja se finnas på en symaskin i framtiden? (andra funktioner som du tänker att du saknar)

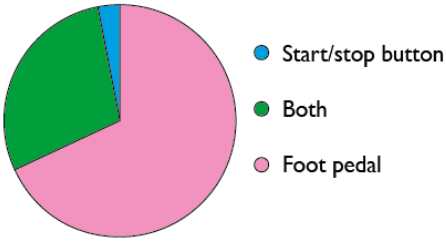
- Vad tror du kommer ske i framtiden av symaskiner?

## 12.4 Circular diagrams

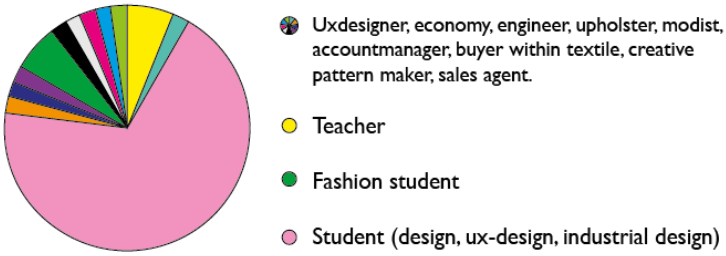
Important while sewing



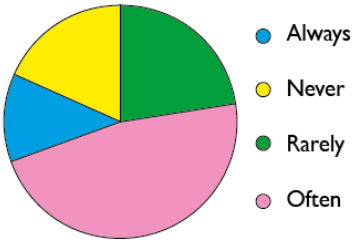

Sewing machine control



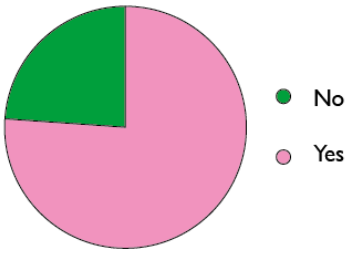

Occupation



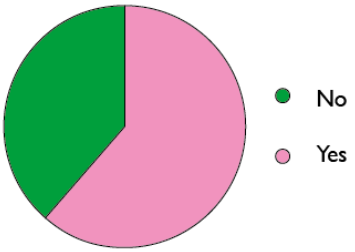

Reading the manual



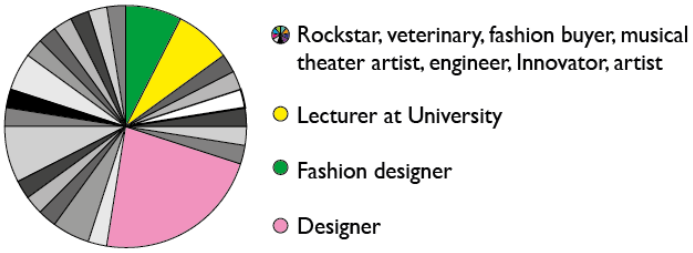

Change settings (ALL)



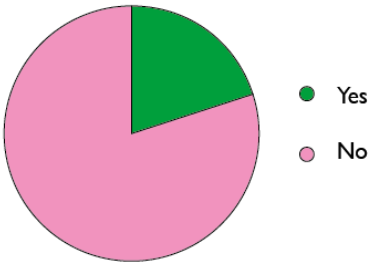

Change settings (Singer)



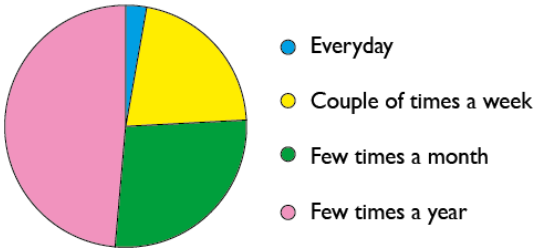

If you could choose any career



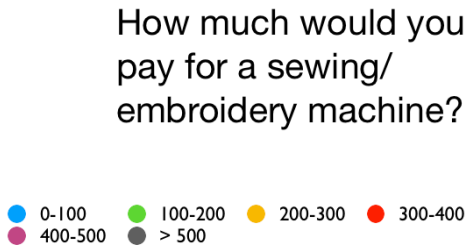

Use embroidery

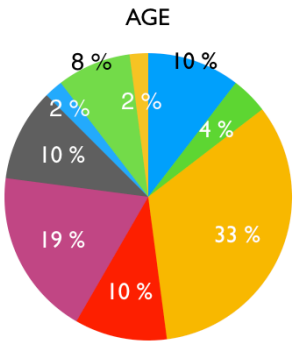


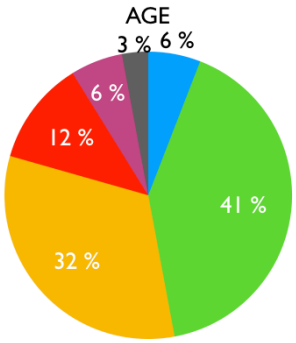

How often do you use a sewing machine?

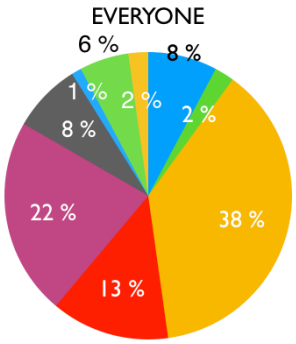


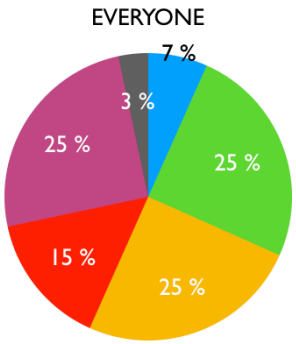
12.5 Circular diagrams from the extended survey.

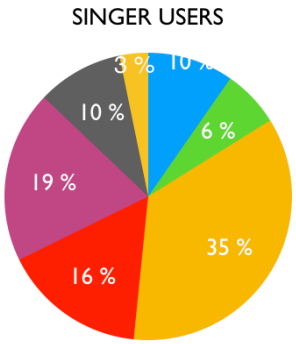



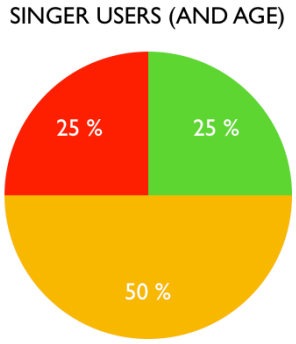



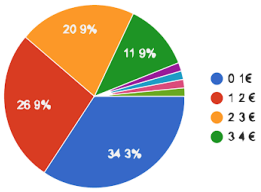



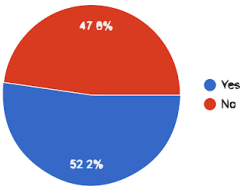



## 12.6 Additional seam types

What would you be willing to pay for an additional seam type?




Would you be interested in buying additional seam types for the sewing machine?



## 12.7 General results from usability test

| | | P1A (1,2,3) | P2A (1,2,3) | P3A (1,2,3) | P4B (3,2,1) | P5B (3,2,1) | P6B (3,2,1) |
|---|---|---|---|---|---|---|---|
| Part 1.1 | | | | | | | |
| | Foot pedal or button (P,B) | P | P | P | B | F | B |
| | Control (actual, 1-5) | 5 | 5 | 5 | 5 | 5 | 5 |
| | Control settings (1-5) | 3 | 4 | 3 | 5 | 5 | 3 |
| | Changing settings | Yes | Yes | Yes | Yes | Yes | Yes |
| | Reading the manual | Yes | Yes | No | No | No | Yes |
| | Try before reading | No | Yes | Yes | Yes | Yes | No |
| | Experienced success rate (1-5) | 5 | 3,5 | 3,5 | 5 | 5 | 4,5 |
| | Success rate | 4 | 5 | 5 | 5 | 5 | 5 |
| | Time 1.1 (minutes:seconds) | 5:15 | 6:00 | 6:30 | 2:30 | 3:00 * | 5:00 |
| | | | | | | | |
| Part 1.2 | | | | | | | |
| | Foot pedal or button | B | FB | B | B | B | B |
| | Control settings (actual, 1-5) | 3 | 4 | 3 | 5 | 5 | 4 |
| | Changing correct settings | Yes | Yes | Yes | Yes | Yes | Yes |
| | Reading the manual | Yes | Yes | Yes | Yes | Yes | Yes |
| | Try before reading | No | No | Yes | Yes | No | Yes |
| | Experienced success rate (1-5) | 5 | 4,5 | 4 | 5 | 5 | 4,5 |
| | Success rate | 5 | 5 | 5 | 5 | 5 | 5 |
| | Time 1.2 (minutes:seconds) | 9 | 4 | 9 | 0:25 | 0:40 | 2 |
| Part 1.3 | | | | | | | |
| | Foot pedal or button | B | B | B | B | B | B |
| | Control settings (actual, 1-5) | 5 | 5 | 5 | 5 | 5 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Changing correct settings | Yes | Yes | Yes | Yes | Yes | Yes |
| | Reading the manual | Yes | Yes | Yes | Yes | No | Yes |
| | Try before reading | No | No | No | No | Yes | Yes |
| | Experienced success rate (1-5) | 5 | 4,5 | 5 | 5 | 5 | 4 |
| | Success rate | 5 | 5 | 5 | 5 | 5 | 5 |
| | Time 1.2 (minutes:seconds) | 0:50 | 1:15 | 0:35 | 0:20 | 0:12 | 1:00 |

| | | P1A (1,2,3) | P2A (1,2,3) | P3A (1,2,3) | P4B (3,2,1) | P5B (3,2,1) | P6B (3,2,1) |
|---|---|---|---|---|---|---|---|
| Part 2.1 | | | | | | | |
| | Placement of smartphone (passive) | RH | RT | RH | RH | RT | |
| | Placement of smartphone (active) | RT | RT | RT | LT | RT | |
| | Foot pedal or button (P,B) | P | P | P | B | P | |
| | Control (actual, 1-5) | 5 | 5 | 5 | 5 | 5 | |
| | Control settings (1-5) | 3 | 5 | 5 | 5 | 4 | |
| | Changing settings | Yes | Yes | Yes | Yes | Yes | |
| | Reading the manual | No | No | Yes | No | No | |
| | Try before reading | Yes | Yes | No | Yes | Yes | |
| | Experienced success rate (1-5) | 5 | 4,5 | 4,5 | 5 | 3,5 | |
| | Success rate | 5 | 5 | 5 | 5 | 5 | |
| | Time 2.1 (minutes:seconds) | 3:00 | 3:30 | 5:30 | 3:00 | 3:00 | |
| Part 2.2 | | | | | | | |
| | Placement of smartphone (passive) | RT | LH | RH | LT | LT | |
| | Placement of smartphone (active) | RT | RT | RH | LT | LT | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Foot pedal or button | B | B | B | B | B | |
| | Control settings (actual, 1-5) | 5 | 5 | 5 | 4 | 2 | |
| | Changing correct settings | Yes | Yes | Yes | Yes | Yes | |
| | Reading the manual | Yes | Yes | Yes | Yes | Yes | |
| | Try before reading | No | Yes | No | No | Yes | |
| | Experienced success rate (1-5) | 5 | 5 | 5 | 5 | 5 | |
| | Success rate | 5 | 5 | 5 | 5 | 5 | |
| | Time 2.2 (minutes:seconds) | 1:00 | 2:00 | 1:10 | 1.30 | 2:20 | |
| Part 2.3 | | | | | | | |
| | Placement of smartphone (passive) | RT | RH | RH | LT | LT | |
| | Placement of smartphone (active) | RT | RT | RH | LT | LT | |
| | Foot pedal or button | B | B | B | B | B | |
| | Control settings (actual, 1-5) | 5 | 5 | 4 | 4 | 5 | |
| | Changing correct settings | Yes | Yes | Yes | Yes | Yes | |
| | Reading the manual | Yes | No | No | No | No | |
| | Try before reading | No | Yes | Yes | Yes | Yes | |
| | Experienced success rate (1-5) | 5 | 5 | 5 | 5 | 5 | |
| | Success rate | 5 | 5 | 5 | 5 | 5 | |
| | Time 2.3 (minutes:seconds) | 0:35 | 0:40 | 0:50 | 0:30 | 0:20 | |

| | | P1A (1,2,3) | P2A (1,2,3) | P3A (1,2,3) | P4B (3,2,1) | P5B (3,2,1) | P6B (3,2,1) |
|---|---|---|---|---|---|---|---|
| Part 3.1 | | | | | | | |
| | Placement of smartphone (passive) | RT | RT | LH | LT | LT | LT |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Placement of smartphone (active) | RT | RT | RT | LT | LT | RT |
| | Foot pedal or button (P,B) | B | B | B | B | B | B |
| | Control (actual, 1-5) | 2 | 4 | 1 | 4 | 1 | 3 |
| | Control settings (1-5) | 5 | 5 | 2 | 4 | 4 | 2 |
| | Changing settings | Yes | Yes | Yes | Yes | Yes | Yes |
| | Reading the manual | No | No | Yes | Yes | No | Yes |
| | Try before reading | Yes | Yes | No | Yes | Yes | Yes |
| | Experienced success rate (1-5) | 5 | 5 | 5 | 5 | 5 | 2,5 |
| | Success rate | 5 | 5 | 2 | 5 | 3 | 5 |
| | Time 3.1 (minutes:seconds) | 2:30 | 5:00 * | 2:00 | 5:30 | 4:30 | 17:00* |
| Part 3.2 | | | | | | | |
| | Placement of smartphone (passive) | RT | RH | LH | LT | LT | LT |
| | Placement of smartphone (active) | RT | RH | LH | LT | LT | LT |
| | Embroidery placement check (paper, phone) | No | PP, PH | PH | PP | No | No |
| | Foot pedal or button | B | B | B | B | B | B |
| | Control settings (actual, 1-5) | 4 | 5 | 5 | 3 | 5 | 5 |
| | Changing correct settings | Yes | Yes | Yes | Yes | Yes | No |
| | Reading the manual | Yes | No | No | Yes | Yes | Yes |
| | Try before reading | No | Yes | Yes | No | No | No |
| | Experienced success rate (1-5) | 5 | 5 | 5 | 4.5 | 5 | 4 |
| | Success rate | 5 | 5 | 5 | 5 | 5 | 3 |
| | Time 3.2 (minutes:seconds) | 2:40 | 1:00 | 1:00 | 3:30 | 3:00 | 4.00 |

| Part 3.3 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Placement of smartphone (passive) | RT | RH | LH | LT | LT | |
| | Placement of smartphone (active) | RT | RT | LH | LT | LT | |
| | Foot pedal or button | B | B | B | B | B | B |
| | Control settings (actual, 1-5) | 4 | 5 | 5 | 5 | 5 | |
| | Changing correct settings | Yes | Yes | Yes | 5 | 5 | |
| | Reading the manual | No | No | No | No | No | |
| | Try before reading | Yes | Yes | Yes | Yes | Yes | |
| | Experienced success rate (1-5) | 5 | 5 | 5 | 5 | 4,5 | |
| | Success rate | 5 | 5 | 5 | 5 | 5 | |
| | Time 3.3 (minutes:seconds) | 1:00 | 0:50 | 0:25 | 0:40 | 1:30 | |

## 12.8 Validation test general results

| | | G | J | A | K | A | M |
|---|---|---|---|---|---|---|---|
| Connecting machine | | | | | | | |
| | Pressing on/off | Yes | No | Yes | Yes | No | No |
| | Pressing bluetooth button | Yes | No | Yes | Yes | No | No |
| | Press connect | Yes | Yes | Yes | Yes | Yes | Yes |
| Task 1 | | | | | | | |
| Buying project | | | | | | | |
| | Placement of smartphone | RT | RH | RT | LH | RH | LH |
| | Control (actual, 1-5) | 5 | 2 | 5 | 5 | 1 | 5 |
| | Reading the manual | No | No | No | No | No | No |
| | Try before reading | Yes | Yes | Yes | Yes | Yes | Yes |
| | Experienced success rate (1-5) | 5 | 2 | 5 | 2 | 2,5 | 5 |
| | Success rate | 5 | 4 | 5 | 4 | 1 | 5 |
| | Time 2.1 (minutes:seconds) | 1:30 | 6:00 | 0:39 | 5:20 | - | 1:20 |
| Task 2 | | | | | | | |
| Välja söm | Placement of smartphone (passive) | RT | RT | RT | LRH | RH | RT |
| | Placement of smartphone (active) | RT | RT | RT | LT | RT | RT |
| | Control settings (actual, 1-5) | 5 | 5 | 5 | 5 | 5 | 5 |
| | Reading the manual | No | No | No | No | No | No |
| | Try before reading | Yes | Yes | Yes | Yes | Yes | Yes |
| | Experienced success rate (1-5) | 5 | 3 | 5 | 5 | 4,5 | 5 |
| | Success rate | 5 | 5 | 5 | 5 | 5 | 5 |
| | Time 2.2 (minutes:seconds) | 0:25 | 2:37 | 0:46 | • | 0:40 | 1:10 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Task 3 | | | | | | | |
| Köpa söm | Placement of smartphone (passive) | RT | RT | RT | RLH | RLH | RT |
| | Placement of smartphone (active) | RT | RT | RT | LT | LT | RT |
| | Control (actual, 1-5) | 5 | 5 | 4 | 4 | 5 | 3 |
| | Reading the manual | No | No | No | No | No | No |
| | Try before reading | Yes | Yes | Yes | Yes | Yes | Yes |
| | Experienced success rate (1-5) | 4 | 3 | 5 | 5 | 4 | 5 |
| | Success rate | 2 | 5 | 5 | 4 | 5 | 5 |
| | Time 2.3 (minutes:seconds) | 1:00 | 1:45 | 1:08 | • | 1:09 | 3:30 |
| Task 4 | | | | | | | |
| Finding pattern | Placement of smartphone (passive) | RT | RT | RT | RH | RLH | RT |
| | Placement of smartphone (active) | RT | RT | RT | RT | LH | RT |
| | Control finding pattern | 5 | 5 | 5 | 5 | 5 | 5 |
| | Control finding embroidery home screen | 1 | 1 | 4 | 5 | 5 | 5 |
| | Control starting embroidery | 5 | 1 | 3 | 4 | 5 | 5 |
| | Reading the manual | No | No | No | No | No | No |
| | Try before reading | Yes | Yes | Yes | Yes | Yes | Yes |
| | Experienced success rate (1-5) | 4 | 5 | 5 | 4 | 5 | 5 |
| | Success rate | 4 | 3 | 5 | 5 | 5 | 5 |
| | Time 2.4 (minutes:seconds) | 5:00 | 11:15 | 2:25 | - | 0:05 | 0:30 |
| Task 5 | | | | | | | |
| Mumin | Placement of smartphone (passive) | RT | RT | RH | LH | LRH | RT |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Placement of smartphone (active) | RT | RT | RT | RT | LH | RT |
| | Control (actual, 1-5) | 5 | 4 | 5 | 4 | 5 | 5 |
| | Reading the manual | No | No | No | No | No | No |
| | Try before reading | Yes | Yes | Yes | Yes | Yes | Yes |
| | Experienced success rate (1-5) | 5 | 5 | 5 | 4.5 | 4.5 | 5 |
| | Success rate | 5 | 5 | 5 | 5 | 5 | 5 |
| | Time 2.5 (minutes:seconds) | 2:15 | 2:34 | 0:43 | • | 0:56 | 0:40 |
| Task 6 | | | | | | | |
| T-shirt | Placement of smartphone (passive) | RT | RH | RH | RH | RH | RH |
| | Reading the manual | No | No | No | No | Yes | No |
| | Placement of smartphone (active) | RT | RT | RT | RT | RH | |
| | Control (actual, 1-5) | 5 | 2 | 4 | 4 | 2 | 1 |
| | Experienced success rate (1-5) | 4 | 0 | 5 | 1 | 4,5 | 5 |
| | Success rate | 5 | 3 | 5 | 5 | 1 | 1 |
| | Time 2.6 (minutes:seconds) | 3:50 | 2:46 | 2:40 | • | • | - |
| Task 7 | | | | | | | |
| Buying embroidery | | | | | | | |
| | Placement of smartphone | RT | RT | RH | LH | RH | RT |
| | Control (actual, 1-5) | 5 | 2 | 4 | 5 | 5 | 5 |
| | Reading the manual | No | No | No | No | No | No |
| | Try before reading | Yes | Yes | Yes | Yes | Yes | Yes |
| | Experienced success rate (1-5) | 5 | 1 | 5 | 5 | 5 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Success rate | 5 | 5 | 5 | 5 | 5 | 5 |
| | Time 2.7 (minutes:seconds) | 0:43 | 5:11 | 0:30 | • | 0:30 | 0:20 |

## 12.9 Validation test

| | | |
|---|---|---|
| Connecting machine | | |
| | Pressing on/off | 50 percent of the participants pressed the on/off button |
| | Pressing bluetooth button | 50 percent of the participants |
| | Press connect | Everybody pressed the connect button on app |
| | | |
| Task 1 | | |
| Buying project | | |
| | Placement of smartphone | 66 % held the smartphone in their hands and the rest had the phone on the right side of the machine. |
| | Control (actual, 1-5) | 66 % scored an high amount of control while the rest had a very low control. |
| | Reading the manual | No One read the manual but one participant searched for the manual in the app. |
| | Try before reading | 100 % of the participants tried before reading manual. |
| | Experienced success rate (1-5) | The participants who did not have much control during this task had a low amount of experienced success rate while 50 % experienced a very high success rate. |
| | Success rate | The success rate was high but the participants was unsure if the task was completed. One participant wanted to go further because she was unsure about if the embroidery was bought when buying a project. Another participant was worried and went further to choose material. One participant did not pass the test due to the fact that she went straight into the embroidery section and only bought the embroidery. |
| | Time 2.1 (minutes:seconds) | The overall time for participants completing this task was about 3 minutes. |
| Task 2 | | |
| Välja söm | Placement of smartphone (passive) | 66 procent had the phone on the right side of the table. The rest held the phone in their hands. |

| | | |
|---|---|---|
| | Placement of smartphone (active) | 84 % had the phone on the right side of the table while one participant had it on the left side of the table. |
| | Control settings (actual, 1-5) | The control was high on this task except for that some participants did not know what the different settings meant. |
| | Reading the manual | Noone read the manual but one of the participants would have liked the option of doing so. |
| | Try before reading | Everyone tried before reading. |
| | Experienced success rate (1-5) | High amount of experienced success rate |
| | Success rate | The success rate was 100 % |
| | Time 2.2 (minutes:seconds) | The average completion time was 1:13. |
| Task 3 | | |
| Köpa söm | Placement of smartphone (passive) | 66% had the phone on the right side of the table. The rest had it in their hands. |
| | Placement of smartphone (active) | Everyone kept the phone on the table. 66% on the right side and the rest on the left side of the table. |
| | Control (actual, 1-5) | The average control was 4.3. One of the participant tried to go to project store to buy the seams at first. One participant did not know how to get to the seam types menu. |
| | Reading the manual | No one read the manual |
| | Try before reading | Everybody tried before reading |
| | Experienced success rate (1-5) | The average experienced success rate was 4.3 |
| | Success rate | The average success rate was 4.3 but two participant missed out on either choosing the material. Which means that problems could occur if sewing is proceeded. One participant did not program the settings into the machine. The participant did not tap the green marked button. This means that the participant was sewing with the default seam type. Which is straight seam. |

| | | |
|---|---|---|
| | Time 2.3 (minutes:seconds) | Average time 1:42 |
| Task 4 | | |
| Finding pattern | Placement of smartphone (passive) | 66% had their phones on the right side of the table. The rest had it in their hands. |
| | Placement of smartphone (active) | One participant held the phone in the hand while the rest kept their phone on the right side of the table. |
| | Control finding pattern | 100 % control |
| | Control finding embroidery home screen (1-5) | Average 3,5. Two participants had a very low amount of control. They could not find the embroidery home screen. |
| | Control starting embroidery (1-5) | Average 3,8.<br>Participants managed to follow the steps to the end page but did not understand that they were supposed to press play on the machine. One participant was unsure of the result of the embroidery. She did not know what size the embroidery was. |
| | Reading the manual | 100 % No |
| | Try before reading | 100 % Yes |
| | Experienced success rate (1-5) | 4,7 |
| | Success rate (1-5) | 4,5 the success rate was relatively high but two participant had to have guidance in how to find the switch to embroidery screen. |
| | Time 2.4 (minutes:seconds) | 2:3 |
| Task 5 | | |
| Mumin | Placement of smartphone (passive) | 50 % of the participants had the phone on the right side of the table and 50 % held the phone in their hands |
| | Placement of smartphone (active) | 50 % of the participants had the phone on the right side of the table and 50 % held the phone in their hands |
| | Control (actual, 1-5) | 4,6 |
| | Reading the manual | No |

| | | |
|---|---|---|
| | Try before reading | Yes |
| | Experienced success rate (1-5) | 4.8 |
| | Success rate (1-5) | 100 % got a 5 |
| | Time 2.5 (minutes:seconds) | 1:11 |
| Task 6 | | |
| T-shirt | Placement of smartphone (passive) | One participant had the phone in their left hand and the rest had it in the right hand. |
| | Reading the manual | One read the manual the rest did not |
| | Control (actual, 1-5) | The overall control was 3 which is low. Many of the participants did not understand why the function of this task was. They did not understand what the different steps was och did not understand what the referens (bobbin) did. |
| | Experienced success rate (1-5) | 3.25 was the overall experienced success rate. |
| | Success rate | The overall success rate was 3.33 which is very low for this task. One participant did not perform the task correctly. One participant did not use the bobbin and use this as a reference. The participants did not understand the meaning with doing the tasks. |
| Task 7 | | |
| Buying embroidery | | |
| | Placement of smartphone | The participants had the phone on the right side of the table. And three participants had the phone in their hands. |
| | Control (actual, 1-5) | Average 4,3. Two participants did find the embroidery but did not understand that the embroidery had been bought. One participant wanted to find the embroidery by clicking on the plus symbol. |
| | Reading the manual | 100% - No |
| | Try before reading | Yes - everyone |

| | | |
|---|---|---|
| | Experienced success rate (1-5) | The experienced success rate was high except for one participant that required a confirmation on that she had a bought an embroidery. |
| | Success rate | 100% success rate |
| | Time 2.7 (minutes:seconds) | 1:44 |

12.10 CW

| **Entering the embroidery pattern store** | | | |
|---|---|---|---|
| | **Y/N** | **Why?** | **Problems** |
| **Will the user try to achieve the right outcome?** | Y | They know they need a pattern that they currently don't have. | |
| **Will the user notice that the correct action is available to them?** | Y | Large "+" button | |
| **Will the user associate to correct action with the desired target?** | Y | The "+" button is consistent to the "+" button on the home screen that also opens a menu where content can be added. | |
| **If the correct action is taken, does the user get feedback?** | Y | The popup window appears, revealing the shopping cart. | |

| **Opening the slide out menu** | | | |
|---|---|---|---|
| | **Y/N** | **Why?** | **Problems** |
| **Will the user try to achieve the right outcome?** | Y | No embroidery functions are visible at the sewing home screen. Switching modes is necessary. | |
| **Will the user notice that the correct action is available to them?** | Y | Yes the symbol is clearly visible in the top left corner | |
| **Will the user associate to correct action with the desired target?** | N | The user will look for the embroidery menu somewhere else | The user regards embroidery as an important function that should be available at all times. |
| **If the correct action is taken, does the user get feedback?** | Y | Yes the menu slides out. | |

| **Entering the embroidery home screen** | | | |
|---|---|---|---|
| | **Y/N** | **Why?** | **Problems** |

| | | | |
|---|---|---|---|
| **Will the user try to achieve the right outcome?** | Y | The user knows that the slide out menu is only a menu and not the embroidery home screen. Further actions are therefore required | |
| **Will the user notice that the correct action is available to them?** | Y | It's clearly visible at the top of the slide out menu. | |
| **Will the user associate to correct action with the desired target?** | Y | The button is marked with "switch to embroidery" and arrows to indicate the intended action. | |
| **If the correct action is taken, does the user get feedback?** | Y | The embroidery home screen slides in from the left. | |

| **Finding additional seams** | | | |
|---|---|---|---|
| | **Y/N** | **Why?** | **Problems** |
| **Will the user try to achieve the right outcome?** | Y | The user assumes there are more than 10 available seams - due to there being many more on a traditional sewing machine. | |
| **Will the user notice that the correct action is available to them?** | Y | The arrows are visible near the vertical middle of the screen | |
| **Will the user associate to correct action with the desired target?** | N | The user might try pressing the + button in order to enter "buy seams". - both options are available. | The arrows could indicate a slide up menu containing other content. |
| **If the correct action is taken, does the user get feedback?** | Y | The slide up menu appears | |

| **Starting embroidery** | | | |
|---|---|---|---|
| | **Y/N** | **Why?** | **Problems** |
| **Will the user try to achieve the right outcome?** | Y | The user notices that nothing happens - regarding the embroidery - and will therefore look to take further action | |

| | | | |
|---|---|---|---|
| **Will the user notice that the correct action is available to them?** | Y | The play button on the machine has a flashing light and is clearly visible. | |
| **Will the user associate to correct action with the desired target?** | Y | The app directs the user to" press the play button on the machine to start embroidery" | |
| **If the correct action is taken, does the user get feedback?** | Y | Embroidery starts. | |

## 12.11 Manual

**EMBROIDERY SETTINGS**

CONNECTING THE EMBROIDERY UNIT

1. Turn the machine off before connecting the embroidery unit (A).
2. Slide the embroidery unit onto the arm of the machine until it plugs firmly into the socket.


HOME SCREEN (B)

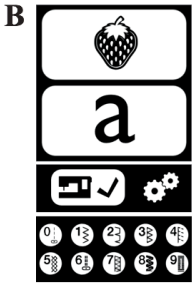
When you have attached the embroidery unit correctly the embroidery home screen will appear (B)
You can start selecting and editing embroidery from this screen.

SELECTING A EMBROIDERY DESIGN

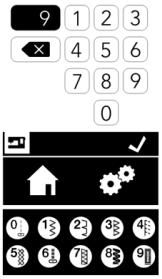
Your machine has 9 built-in embroidery designs.

1. Press the strawberry button on the Home screen (B). A nine-key screen will appear (C).
2. Select a design from the embroidery collection (D) and use the seleced designs number which is then printed on the 9-key screen (C).

B




C

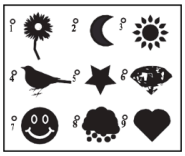



4

EMBROIDERY PLACEMENT SCREEN (F)

After you have selected one design, press the check box off (E). The chosen design will appear on a emboridery placement screen (F).
You can now move the placement of the selected embroidery design.
Press the four arrow buttons to move the position. Up, left, right and down (1). If wanted you could choose to place the design in the center of the hoop by pressing the center button (2)

D

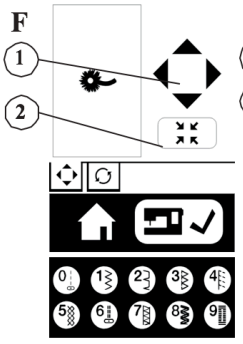


E

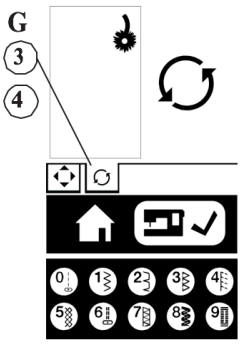
EMBROIDERY ROTATION SCREEN (G)

- Press the embroidery rotate tap (3)
- Press the rotate button(4). By pressing this button, the design will rotate 90 degrees clockwise. If the design is too wide or too high to rotate 90 degrees, it will rotate 180 degrees.

F




G




5

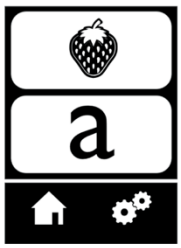
## EMBROIDERY LETTER FUNCTION

You can combine letter stitches into a sequence. To enter the sequence mode, press the letter button at the home screen (A).

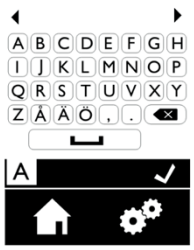
## HOW TO EDIT A LETTER FROM THE SEQUENCE

1. Press the letter button
2. Write the letter-sequence (B)
3. Edit the lettercombination (C) as described on page 5.

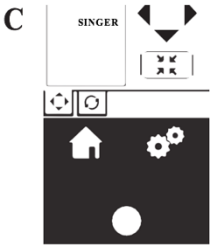
A




B




C



## 12.12 Usability test task arrangement

Testet är uppdelat i tre delar.

1: alla funktioner sitter på maskinen
2: alla inställningar är i en extern app, men knapparna som styr maskinen under användning är kvar på maskinen.
3: alla funktioner finns i den externa appen.

Tre deltagarna kommer göra testet i ordningen 1,2,3, medan de resterande tre gör testet i ordningen 3,2,1.

Mellan varje del kommer frågor att ställas för att ta reda på hur deltagarna upplevde testet och hur det var att utföra uppgifterna.

**INNAN TESTET**

"Jag, Nanny, kommer att ge dig uppgifter av varierande svårighetsgrad som du ska utföra. Uppgifterna är alla relaterade till maskinen och du väljer själv om eller vad för inställningar du vill ändra på för att utföra uppgiften. Du får gärna prata högt när du utför uppgifterna, då kan vi lättare följa din tankegång. När du känner att du är klar med en uppgift säger du "nu känner jag att jag är klar" (Då ställer vi frågan : På en skala 0-10, hur säker är du på att du är klar?). Vi kommer inte kunna svara på frågor gällande uppgifterna, men har du frågor gällande testet överlag så är det bara att säga till. Testet kommer att filmas och ljudet kommer att spelas in, *och vi testar produkten och inte dig!*

Jag, Johan, kontrollerar den feedbacken du får från maskinen när du interagerar med den. Om ingenting händer när du försöker interagera med maskinen kan det bero på att du utför fel handling eller att vår modell saknar den funktionen. Alla funktioner som behövs för att utföra uppgifterna finns dock. Genom att tänka högt kan jag lättare ge rätt feedback. Exempelvis får du gärna säga "nu trampar jag hårdare på fotpedalen" etc. "

**UNDER TESTET**

**Part 1**

Du skall nu sy upp ett kant av tyget genom att fålla in några mm.

1. *Starta maskinen*
2. *Välj lämplig söm och diverse inställningar*
3. *Börja sy*
4. *Avsluta sy-moment*

Du skall nu brodera in en stjärna på detta tyg (tyg i hoop).

1. *Välj ett snyggt broderi*
2. *Justera broderiet positio**n i mitten längst till vänster***
3. *Börja sy broderiet*
4. *Avsluta broderi-moment*

Du skall brodera in namnet KIM på valfritt ställe på tyget (tyg i hoop)

1. *Skriv in namnet KIM*
2. *Placera KIM **mitt på tyget.***
3. *Börja sy broderiet*
4. *Avsluta broderi-moment*

**Part 2**

Katten har lekt med dina gardiner och du skall laga en kant så att inte tyget börjar lösas upp.

1. *Start maskinen*
2. *Välj lämplig söm och diverse inställningar*
3. *Börja sy*
4. *Avsluta sy-moment*

Du skall nu brodera in ett hjärta på detta tyg (tyg i hoop).

1. *Välj ett snyggt broderi*
2. *Justera broderiets position **i mitten längst till höger***
3. *Börja sy broderiet*
4. *Avsluta broderi-moment*

Du skall brodera in namnet KIM på valfritt ställe på tyget (tyg i hoop)

1. *Skriv in namnet KIM*
2. *Placera KIM **längst ner i högra hörnet***
3. *Börja sy broderiet*
4. *Avsluta broderi-moment*

**Part 3**

Du skall sy ihop dessa två tyger med varandra - långsida mot den andra långsidan.

1. *Starta maskinen*
2. *Välj lämplig söm och diverse inställningar*
3. *Börja sy*

Du skall nu sy till en blomma på en t-shirt (tyg i hoop). Du vill att den ska se likadan ut som den här bilden.

1. *Välj ett snyggt broderi*
2. *Justera broderiets position*
3. *Börja sy broderiet*

Du skall brodera in namnet KIM på tyget (tyg i hoop)

1. *Skriv in namnet KIM*
2. *Placera KIM* ***längst upp i vänstra hörnet.***
3. *Börja sy broderiet*
4. *Avsluta broderi-moment*

## 12.13 Test arrangement validation test

**UNDER TESTET - Sy-del**

*Du vill göra ett kuddfodral som du vill brodera in en blomma på. Vi vill nu att du skall leta upp ett projekt som passar dina önskemål och köpa det. Du behöver inte tänka på att du ska sy projektet.*

1. Får mobil i handen. Appen har inte satts igång ännu utan det får användaren göra.
2. On/off knapp
3. Trycker på bluetooth knapp
4. Får igång appen
5. Leta upp ett projekt - kuddfodral med blomma
6. Köpa det

**Sy ihop tygbitar**

*Får två tygbitar och kanten skall sys ihop.*
*När du gör detta skall du använda dig av två olika sömmar. Du börjar med att sy kanten med sicksack-söm.*

*Då är det bara att sätta igång maskinen - välja sicksacksöm och börja sy ihop kanten av tygbitarna. Tygbitarna är gjorda i ett* ***normalt material som ej är elastiskt.***

1. Ställer in söm
2. Går in på diverse inställningar
3. Kör igång

**Köp av söm**

*Du känner inte riktigt att du var klar med att sy ihop tygbitarna utan behöver en extra söm som ger ett bättre resultat. Nu skall du köpa en söm för att du vill använda denna. Du skall köpa denna söm - visa bild på sömmen. Hur går du tillväga?*

1. Går in i sydelens homebutton
2. Hittar den
3. Köper den

*Nu har du köpt din invisible hem stitch.*
*Du vill använda den - vart hittar du den - visa oss*

1. Går in i sömmar
2. Väljer den

Sydel 2.

**Sy raksöm**

Din katt har gjort sönder din gardin och du skall sy in kanten på ditt tyg. Du vill då använda raksöm. Hur går du tillväga.

**UNDER TESTET - broderi-del**

*Du kom på att du har ett bra kuddfodral hemma som du skulle vilja sy in blomman som ingick i projektet som du tidigare köpt. Du vill alltså endast använda broderiet som är blomman och brodera detta på ett tyg. (ger användaren en hoop med tyg i) Du har redan spänt fast tyget i en hoop. Och vill nu hitta broderiet och brodera detta på tyget.*

1. Går in i broderimeny
2. Hitta mönster

**Mumin**
*Du har en muminfigur på ett underlägg som du tycker om väldigt mycket och vill använda detta mönster för att brodera in på en tygbit. Hur går du tillväga?*

1. Tar kort på mumin
2. Redigerar mumin
3. Skickar iväg mumin till hoop-bild

**Tshirt röd**
Du har en röd kortärmad tröja som du vill brodera in en nalle på. (lägger fram tyget)
Du vill se hur detta mönster skulle kunna att se ut på ditt plagg innan du broderar in det. Hur går du tillväga?

**Köp och sy broderi**
*Du vill brodera ett broderi på din halloween-dräkt men har ingen inspiration till hur mönstret skall se ut. Så du går in på din app och letar upp ett broderi i biblioteket som du gillar och köper det. Du behöver ej sy det.*

- Letar upp ett broderi i biblioteket
- Köper det.

## 12.14 Singer Legacy SE300

## 12.15 Singer Legacy SE300 - Settings panel

## 12.16 Mock-up and prototype app