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Communicating rein forces

For efficient and safe training

Master of Science Thesis, Industrial Design Engineering

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Master of Science Thesis

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Foreword

This project is a master's thesis performed by two students from the Industrial Design Engineering programme during spring 2018. We would like to thank Maria Sundin, senior lecturer from the Department of Physics at University of Gothenburg and professor Paul McGreevy who helped initiate the project. Thank you Maria for being a great support by providing contacts and helping us along the way. Also, our supervisor Anna-Lisa Osvalder, professor from the Division of Design & Human Factors at Chalmers University of Technology, who has been enthusiastic about the equitation subject and supported us with technicalities during the process. Thank you Lars Bengtsson for putting time and effort in helping us to build a prototype. We would also like to thank Jan-Åke Wiman and Lars Hellberg for supporting us in the creation of the prototype. We are thankful for the help and input given by Ida Hermansson and Mats Johansson from the University of Borås, providing information about materials. We would also like to thank Annika Gustafsson and the company RISE for explaining and discussing technicalities and theoretical solutions for the product concept. A big thank you to everyone who participated in our user studies and user tests, contributing with valuable insight and ideas. Finally, thank you to Edvin, the horse who put up with a lot of practical testing.

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Klara Dahlstedt and Therése Warberg

Abstract

A large issue within the equestrian world is uneven force distribution between the reins when riding. This is a problem that can cause injuries or wear for both horse and rider, as well as restrict development and performance. It is of interest to strive against physical evenness and therefore the project aims to develop a product that can measure and communicate the force in each rein. To do this is also a step towards developing the equestrian world in a more scientific and technical direction. The concept of the project consists of sensors that measure the force in each rein, as well as three different parts that communicate the measured data to the rider. The communication is both directly available during ride, through visual and haptic feedback, and available post ride through an app, to track patterns over time. There are several competitor products, but none that provides this combination of communication to the rider. That is why the communication is considered the major competitive strength of the concept. The concept also comes with a brand spirit emphasising a feeling of sport, where team spirit and product contributes to improved performance, something that falls in line with the aim of the project. It is believed that this concept can change the perception of technique working against rider's feeling and horsemanship, since an increased insight can help the rider's understanding of the horse and perception of their own skill.

Terminology

Bit	A type of horse tack placed in a horse's mouth.
Canter lead	Refer to the leg which the horse throws further forward when cantering.
Dressage	The art of training the horse so it is agile in its performance, as well as responsive and obedient to the rider. Also, a competitive sport where the horse's natural movement is judged and an ideal is strived for.
English riding	A horse riding form where a flat English saddle is used.
Equitation	The art and practice of horse riding.
Gait	The paces at which horses move, as walk, trot, canter or gallop.
Horse tack	A piece of equipment placed on horses, as bits, reins, bridles and saddles.
Laterality	When one side of the brain or body is dominant
Left track	Riding in an arena with the wall/rail on rider's right side, making left turns at the corners.
Rein	A strap fastened in each end of the bit of a bridle, by which the rider controls the horse by pulling or releasing.
Right track	Riding in an arena with the wall/rail on rider's left side, making right turns at the corners.
Show jumping	A sport in which horses are ridden in competitions to demonstrate skills in jumping over or between obstacles.
Thoroughbred	A horse breed

List of contents


1

1. Introduction

Within equestrian sports, the horse's performance is to a large extent affected by the rider. One way that the rider communicates with the horse is through reins that are connected to a bit in the horse's mouth (see figure 1). It is of interest to understand how this particular communication actually works, to help both rider and horse to develop and perform better. The impact of one rein can deviate from the impact of the other rein, which both can and cannot be a cause of problems depending on the situation. In any way, it is highly relevant to investigate if the impact from the two reins are different or equal and to know how big the impact is. McGreevy et al. (2014) describe how the weight of the rein itself creates a natural tension and how long reins reduce the rider's possibility to feel the horse's mouth, simply because of the distance between rider and horse. These are examples of the complexity of the use of reins when riding and it is therefore relevant for this project to investigate how the impact can be monitored.

Figure 1. A horse with equipment.

Another relevant factor is that horses and riders are not completely even physically. Kuhnke et al. (2010) write that laterality occurs in both humans and horses and that sensory and motor skills differ between dominant and non-dominant sides in humans. These differences affect the perception of hand-held objects, such as reins, between the left and right hand. They exemplify a study that shows how the contact between hand and rein was perceived by the rider as even, but when measured turned out to be uneven. Hence, the tension in the reins are affected by both the characteristics of the rein, the laterality of the horse and the rider.

On a short term, knowledge about the impact of the reins can help the rider to make immediate changes to the technique and thereby the performance, but also to relieve horse or rider from discomfort. Since there is always a discussion within the equine world about ethics regarding horse welfare, there are wishes to avoid eventual discomfort for the horse caused by, for instance, impact from the reins. In long term, knowing the change of the reins' impact over time can help evaluate if the horse and rider are developing the right way - if either the horse or the rider is getting more even and soft, or if there is any growing laterality. Knowing this can help prevent future injuries for both horse and rider. A positive development regarding laterality would also most probably improve the performance of horse and rider,

since as Kuhnke et al. (2010) writes - balance and symmetry of the horse is important for superior performance in most equestrian sports.

McGreevy et al. (2014) mean that an evidence-based approach to horse training comes with a need for data that represents human interaction with the horse during ride, and that this can help reveal the impact of the rider's communication with the horse, for example through the hands. McGreevy et al. (2014) further express a need for equitation science to collect data of the role of materials that separate horse and rider during training.

There is laterality in both horse and rider causing different forces in the reins which affect the development and performance of rider and horse. There is also a desire to develop the scientific approach within equestrian sports, including quantitative data collection. These factors motivate the development of a product that can measure the impact of the reins and efficiently and sufficiently communicate this data.

1.1 Aim

The aim of the project is to develop a product that can measure and communicate the force of the reins during horse riding.

1.2 Objectives

- To communicate the impact of the reins to rider.
- To enable supervision of rider's and horse's physical and technical development over time.
- To avoid long term wear and injuries on both horse and rider.
- To increase the efficiency of performance development.

1.3 Questions

1. How can the measuring of the force in the reins be solved technically?
2. How can the measuring of the force in the reins be communicated for good and intuitive understanding?

1.4 Demarcations

- The project will focus on equestrian training only, not competing. This due to the many rules and regulations within competing, see the following competition rules that apply for dressage, moment 211 (Svenska Ridsportsförbundet, 2018), which for example state that reins can only be made of leather or textile and cannot be elastic. These rules greatly limit the idea generation for a new product and focus will therefore be on training.

- Another demarcation is that user studies and tests only will be performed with users in Sweden due to geographical convenience.

- The product is supposed to be used by anyone, but the project will focus on English riding style.

- The project will mainly focus on user needs and understanding, rather than detailed technical functionality.

- The product is thought to be a passive indicator providing the user with all the necessary feedback and data during and/or after ride. Hence, it will not act as an active adjuster/operator performing intervening actions during ride.

- The project will not consider any external factors that affect the force in the reins and the resulting impact such as type of bit, additional reins or similar. The project will simply focus on showing the actual force in the reins, regardless the cause.

- The project will focus on communicating the force and potential difference between the reins but will not analyse or present factors behind the difference.

- Severe physical or cognitive disabilities will not be taken into account when developing the product.

1.5 Process

The project process is divided into five parts (see figure 2). The pre-phase consists of introduction to the area and project, literature study and methods. The first main part is called “exploration” and serves to create a base for concept generation. It consists of user studies to explore the needs for a product, a competitor analysis as well as a customer mapping to understand user behaviour and context. The second phase is “creation” which is based on the findings from phase one and contains idea generation, creation of concepts and quick evaluations. This phase consists of several iterations and will result in one full concept. The third phase “evaluation”, consists of a practical and theoretical evaluation of the concept as well as user tests to find possible problems and improvements for the concept. In the final step which is called "final update", the concept is updated with regards to the evaluation phase.

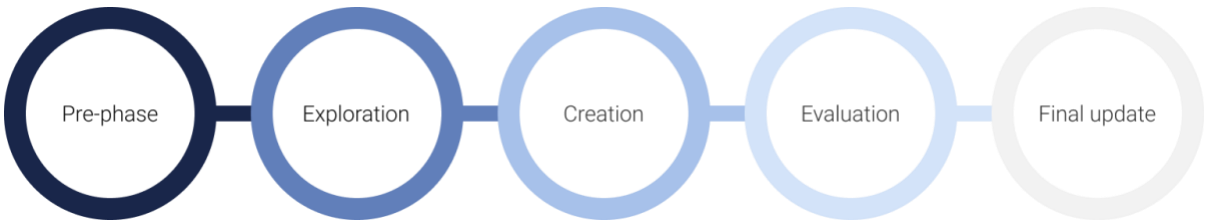


Figure 2. Project process with five phases.


2

2. Literature

This chapter serves as a knowledge base for the report, thus, consider it as a support when reading.

2.1 English riding

Rider's aid

The rider communicates with the horse through riding aids, with which the rider gives cues that the horse has been learnt to understand. Riding aids can be separated into the three main groups; weight, legs and reins. The weight aids work naturally and do not have to be learnt, since all living creatures strive for equilibrium (Tibblin, 1988). Weight aids can be used actively by the rider moving its centre of gravity, so the horse follows to achieve balance once more. They can also be used passively as the rider follows the horse's movement to stay in balance. The leg aid can be divided into upper leg, for stability, and lower leg, through which most cues are given. The leg aid is used for forward motion, side motion, regulation of motion and bending of the horse (Tibblin, 1988). Rein helps give cues to the horse by a connection to the bit in the mouth of the horse. For these cues to work efficiently, the rider's hands need to be sensitive and the arms relaxed, to separate the movement of the rider's body from that of the hands. Rein aids can be used to slow down, to relieve the horse of pressure, to steer, to raise the head and as support (Tibblin, 1988).

The connection between the horse's mouth and the rider's hand is called contact and it should be gentle, balanced and steady - neither too strong nor too loose. A strong contact risks injuring the sensitive parts of the horse's mouth and to make it struggle against the bit, while a loose contact does not give the horse any support or guidance in its work. The rider needs to be still and balanced and able to separate different aids from each other (Higgins, 2017).

Tack

Tack is horse gear designed to either disperse or concentrate pressure. The saddle is supposed to spread the weight of the rider on to the back muscles of the horse to not burden the spine. Most people use a layer between the saddle and the horse to keep the saddle clean and to provide increased comfort for the horse (McGreevy et al., 2014). The saddle must be designed to fit the individual horse well. Sometimes additional gear can be used to keep the saddle in the right place, like a breastplate or a saddle pad (SvRF, 2009).

Types of head restraints concentrates pressure (McGreevy et al., 2014). Also, the bridle needs to be individually fit to the horse, and the bit must fit the mouth of the horse or risk causing discomfort (SvRF, 2009).

Training system

One common principle within riding is the scales of training, which is a training system aiming to benefit the horse's physical and mental skills. Regardless of discipline, following this system gives a horse that is well-trained, cooperative and comfortable. The six principles are:

- Rhythm and regularity of steps
- Suppleness, relaxation and elasticity of movement
- Contact, acceptance of bit and aids

- Impulsion
- Straightness and equal contact on both reins
- Collection, increased engagement and balance

These principles build on each other and one step should be established before concentrating on the following. However, they are interdependent and must always be considered as a whole (Higgins, 2017).

2.2 Physical ergonomics

Symmetry / Asymmetry

One usually refers to bilateral symmetry regarding skeleton and muscles when describing symmetry in horses. If a horse is symmetric, both its sides are almost identical in terms of shapes, position and size. The ideal, symmetry, means that the step or leap length or other movements are the same in both right and left circle (Higgins, 2017). Laterality is found in many species, among these are humans and horses (Kuhnke et al., 2010).

Dominating side

The left or the right cerebral hemisphere is often referred to when talking about dominating sides. In some horses, one half of the brain is more dominant, just like in humans who can be left or right handed. The horse's dominating side can be noted by seeing if the horse has more difficulties when riding in the left or right circle (Higgins, 2017).

In humans, sensory and motor skills differ between the dominant and non-dominant side. Examples of this are different proportions of muscle fibre types, different amount of muscle mass and activity resulting in about 10% more grip force in the dominant hand, as well as more accurate motor control. Also, the *perception* of hand-held objects normally varies between the two hands, where reins are included. One study showed that an uneven and strong rein contact was experienced as even and smooth by the rider (Kuhnke et al., 2010).

Asymmetry in the rider

About 80% of all humans have a dominant left brain and are right-handed, which means that the right side of the body handles motor functions and the left side of the body stands for support and balance. The congenital asymmetry can be minimized by physical activity, such as horse riding, and requires specific neuromotor training. The rider can be seen as the horse's personal trainer and has a large responsibility when it comes to minimizing both their own and the horse's asymmetry. Hence, the riding will be affected if the rider has one exceptionally dominant left or right side (Higgins, 2017).

Asymmetry in the horse

Asymmetry in a horse may be a result of injury, exercise or uneven muscle development, or it may be innate. An asymmetric horse will move unevenly, whereas a symmetric horse will move correct while distributing its body weight evenly and using the least energy possible, similarly to an almost symmetrical rider (Higgins, 2017). If, for instance, a horse is always saddled or led on the same side or always pulls hay from the same direction, the asymmetry can be exacerbated. It is common that the asymmetry is aggravated by the strong muscles being strengthened while the weak muscles are

weakened and some effects of this may be; uneven development of skeletons and muscles, uneven motion patterns and uneven body mass (Higgins, 2017).

For horses, the majority are left-biased where the left eye is related with higher reactivity. Other indicators are choice of advanced foreleg when grazing and preferred canter lead. Laterality is seen to probably increase with age. Rein tension on the horse's preferred side has been seen to be more continuous, with higher peaks of the force. On the other hand, the non-preferred side corresponded with a sometimes-slacking rein and lower peaks (Kuhnke et al., 2010).

Importance of evenness

If a horse shows a certain degree of asymmetry and imbalance it is possible to take action to counteract the effects by strengthening the horse and exercising the muscles. This will create a better body posture and increase the possibility of making the horse move better. A straight horse has evenly distributed body weight and the hind legs pushing to the centre of the body, this makes the wear on the joints become smaller. A horse that is straight can be formed in the longitudinal axis along a curved or straight track. Furthermore, it can perform maximally when it can be bent equally in both directions (Higgins, 2017).

The balance of the horse is important for the possibility to perform and asymmetries are a main reason behind poor performance of the horse, so in most riding theories a symmetric movement pattern is strived for. Consistent stimuli are required for efficient learning in horses. To apply different rein tensions in a clockwise and counter clockwise direction is an inconsistent stimulus that has been shown to decrease and slow down training results (Kuhnke et al., 2010).

In Thoroughbreds, the outer legs were seen to be more likely to get severe injuries due to the uneven strain during races. In riders, asymmetric rein tension could give microtrauma and repetitive strain injury in the shoulder region. Laterality leads to uneven distribution of muscle mass and strength, flexibility and loading of the limbs, resulting in a higher risk of injury (Kuhnke et al., 2010).

The head

In order to influence and control the horse during riding, the horse's head is used more than any other part of the horse body. Factors that can lead to a horse becoming less harmonious and perform poorer are; pressure on the neck, nose or jaw, equipment that fits badly and pain reactions followed by injuries or accidents (Higgins, 2017). In order to handle the horse in a responsive manner, knowledge about the anatomy of the horse's head is crucial. It is important that the hand of the rider is soft and still during horse riding to achieve a gentle contact with the horse's mouth (Higgins, 2017).

2.3 Cognitive ergonomics

Senses and user experience

When experiencing products, people use several senses and the information derived from those senses will hence affect a person's product experience (Ludden et al., 2006; Fenko et al., 2010; Özcan & Van Egmond, 2012). Thus, in order to find out how users experience and interact with products, many different senses need to be considered in product development and design (Dagman et al., 2010a; Dagman et al., 2010b; Schifferstein, 2006; Wikström et al., 2011). The visual sense is often seen as the most dominant one (Wikström et al., 2011; Dagman et al., 2010a; Schifferstein, 2006) which, according to Ludden et al. (2006) is because people can see, smell and hear objects from a distance, whereas taste

or touch requires that the user interacts with the product physically. Moreover, a user's experience may differ from the designer's intended experience or over time and depending on the situation, due to the fact that every user experience is subjective (Hassenzahl, 2003; Forlizzi, 2008).

2.4 Smart textiles

Systems and intelligent materials that can sense and respond to their surrounding in a foreseeable and suitable way can be explained as "smart systems". A smart textile system can be categorised in three different categories depending on its performance (McGreevy et. al., 2013). One category refers to so called "passive smart textiles" which means textiles that have a sensing function, for example pressure-sensing or stretch structures. Another category is referred to as "active smart textiles" and involves textiles that have an actuating function, meaning that they are able to react to and sense stimulus from the environment (McGreevy et. al., 2013). Such textiles can include shape- and colour change materials. Last, a third category contains "very smart textiles" and includes textiles with an adaptive function, where the textiles are able to change their behaviour according to the circumstances. Here, computer-aided measurement tools and electronics can be used to store, process and analyse the signals that the textile actuators/sensors have generated. Smart textiles make it possible to present results and analyse data in a novel way (McGreevy et. al., 2013).

Measuring the environment by the use of textile structures with integrated intrinsic sensing functions allow for appealing, flexible, soft and washable characteristics, as the sensors can be integrated into various types of textile products. Even though there is no objective means of measuring "feel" (when riders rely on biofeedback in their application of pressure cues), the importance of feel is often emphasized by equestrian coaches. "Smart textiles" are possible to integrate in devices, textile structures or fibres that for instance can measure heat, moisture, pressure or tension. This means standard horse equipment can be used together with smart textiles without causing the horse any pain. (McGreevy et. al., 2013)

2.5 Piezoelectric effect

Fabric developed by researchers at Chalmers is able to transform kinetic energy into electrical energy. When stretched or under pressure, the woven fabric can emit enough electricity to send wireless signals, power small electrical devices such as a digital clock, or light a LED (Chalmers, 2018).

The technology used by the researchers is based on the piezoelectric effect which means that when deforming a material, for example by stretching, electricity is created. The textile created by the researchers contains an electrically conductive wire and a piezoelectric wire woven together, making it possible to transport the electricity in order to use it (Chalmers, 2018). An electrically conductive core surrounded by a piezoelectric shell constitute the piezoelectric wire. When soaked or wet, the soft textile becomes more efficient. The researchers' work has mainly focused on using sensors and pressure sensitivity to collect measurement data, but the technology is basically ready to be produced if the right product developers in industry are willing to make use of it. A great advantage with this advanced technology is the relatively low cost (Chalmers, 2018).

2.6 Strain gauge sensor

A sensor with varying resistance when force is applied is called a strain gauge. Force, weight tension, pressure etc. are converted into a change in electrical resistance by the sensor and the resistance can

thus be measured. Strain and stress are the result of external forces being applied to a static object, where strain is described as the deformation and displacement and the stress is defined as the resisting forces internally in the object. Strain gauge sensors are used to measure strain and the term strain consists of two words; compressive and tensile strain which are distinguished by a negative or positive sign. Contractions and expansion are thus both possible be picked up by a strain gauge. A common field of application when it comes to strain gauges is to predict and determine the endurance and safety of a material. (Omega, 2018)

2.7 Graphical guidelines

1. Gestalt Principles should be used to support clustering of appropriate information (Woods, 1996).
    a. Coherent interface (Woods, 1996).
    b. A common color scheme.
    c. Consistent placement of similar and same information (Bligård and Osvalder, 2009; Bennett, Nagy and Flach, 2012).
    d. Similarity (Monö and Knight, 1997).
    e. Similar icons to clarify connection between functions.
    f. Proximity (Monö and Knight, 1997).
    g. Proximity to promote clustering of functions.

2. Avoid mental overload (Bligård and Osvalder, 2009; Bennett, Nagy and Flach, 2012).
    a. Minimized amount of irrelevant information that need to be scanned before finding relevant information, in order to reduce processing and response time.
    b. Important information placed in a way so it is standing out from other information, e.g. on a separate row (Bligård and Osvalder, 2009; Bennett, Nagy and Flach, 2012).

3. Visual messages consist of simple icons and fonts with only the necessary details included (Campbell et al., 2016).

4. Visual information communicated in the easiest way possible for human cognition to decode which, in falling order, is according to Bennett, Nagy and Flach (2012):
    a. Position along a common scale
    b. Position along identical, nonaligned scales
    c. Length
    d. Angle/slope
    e. Area
    f. Volume
    g. Colour
    h. Hue/colour
    i. Saturation/density

5. Larger elements provide more room for content and attract more attention (Hoober & Berkman, 2012).

6. Pointed shapes, for instance triangular warning signs or circular helping icons, attract the most attention (Hoober & Berkman, 2012).

7. Connect colour with the criticality level of the warning and information:
    a. Red: critical situation or danger (Campbell et al., 2016).
    b. Yellow: caution (Campbell et al., 2016).
    c. Green: normal operation (Campbell et al., 2016).
    d. White and blue: system control and neutral information (Young and Stanton, 2002).

8. A neutral background colour does not disturb (Young and Stanton, 2002).

9. As few colours as possible make warnings and other important information stand out, no more than four colours are appropriate (Young and Stanton, 2002; Woods, 1996).

10. Enable users with impaired colour sight to detect changes in contrast. Avoid the combinations: green/red, green/blue, yellow/red, yellow/blue, violet/red (Campbell et al., 2016).

2.8 Design methods

Brand platform

The brand platform formulated by Leidenkrantz (2017) consists of the following six levels:

1. Insight
2. Vision and purpose
3. Role and relation
4. Differentiating competence and differentiating personality
5. Differentiating rational added values and differentiating emotional added values
6. Promise

Insight is the first step of the brand platform, the next being vision and purpose. Vision is the brand's ideal end-state, while purpose answers why the brand is where it is today. The next level consists of role and relation, where role refers to the role that the brand wants to play on the market and relation meaning the brand's relationship with its customers. The fourth level consists of differentiating competence and differentiating personality, meaning the main competence that distinguish the brand from its competitors and the perceived personality that distinguish the brand from its competitors. Level five consists of differentiating rational and emotional added values that the brand offers its customers and the last level concerns the brand promise.

Collage

To visualise and communicate design criteria, a collage with collected images can be used. The purpose of a collage is not to show how a product should look, but rather raise associations and support the experience obtained by the final solution. Various types of collages can be used, for instance: styling board, usage board, moodboard and lifestyle board (Wikberg-Nilsson et al., 2015).

Moodboard

When creating a moodboard, images of a user group, context, styles, brands, environments or aesthetics defined by the designer are typically gathered, edited and collaged. Moodboards can be helpful both

when communicating a design to a client, or when there is a need to clarify the design visually, or visualise the intended target group (Martin & Hanington, 2012).

Questionnaire

Questionnaires is a very common and simple tool used when collecting survey information. When formulating a questionnaire, it is important to consider the instructions, length, appearance, clarity, response options, design, layout and arrangement, in order to achieve a good response rate. The responses and analysis will be affected by how the questions are posed. Closed-ended questions tend to be easier to both communicate and analyse, while open-ended allow for more in-depth responses (Martin & Hanington, 2012).

KJ analysis

Information and ideas can be organized by teams using the KJ technique. Although the results are qualitative and subjective, data can, in an effective way, be prioritised and organised. In the KJ technique, similar concerns and requirements are clustered and issues can thus be solved (Martin & Hanington, 2012).

Customer Journey Map

A customer journey map is a tool that can be used by either customer themselves or by the researchers in a project. In order to understand the different steps that users encounter during their experiences with a service or product, a customer journey map can be used. Interactions, emotions, barriers and goals that occur during the different parts of the users' experiences can be covered in the customer journey map. A common way to present a customer journey map is to graphically display the different phases of the journey on a timeline. By using the customer journey map technique, a greater understanding of the entire experience and process can be achieved (Boeijen et al., 2013).

UX curve

A UX curve is a simple method to use when categorising user experiences in a chronological order. The method can be used to identify user experiences all the way from first impression until the product is part of daily life (Kujala et al., 2011). According to Forlizzi (2008), it is important for designers to know that users' need in different situations are always changing and it is thus important to reflect on how the user-product relationship changes over time.

Function analysis

To illustrated the main purpose of a product and how it can be fulfilled, a function analysis can be used. The main task of the product is initially defined, as well as the functions necessary to fulfil it. The functions are further divided into sub-functions and support functions. A hierarchy illustrated as a tree structure will appear as a result of the function analysis. A downward movement towards the sub-functions will describe *how* the function can be fulfilled, while an upward movement towards the main function will describe *why* the functions exist (Österlin, 2010).

List of requirements

In order to be successful, a design has to meet important factors. These factors are stated in a list of requirements and are mainly based on the results from a project's research study. The list of

requirements is an iterative process and additional requirements are continuously added throughout the project. The concept evaluation phase during the design process can also benefit from the list of requirements (Boeijen et al., 2013).

Brand experience / Uniformity

Brands have the power to make customers understand a product or service, which is often exactly what a successful business wants to achieve. The brand experience is constituted by various impressions that a customer encounters from a company. Such impressions are gathered in the brand experience and concerns both verbal and visual encounters with a product or service. When customers interpret all the various impressions and experiences, they are left with a holistic brand image and brand loyalty can be achieved (Karjalainen et al., 2013).

Brainwriting / 635

Brainwriting can be used by teams to generate ideas together and, thus, avoid that all ideas become similar. Quantity is more important than quality and critique is not allowed. Everyone in the team writes down his/her ideas on a paper each and pass the ideas on to the next person to elaborate on. The ideas are further categorised and discussed within the team (Wikberg-Nilsson et al., 2015).

Weighted matrix (Elimination matrix)

When multiple potential design concepts have been generated by a team, a weighted matrix is good to use to reduce the number of ideas to a more manageable number and prioritize the most promising ones.. Key success criteria are ranked against potential design solutions, which makes the method structured but also subjective and qualitative. Since the process is very structured, personal opinions are often reduced while team conversations are improved (Martin & Hanington, 2012).

Concept screening (Pugh matrix)

According to Ulrich & Eppinger (2012), a structured concept selection procedure facilitates successful design. When evaluating concepts with concern to user needs, concept screening can be conducted. The weaknesses and strengths of different concepts are compared in a matrix and one or several concepts are selected for further development. The process involves six steps and the first is to prepare the matrix. The concepts are further rated, ranked, and improved before one or several concepts finally are selected. Concept screening can be conducted throughout the entire development process and not only during the concept development (Ulrich & Eppinger, 2012).

Morphological matrix

A morphological matrix is an effective generation tool often used in conceptual design. The tool is important during product development, both when redesigning existing products and when developing new ones (Ma et al. 2017). The morphological matrix is completed by adding part-functions and part-solutions, which are further combined into concepts.


3

3. Exploration

3.1 Aim exploration

The aim of the exploration phase is to find the user needs, requirements and market opportunities for a product that measures and communicates the force in the reins.

Deliverables

- Competitor analysis
- Mapping of competitor customer journey and UX curve
- Function analysis
- List of requirements

3.2 Process exploration

The exploration phase is divided into three parts, the first which will consist of user studies to map the user need for a product.

The second part consists of a competitor analysis to learn about similar products and their pros and cons, which can serve as inspiration for developing a new product. The competitor analysis also contributes with an understanding for the existing market and shows potential gaps which are not yet occupied.

The third part of the phase consists of customer mapping where user interaction with a generic competitor product will be explored, as well as the experience during this interaction.

The three parts will present a base for a list of requirements regarding the product. To give the requirements structure a function analysis will be performed.

3.3 User studies

The aim of the user studies is to explore whether there is a need for a product that measures and communicates the force in the reins and what that need looks like.

3.3.1 Method user studies

The user studies are performed by collecting data through a web-based questionnaire (Martin & Hanington, 2012). The motivation for using a questionnaire is primarily because there is no actual product to explore. As the competitor analysis showed, there are a few products that measure the force of the reins, but these are not perceived as widely used, as the result would confirm later. Thus, there are no products to focus an interview or observation around and personal interaction with respondents is therefore considered inefficient. A wider range of respondents can be reached and a greater amount of answers received by using a web-based questionnaire. The aimed users are riders and/or equestrian trainers of all ages, from various countries.

The questionnaires are sent out electronically in different Swedish web forums and by email, therefore most respondents are expected to be Swedish. In common for the target group is horse riding and/or training experience, internet access and reading skills. The two last mentioned factors are not expected to affect the result of the user studies and the first factor is a prerequisite.

The questionnaire consists of 18 short questions, a mix between multiple choice questions and questions that require a short-written answer. The questions cover personal information, including riding experience, the potential need for the product described in "Aim" and important aspects regarding the use of such a product (see Appendix A and B for questionnaire templates).

The multiple-choice questions are summarised in percentages and diagrams. The written answer questions are analysed using KJ-analysis (Martin & Hanington, 2012), where the collected opinions are organised into groups with a common theme. Both types of answers are presented below under "Result".

3.3.2 Result user studies

The result of the user studies is divided into "rider" and "trainer" because of separate questionnaires for each group of users. Each part is sorted after the questions in the questionnaires and the full result can be found in Appendix C and Appendix D. The questionnaire contains questions about a potential app since this is a method of communication commonly used by most competitors (see section 3.4 Competitor analysis).

Rider background

There are 392 respondents to the questionnaire. The respondents are in the ages 10-60+ years old, about 97% living in Sweden and the rest in a variety of European countries (see full results for specific countries). A majority of the respondents assess themselves as being higher intermediate riders, around 69%. Around 17% assess themselves as advanced riders, about 13% as lower intermediate, 2% as professional and one person (0,3%) as beginner. About 97% ride the same horse regularly. A majority (about 53%) rides the same horse more than five times a week, 43% 2-4 times a week, 12% only once a week and 4% less than once a week (the total of percentage adding up to more than 100% is probably due to respondents riding more than one horse regularly and choosing multiple answers). About 84% of the respondents ride dressage, about 40% practice jumping, and other disciplines are spread around a few percent each.

About 89% of all the respondents state that they have experienced an uneven feeling between the two reins when riding (see figure 3). Of 363 responses (of 392 total), 97% state that they have tried working towards a more even feeling between the two reins. Of 353 answers, 57% state that it works sometimes, 41% that it works and 2% that it does not work.

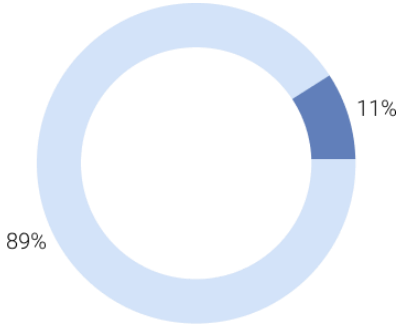


Figure 3. Diagram showing the number of riders experiencing unevenness in the reins during ride. 89% answered yes and 11% answered no.

Rider's need for product

When asked if they would use a product that could show the force in each rein, 36% say yes, 51% maybe and 13% no (see figure 4). When asked to motivate their answers, several common themes are identified among the 208 answers. One is the economic aspect, the use of the product depending on how much it would cost and that it would not be too expensive. Another theme is that of the rider considering their ability to know themselves whether the force is evenly distributed in the reins or not, referring to a good "know how" and feeling in their hands. Many of these responses also indicate that it is part of true riding to be able to feel a difference. They also express that such a product could risk the rider focusing less on feeling, impairing the development of the rider's feeling. A third theme is that of the product being unnecessary, where the respondent(s) does not feel the need of such a product. Some would rather use the money on a trainer, others point out that similar products already exist.

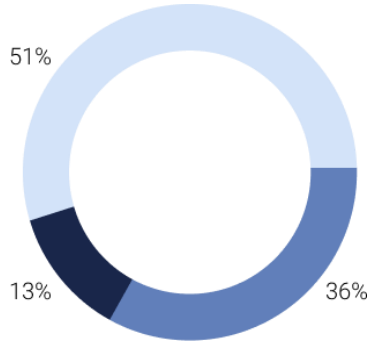


Figure 4. Diagram showing the number of riders wanting a product that shows the force in each rein. 51% maybe, 36% yes and 13% no.

Another group of users see potential in the product validating the experienced feeling when riding. To compare a feeling to "reality", in terms of data, to know whether an experienced (un)evenness is or is not true. Many of these respondents express that a feeling is subjective and not always reflects reality. Another theme regarded the functionality of the product. Using the product depend on how easy it would be to handle, to understand and how it would be shaped. Many are concerned that the product would distract them from riding, interfere physically or impact the feeling. Another theme is identified as using the product only occasionally. A wish to "check in" on the status of both rider and horse, to make sure everything is okay and that development goes the right way. A last and big theme identified is a potential to use the product as a tool for development and performance, appreciating the possibility to feel in control. Many would use it if their horse would benefit from it, mentioning an increased physical evenness for both rider and horse as desirable. They see potential for becoming better riders, the product giving them input to train more efficiently and develop the right way. One respondent mean that it is the small details that matters at an advanced level.

Of 320 respondents, 61% say they would use the product for both evaluation over time and immediate feedback, 24% favour direct feedback and 15% evaluation over time.

Rider's desired features for app

When asked about potential features for an app storing the measured rein forces, four suggested answers are given and the respondents are also encouraged to add their own ideas. Because the suggested answers are naturally favoured since already formulated and presented, these are analysed separately. Multiple answers are possible and from 351 respondents 71% would like statistics, 69% profiles for different horses, 56% rein forces connected to riding paths and 50% diagrams. Some main themes are recognised in the added ideas. The first and largest one is the desire to in any (not specified) way display how the rein forces correlate with different types of movements, riding paths or exercises. Suggestions include gaits, which is easily the most common, left or right track, speed, lateral movements, degree of collection and before, over and after a jump. Another theme is a wish for a warning at some point, when the difference between the two reins has been present for a certain time or when a force becomes "too big". A third theme regards tips and exercises to improve potential laterality. The next theme refers to the possibility to add external information, like different treatments for the horse, if the rider feels stiff on a particular day, what exercises are performed over time and so on. A few extra comments are made about having profiles for different riders and the possibility to export data to another program.

Potential benefits

When asking the respondents about what potential benefits they see in the product, including an app, the 194 answers can be sorted into five themes of which two stand out. For one of them the respondents express that the product could help improve riding performance and development in general, physically for both horse and rider, and that this improvement could be monitored over time. Riders see a possibility to improve balance, evenness, even strength, similar riding in both tracks and an increased body awareness. They also expect an increased rider's feeling, finer aids and better technique. A second theme regards the benefit of increased understanding and knowledge about riding with help from the product. A general awareness of horse and rider interaction, for example how the rider's laterality and the reins affect the horse. A possibility to pinpoint a specific problem and understand in what situations it occurs, if there are correlations with riding paths or exercises. One benefit is seen as that of the rider becoming aware of laterality they are not aware of, or to be able to compare an even feeling to measured data in order to understand if perception matches reality. Another benefit is comparison between riders and horses to understand if the problem lies with the horse or the rider. A third group of respondents see the product as a tool in training, providing data and numbers to objectively concretise "feeling". To get continuous response and be able to act immediately upon that feedback. To track development and laterality for both horse and rider. The product is expressed as a compliment to basic and wide knowledge about horses and riding, which is stressed as important. It could work as a reminder and an immediate proof of a present situation and be a support when a trainer is not present. Many opinions regard horse welfare, which forms another theme. Many see a potential for kinder riding, less discomfort for the horse and horses that last longer without injuries. A last theme regards the use of the product and specifically app, pointing out that it would be useful since the phone is "always" with them.

Potential problems

When asking the respondents about what potential problems they see in the product, including an app, the 174 answers can be categorised into the following eight themes; price, difficulties during use, technology, feeling, shape, the horse's well-being, development, understanding/information and other impact. When it comes to price, some respondents see a risk of a new product becoming too expensive. Regarding difficulties to use, some responses refer to complicated systems, risk of the rider being negatively affected when knowing that the riding is being monitored, shattered focus due to analysis during ride, difficulties to use the analysis effectively, more equipment to keep track of, more focus on technology than riding. Other responses are about the risk of focusing too much on the hands and forget

about the entirety, and that the possibility of riding "as usual" should not be affected when using the product.

The next theme, technology, involves responses about potential technical problems such as incorrect measurements, technologically complicated product, phone discharge during cold weather, waterproofness, internet access and battery consumption. Other responses refer to the weight of the equipment possibly affecting the results, which can lead to unevenness for both rider and horse. Another respondent sees a problem in that it could be easy to manipulate the results by mistake and thus not get the correct representation of reality. The third theme is about feeling and includes several responses about the potential risk of only focusing on the feedback from the product and thereby "lose the feeling". Other respondents believe that a problem might be to connect the feeling during ride to the analysis afterwards, due to the time gap in between. Many responses are about the risk of trusting the technology more than oneself. Another input is that the rein forces are not always supposed to be equal in both reins, depending on the situation.

The fourth theme is shape, where many respondents mention that a big and clumsy product is not of interest and that it needs to be easy to attach to different equipment and horses. One respondent believes it is a problem if the product has a "crazy" design and interface. The fifth theme, about the horse's well-being, includes responses regarding the product interfering with the horse and that it would be unsafe to interact with a product while riding. One respondent expresses a request of having as little equipment as possible on the horse and that a product feels unnecessary. The next theme, development, involves concerns about the feedback being analysed after riding, which potentially could obstruct the rider's development.

A majority of the responses in theme number seven, referring to understanding/information, is about the functions in the product being easy to interpret. A few respondents would see a benefit in the app recognising different riding paths, eg. a volte, in order to get valuable data. Others see a possible problem in that the results might be unnecessary since there are many factors that come into play during riding, such as type of bit or the age of the horse. Last, a few respondents mention that they forget to use apps and end up deleting them.

Rider's most important aspects

When asked to list the three most important aspects for the riders wanting to use such a product, 173 responses are received. One important aspect mentioned is the price of the product, saying either it could not be too expensive or that it must be worth its price. Another theme mentioned by several respondents is reliability, that the product must be trustworthy and also be experienced as such. The data must be valid and there should be no errors or bugs. Regarding a third theme, use is an important aspect. Respondents state that it needs to be easy to use and easy to read, for example with riding gloves and/or from the back of the horse. It should be efficient, safe, present data in an easy way, not disturb riding, feeling or be in the way, not use too much battery, be easy to access, attach and start using. A closely related theme is that of shape. Respondents mean it must not be too big, that it should be small, light and discrete. Also, durable and possible to attach to existing reins/bit. Some want it to look nice, maybe come in several colours and have a name that is easy to remember. Another theme that occurs is how the respondents see the product as a tool to get more information when riding, that it could contribute with information they cannot retrieve themselves. Exact and quick feedback on how much impact there are from the reins that is easy to understand. Such direct information is seen as contributing to knowledge, plus being pedagogic. Close to this theme, another regards development. The possibility

to track development over time, use the product as an aid to improve riding, rider and horse both physically and understanding wise. To be in control of changes over time. Lastly, some see benefits in the possibility to share data and statistics with other people, such as helping riders.

Rider's awareness of competitor products

74% of the respondents have not heard about a similar product to that described under "Aim", while 26% have. Of all, 96% have not used such a product, while 4% have.

Trainer's background

35 trainers in the ages 10-60+ years answer the questionnaire and of all the respondents, 100% live in Sweden. About 49 % of the respondents assess their students as being beginners, 86% lower intermediate riders, around 71% higher intermediate riders, approximately 23 % advanced riders and one person (3%) professional rider. About 97% train the same rider(s) and horse(s) regularly. A majority of almost 65% of the respondents train the same rider(s) and horse(s) once a week, 38% 2-4 times per week, 35% less than 1 time per week and only one trainer (3%) more than 5 times per week (the total of percentage adding up to more than 100 is probably due to respondents training more than one horse and rider regularly and thereby choosing multiple answers). About 88% of the respondents are trainers in dressage, about 44% in jumping, and other disciplines are spread around a few percent each.

All respondents state that they have experienced that the horse(s) and rider(s) are struggling with keeping the same force in both reins when riding. 100% of the trainers state that they have tried helping their students towards a more even feeling between the two reins, where 37% of the respondents state that it have worked and 63% state that it have worked sometimes. When asked if they would use a product that could show the force in each rein, 57% say yes, 37% say maybe and 6% say no (see figure 5).

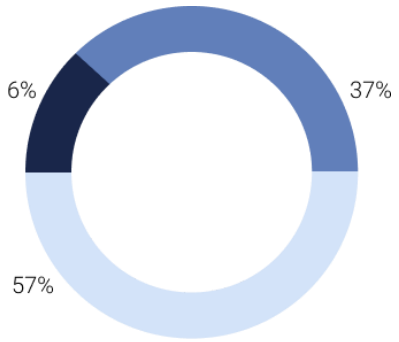


Figure 5. Diagram showing the number of trainers wanting a product that could show the force in each rein. 37% maybe, 57% yes, 6% no.

Trainer's need for product

When the trainers are asked to motivate their answers, several themes are distinguished among the answers received from the 35 respondents. One is the aspect regarding awareness, where several trainers mention that riders are not always aware of what they do and that a product hence could be a good tool to help visualise, communicate and make the riders conscious of how they are riding. Another identified theme is functionality, which refers to whether the product would be easy to use and give comprehensible feedback to the user. Some trainers also comment on the price and say that the product

could not be too expensive in order for them to use it. A last theme that is distinguished is feeling, where some trainers are unsure of whether a product really would be good for long-term evaluation, and express that the most important thing for riders is to focus on their feeling.

Of all the respondents, about 77 % say they would use the product for both evaluation over time and immediate feedback, about 20% favour direct feedback and only one person (3%) evaluation over time.

Trainer's desired features for app

When asked about potential features of an app that can store the measured rein forces, four suggested answers are given and the respondents are encouraged to add their own ideas. Because the suggested answers are naturally favoured, since already formulated and presented, these are analysed separately. Of all the respondents, 78% would like statistics, 63% would like profiles for different horses, 56% diagrams and 46% would like the rein forces connected to riding paths.

32 respondents come with ideas about functions for an app and among the added ideas some trainers express a request for rein forces connected to gait, pace and riding paths. Others mention that it would be beneficial to see disciplines connected to various riding exercises. Last, one wish is to have separate profiles for different riders.

Trainer's potential benefits

Furthermore, the trainers are asked about potential benefits for a new product and, among the added ideas, a few themes are identified from the 18 responses received. The largest themes are quick feedback and awareness. A majority of the trainers mention that direct feedback and immediate confirmation would be appreciated in order to help their students recognise the "correct feeling" quicker. Regarding awareness, many trainers want the riders to be aware of their hands and their impact on the reins. Some also believe that a product may work well as an aid when the rider tends to lose contact with the horse's mouth or if they use too much force in one rein. Another identified theme is development over time and includes tracking the development in order to evaluate the work. The horse's well-being is also brought up among the respondents and some mention that the well-being of the horse would increase if the riders become more aware of their impact. Last, some request easy access and a comprehensible product.

Trainer's potential problems

Moreover, the trainers are asked about potential problems for a new product. The question receives 18 responses, where some answers refer to the usability as well as concerns about whether the product would be used, or if it would be time-consuming. Others respond that the assemblage needs to be simple and easy and that it cannot affect the reins' "normal" function. Some responses refer to technology and it is mentioned that a risk with implementing more technology and equipment into riding might make some riders less focused on feeling and dependent on technical aids. Additionally, it is mentioned that a potential risk could be imprecise answers and too much focus on statistics. A fairly large amount of the respondents does not see any potential problems with a new product. Last, a few mention the price, and others say more specifically that expensive equipment might be a problem.

Trainer's most important aspects

When asked about the three most important aspects when it comes to using such a product, four different themes are identified among the 17 responses. The themes concern usage, development, information and price. Regarding usage, a majority of the respondents want a product that is easy to use and understand. Many respondents also mention the words motivating, clear, user-friendly and adaptable. When it comes to development, the words evaluation, awareness, improved riding, less impairments, happier horses and riding aid are frequently used. The answers regarding information are more concerned with the possibility of getting precise and clear statistics in a pedagogical way, as well as the possibility of monitoring the information during riding. The last theme is price and many respondents mention that the price would need to be reasonable, not too expensive.

Trainer's competitor products

83% of the respondents have not heard about a similar product to the one described under "Aim", while 17% have. None of the respondents have used such a product before.

3.3.3 Conclusion user studies

As can be seen in "Result", the problem of uneven distribution of force between the two reins is widely spread, with 89% of the riders and 100% of the trainers testifying the problem. It appears both riders and trainers have worked to solve the problem, stating both that it works, that it doesn't work and that it works sometimes.

Most riders and trainers are either positive or maybe positive towards a potential product, with only a small part saying they would not use it. The product idea is most popular among the trainers, 57% saying they would use it and only 6% that they would not. Corresponding share for riders are 36% positive and 13% negative. That means the maybe share among riders are larger, which could possibly be explained through the motivations behind the answers.

For riders, the main reasons to use or not use the product are price, a valuing of the own feeling, fear of affecting rider's feeling negatively, the product being excessive, being able to compare the subjective feeling to "reality" through data, practical functionality and lastly a tool for control over long-term development. For trainers, the main reasons are creating awareness for the student, functionality, price, and a concern about students not developing their rider's feeling. There are many similarities, such as price, functionality and the possibility to create insight and awareness of feeling contra reality. A central ambiguity seems to be that between knowledge and the natural feeling, respondents seem concerned about the possibility to combine these. Fear is that technique and data might prevent the rider from developing the necessary feeling or interfere with it. However, the opportunity to create insight and understanding and thereby improve performance is seen as positive.

The two most popular benefits seen by the riders are improved development and performance with the possibility to monitor over time, as well as an increased understanding and knowledge about (their) riding, with the possibility to locate specific problem areas relating to uneven force distribution in the reins. Another potential benefit stressed by the riders is horse welfare and, a last one, good accessibility of the app. From the trainer's perspective, the main benefits are rider awareness, direct and quick feedback to teach the student the right feeling, horse welfare and the possibility to track development over time for the student to evaluate. Also, in the foreseen benefits there are similarities between riders and trainers, such as horse welfare, awareness and control of development.

Potential problems seen from the riders' perspective are price, difficulties during use, technological issues, interference with rider's feeling, horse welfare and security and, lastly, that there are many factors that affect riding except the reins. A fairly large amount of the respondents does not see any potential problems, but those mentioned are usability, practical use, technology interfering with feeling and requiring too much focus, and lastly price. Similarities between riders and trainers are interference with rider's feeling, usability and price.

Regarding competitor products, only 17% of the trainers have heard about a similar product and none have used one, while 26% of the riders have heard about it and 4% have used one.

The following main areas are identified in the KJ-analysis:

- Development over time
- Insight/knowledge
- Horse welfare
- Feeling VS insight
- Price
- Functionality/use

3.4 Competitor analysis

The aim of the competitor analysis is to explore what products exist on the market today, that in some way measure the force of the reins. Further, to understand the competitors, their strengths and weaknesses for inspiration and a possibility to locate a unique selling point for a new product in the same category.

3.4.1 Method competitor analysis

The analysed products are found through internet searches around rein force measuring products. The choice of search is chosen from a competitive perspective, so even though there are interesting techniques, materials and methods outside the sphere of reins, this remains the main focus.

For each competitor, an analysis is performed based on the Brand Platform formulated by Leidenkrantz (2017). The brand behind each product is analysed in terms of for example vision, customer relationship and differentiating factors. A collage (Wikberg-Nilsson et al., 2015) is created for each brand to understand the general visual communication through product and website.

3.4.2 Result competitor analysis

There are four brands analysed in this project, three rein force measuring products and one horse related app. Although it is stated in the aim that the competitor analysis should regard rein force measuring products, one app is included because of its interface being relevant for ideation around the interface of the project product. The products analysed are listed below with a short description. For full brand analysis, see appendix E.

FreeSense Solutions - Equine Rein Coach

The two companies EquinnoLab and FreeSense Solutions from The Netherlands will release a new rein pressure sensor in the first half of 2018 (see figure 6). The solution, called Equine Rein Coach, is currently being tested and improved. The solution is said to be used both by amateur riders and

professional riders and the aim is to provide both riders and trainers with insight regarding training and progress (Equinnolab, 2017). The product is said to combine water and dustproof, wire-free rein tension sensors with an app that presents useful direct feedback to the rider (FreeSense Solutions, 2016). Price is not yet known (May 2018).

Figure 6. Equine Rein Coach by EquinnoLab and FreeSense solutions (Equinnolab, 2017).

FreeSense Solutions appear as the expert and freedom archetype, targeting those who are interested in sports performance and new technology. Their pictures are themed dark with blue highlights, with visual cues bringing the mind to digitalisation. They aim for more sustainable performance in sports through providing wearable sensing technology, focusing on the connectivity trend and Internet of Things. Towards the user they appear as the helping hand that connects user and product to achieve specific goals.

IPOS - IPOS Rein Sensor

The IPOS rein sensor (see figure 7) was developed in Germany by IPOS Technology and aims to give the rider insight in the communication with the horse and help the rider to develop the right feeling to achieve optimal performance and communication. A software app for a smartphone or tablet and two rein sensors to place between the rein and the bit are all part of the system. The price for IPOS Rein Sensor is 595€ and the system can provide the user with information regarding; rhythm, soundness, straightness, training schedule, rhythm, contact and lightness (IPOS Technology 2017).

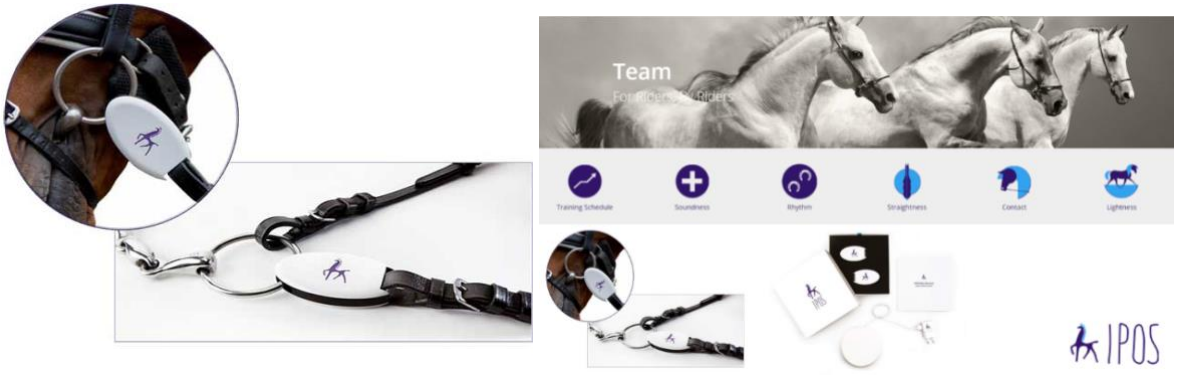


Figure 7. The IPOS Rein Sensor (IPOS Technology 2017).

IPOS mostly communicates expertise and seem to target more advanced or professional riders. Their visual theme is light, a white base with purple details and simple symbols. They aim to improve performance through creating insight into the rider-horse communication. They appear as a leader or guru that the customer is supposed to listen to, trust and follow. One factor that differentiates IPOS is the level of detail in the information provided by the product, information not accessible without the product. Worth to mention is also the conscious design of the physical product.

ProEC - EC Hand

The Swedish company ProEC launched the product EC hand, which is a training tool that the rider attaches to each rein (see figure 8). The rider will then get direct and constant feedback on keeping a soft contact and connection with the horse's mouth. The ideal is that the rider is able to stay within the green field, which implies that the correct release is given and the rider's support is correct. If within the red field, the release is too little. The price for an EC hand is around 50€, however, the brand does not seem to be active in the present moment (May 2018). (EC hand, 2018).

Figure 8. EC Hand product. (ProEC, 2018).

ProEC expresses dominance, mainly through black and red colours and a confident language on the webpage. They appear to target any rider, aiming to get the most out of every rider and horse through smart and functional solutions for daily life. Their differentiating factor is simplicity, the product being mechanic and therefore simple both to understand and to use. The relationship with the customer seem to be more of a teacher role, telling what is right and wrong and how to act.

EquiSense - EquiSense Motion

EquiSense is a device that includes a sensor to place on the horse's girth, a sensor attachment and a charger. The device will send data for the rider to obtain in a smartphone app (see figure 9). The rider will get real-time feedback during training and be alerted to asymmetry in the horse's gaits, as well as long term feedback. The device allows the rider to monitor the horse's jump trajectory, cadence, speed and stride length, and share the data with other people (FEI, 2016).

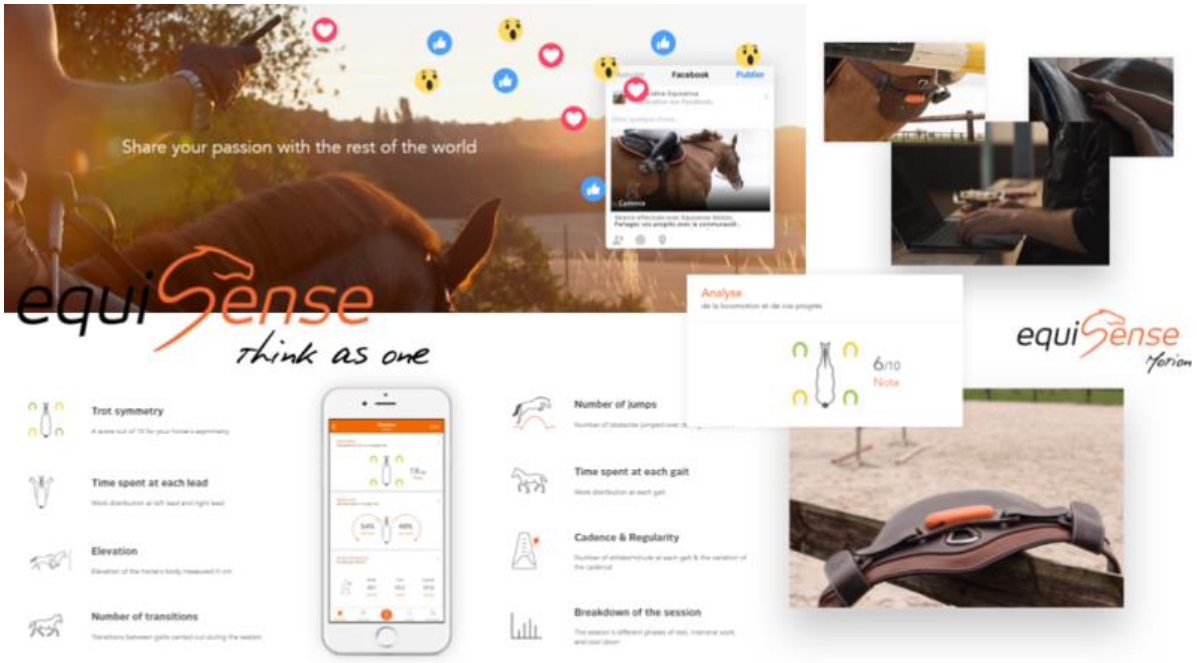


Figure 9. EquiSense product (ProEC, 2018).

EquiSense appear as the expert archetype targeting any rider. The visual theme is light, a white base with orange details and simple symbols. The brand centres around the love of the horse, with a vision to better understand "our horses" to help riders progress through their technology. They focus on the communication with the customer on their webpage and appear to be on the same level, as a friend. The role of the friend, together with the expressed passion for horses creates a very down to earth appearance. EquiSense differentiates through the customer relationship, as well as more practically with riding exercise suggestions in both app and on YouTube.

3.4.3 Conclusion competitor analysis

As can be understood from the result of the competitor analysis, all of the analysed brands relate to the expertise archetype - some with a touch of freedom or dominance, but with an expertise base. Probably this relates to the type of product, because with sensors, measured data and apps it is easy to associate to the expertise field. That being said, it is a challenge to consider desired association when developing a new product. It might not be very unique to head for the expertise feeling, while on the other hand choosing another archetype might not be as trustworthy to the user due to the nature of the product. A considerate discussion about this challenge need to be held during the following creation phase.

Another theme that goes through most of the competitors are a focus on "increased understanding/ knowledge" and "improved performance", which is a natural consequence of the functionality of the offered product. Measuring the force of the reins makes the user understand the impact of the reins and since an even impact is important for performance, this understanding can lead to improvements. The brand that stands out is the one not measuring the force of the reins, but that provides a sensor and an app monitoring different factors during ride - Equisense. Even though they also mention these two factors, their main focus is love of the horse and also something that makes them stand out from the other brands. This should also be considered in the creation phase of a new product - is it possible to have a unique focus that attracts people and creates interest, while still keeping the main functionality

of such a product that is to deepen understanding and improve performance. Can both be communicated?

A common approach for the competitive brands is to use an app to communicate the measured data to the user. This follows the trend of connectivity and gives the user an overview and possibility to track riding details over time. Conclusion is that it is popular to combine a measuring product with a communicating app. However, only EC Hand provides the user with immediate feedback through a physical product, not through an app.

3.5 Customer mapping

The aim of the customer mapping is to describe the user group and explore its potential interaction with a competitor product, in order to understand the different steps that a customer experiences in this interaction and how each of these steps affect the customer. This serves to understand problems and positive parts of the experience which could be used when forming a new product experience. Especially interesting to find is major problem areas, as well as low hanging fruits in terms of easy increases of the user experience. Together, these findings can be formed into potential unique selling points.

3.5.1 Method customer mapping

The first part of the customer mapping consists of a customer journey map (Boeijen et al., 2013) which describes the interaction between user and product. The product mapped for is a generic competitor product based on the insights from the competitor analysis (see chapter 3.4). The interaction is divided into several steps, belonging to different phases of the journey.

The second part consists of a UX curve (Kujala et al., 2011), which relates positive and negative user experience to the different phases and steps located in the customer journey map.

3.5.2 Result customer mapping

Customer journey map

The customer journey map is divided into five main phases:

- Planning
- Purchase
- Unboxing
- Daily use
- End of use

These phases cover the interaction between user and product, from initial awareness to disposal. While daily use might be most time comprising, spanning over a longer period of time than the other phases combined, planning, purchase and unboxing stands for the initial perception and impression and the experience of end of use is close to a potential new purchase, potentially affecting any decisions. That is, time and impact most certainly vary between the different phases. All phases with respective steps can be seen in figure 10, where parallel lines stand for alternative and/or potential uses.

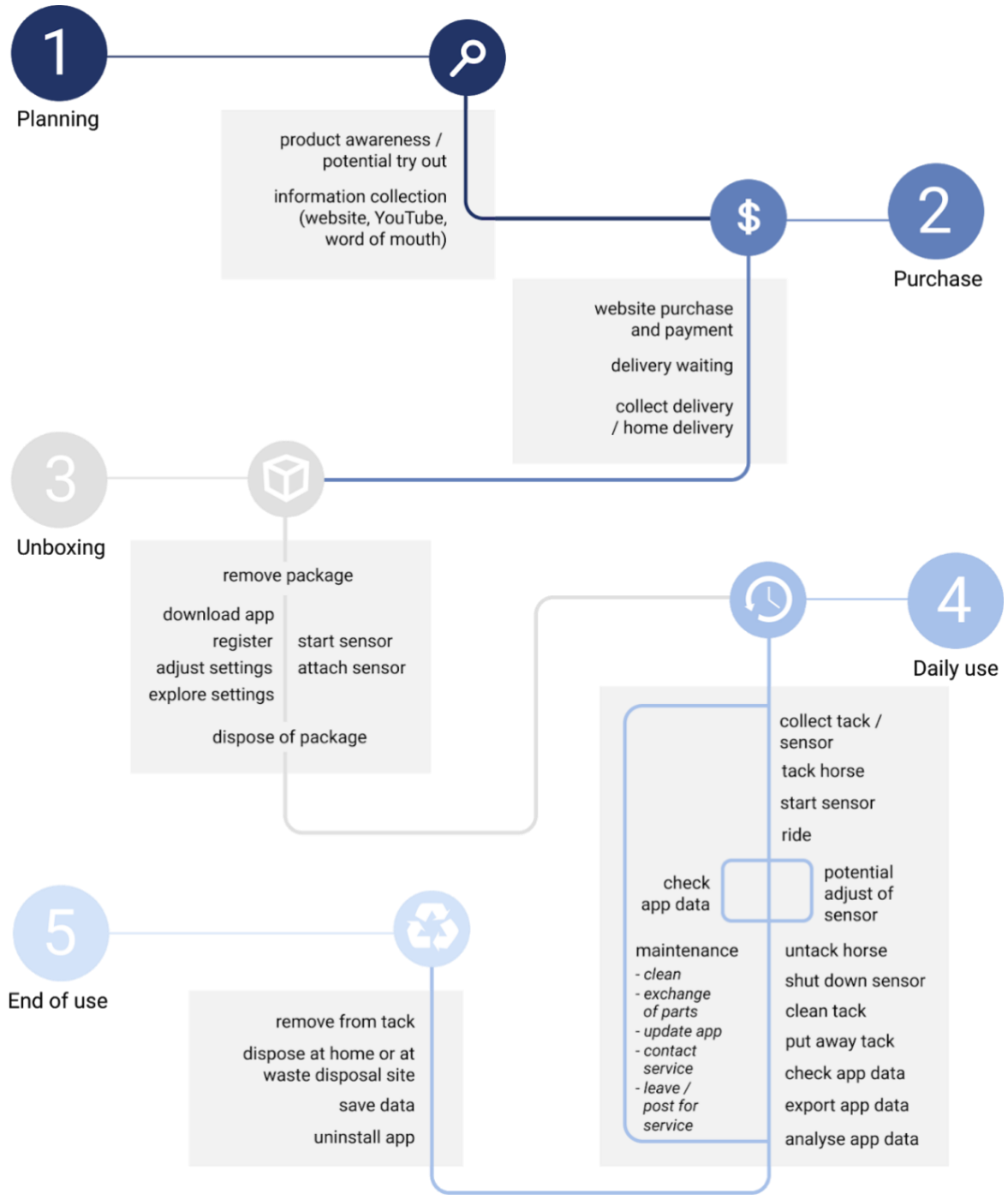


Figure 10. Customer journey map with the five phases; planning, purchase, unboxing, daily use and end of use.

User experience curve

The user experience curve is based on the customer journey map and its different phases and steps. It is therefore, just as the customer journey map, representative of a generic competitor product. The UX curve is described below and shown in figure 11.

The planning phase is expected to be slightly positive, due to the strain of finding and understanding information about the product(s) lifted by a certain amount of anticipation of obtaining a new product. The actual purchase is expected to be experienced as negative due to cost and potential wait for delivery, but compromised shortly afterwards with a high peak of positive experience following the excitement of receiving the product - the unboxing phase. Unboxing also means a first encounter with the product and exploring its functionality which in a successful case would mean more excitement, contributing to the peak. After a while, the features of the product become familiar to the customer and the initial excitement decreases, making the experience level out to a constant positive. If the product works as expected, the experience should stay on the positive side. There are no surprises, either good or bad, explaining the constant level of experience over a long period of time (almost as long as the product lives). After this major time comprising phase, the product is expected to start to show symptoms of wear and/or problems with functionality, resulting in a slight decrease of the positive experience. Once the product breaks down, the end of use phase is reached and the experience becomes significantly negative, not only because of the product ceasing to fulfil its purpose but also because of the struggle of disposing a technical product.

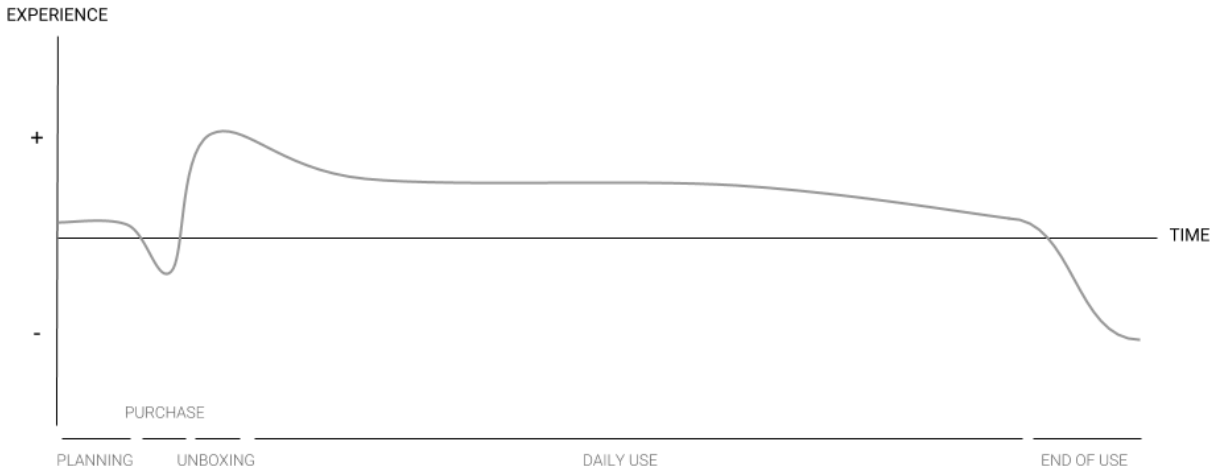


Figure 11. User experience curve of a generic competitor product.

3.5.3 Conclusion customer mapping

A main insight is that most of the customer experience of a generic competitor product consists of daily use. That phase contains tacking the horse, riding with the product, untacking the horse and evaluate presented information, as well as performing everyday maintenance of the product such as cleaning it. This is a phase that often looks the same for many products, since once the customer has become used to a product there are no real surprises, so the customer might not notice it at all - it just works. This is a phase with potential to greatly improve the experience when developing a new product. A long and monotone phase looking the same for most products can, if affected successfully, mean a unique chance to attract and keep customers. Key is to not only increase the overall experience but to consciously create *variations* in the curve. Simply an increase might not be noticeable if the experience is still monotone, but variations will surprise the user and reawaken awareness of the product.

One major negative part of the curve is the end of use, where the user struggles with a broken product and the issue of getting rid of it. These sorts of products often seem to consist of several materials and including electronics, which requires more effort and consideration for disposal. Also, here is a chance for the new product to stand out, if the end of use can be handled smoothly and mean less inconvenience for the customer. One might argue that this phase is short and also at the end of the products life and therefore does not matter to the brand image. However, remember that this phase is preceded by the daily life phase which is noted to be monotonous. That means that the attention drawn to a broken product is the first in a long time, and that attention is most certainly connected to a negative experience. Even if the monotone phase would have more variations and this wouldn't be the case, this phase is close to a potential new purchase and therefore it is of great interest for the brand to appear attractive to the customer. This is an example of a phase with low time comprehension but with potentially great impact.

As for the other parts of the UX curve, there are always possibilities to increase the experience by different means. An overall increase of the experience is of course appreciated, but as mentioned earlier there is a risk that a small margin will not be noticed when compared with the competitors. The key is to break the pattern, which the discussion above exemplifies. Those two examples are at this stage identified the major potentials to stand out.

3.6 Function analysis

The aim of the project states that the solution should be able to 1) measure the force in the reins, and 2) communicate this force. This is considered the two main functionalities of the solution upon which the function analysis is based. The function analysis (Österlin, 2010) separates the different functionalities of a main function, which therefore is done separately for each of the two main functions.

3.6.1 Measure

One function analysis tree was created for the functionality of measuring the force in the reins. This can be seen in figure 12.

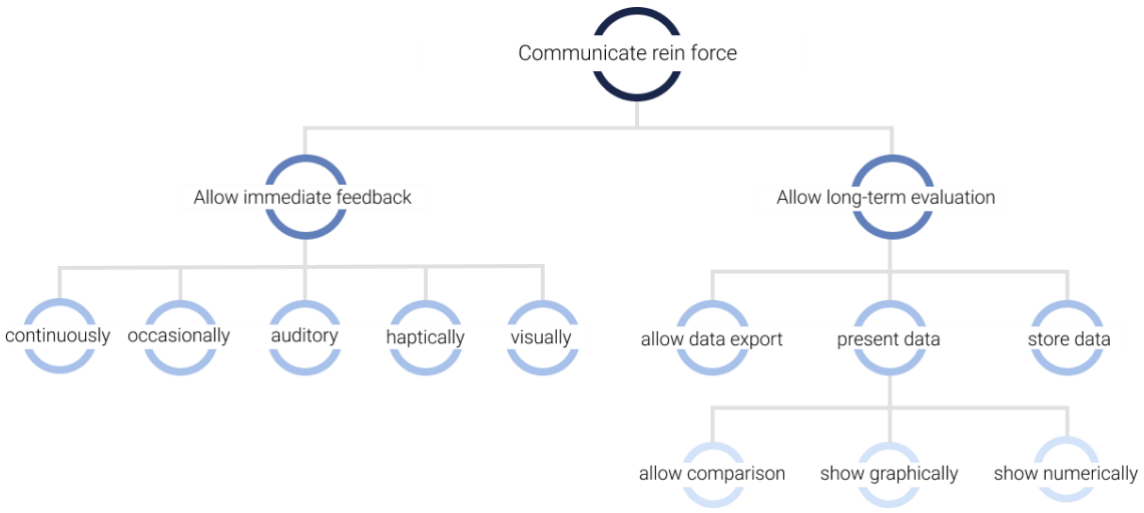


Figure 12. Function analysis of "communicate rein force".

3.6.2 Communicate

A second function analysis tree (see figure 13) shows the second main functionality, to communicate the force in the reins. The main function is divided into two sub-functions: to allow immediate feedback and long-term feedback. The division into these sub-functions is based on the result of the user study.

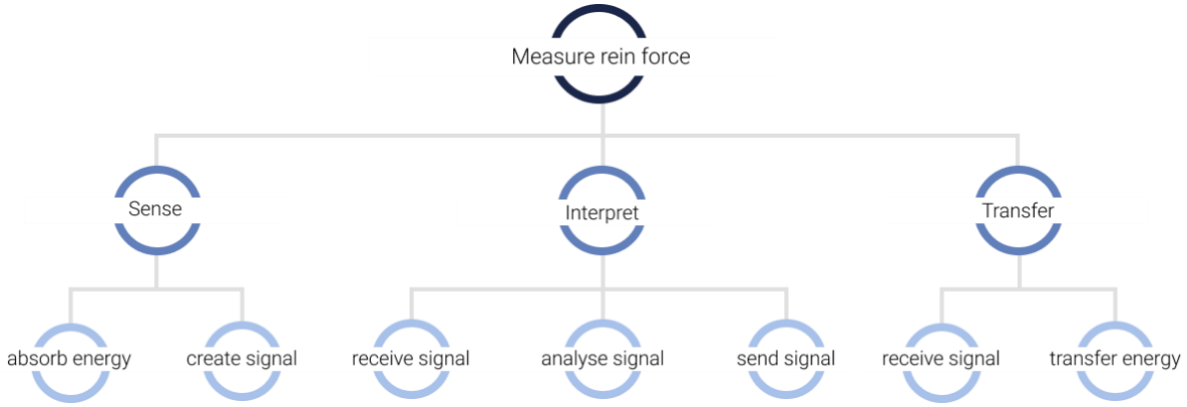


Figure 13. Function analysis of "measure rein force".

3.7 List of requirements

The requirements (see table 1) are based on the results from the user study, competitor analysis and customer mapping. Each requirement is graded as either a requirement, which has to be fulfilled, or a wish that is not compulsory but desirable. The list of requirements (Boeijen et al., 2013) begins with two main requirements upon which the project is based. The following requirements are separated into general requirements regarding physical product, app and brand strategy. Then there is a category of requirements specific for the app. The source of the requirements is noted with either "US", user studies or "CA", competitor analysis or "LS", literature study.

Table 1. List of requirements.

No	R/W	Requirement	Explanation	Source	Last edited
		Main requirements			
1	♕	Measure the force in each rein		Prerequisite	2018-02-02
2	♕	Communicate the measured force		Prerequisite	2018-02-02
		General			
3	R	Allow immediate feedback	Rider and/or trainer should be able to read information in real time during ride.	US	2018-02-13
4	R	Store information	Rider and/or trainer should be able to read information post ride.	US	2018-02-13
5	R	Be adaptable for different horses and/or riders	One rider might ride several horses, or one horse might be ridden by several riders.	US	2018-02-13
6	R	Not disturb horse and/or rider physically	Neither affect movements, distract or hurt.	US	2018-02-13
7	W	Encourage rider's feeling	Not constrain plus communicate that product is compliment to basic horse knowledge.	US	2018-04-09
8	R	Allow for reading real time information without app		US	2018-02-13
9	R	Be possible to read information from a riding position		US	2018-02-13
10	R	Be possible to read information from a distance of <20 m	For trainers.		2018-02-14
11	R	Be possible to adjust from a riding position	If adjustable.	US	2018-02-13
12	R	Be possible to adjust from the ground	When dismounted and/or for trainer.		
13	R	Be possible to handle with riding gloves		US	2018-02-02
14	R	Ensure safe product-user interaction	Handling of product should not impact the present safety level.	US	2018-02-13
15	R	Be possible to clean	Product should withstand leather soap, conditioner and disinfectant.	US	2018-02-13
16	R	Consist of durable materials	Product withstand for example rain, wind, humidity, dust, cold, heat, sunshine, mud and sweat.	US	2018-02-13
17	R	Withstand physical stress	Such as vibrations, bumps and direct forces.	US	2018-02-14
18	W	Withstand long-term wear		US	2018-03-08
19	R	Fit all English standard equipment		US	2018-02-13
20	R	Easy to attach	Regarding time, number of steps, technique and understanding.	US	2018-02-14
21	R	Allow use by ages 10+		US	2018-02-14
22	R	Provide Swedish and English language options	For international use.	US	2018-02-14

23	R	Allow storage		US	2018-02-14
24	R	Allow transportation	By foot, bike and in car.	US	2018-02-14
25	R	Belong to economy tier and price range	To be used by everyday riders, wide target group	US	2018-02-14
26	W	Have exchangeable parts	For longer lifetime, easy maintenance.	US	2018-02-13
27	W	Allow for separation of materials and/or electronics	For sustainable disposal.		2018-02-13
28	W	Be easy to setup	Regarding time, number of steps, technique and understanding.	US	2018-02-13
29	R	Follow graphical guidelines	See graphical guidelines in section 2.7	LS	2018-02-14
30	R	Be communicated uniformly	Graphically for app, brand strategy and physical product.	CA	2018-05-08
31	R	Have a differentiating factor	Concerning the competitors and the present market.	CA	2018-05-08
		App specifics			
32	R	Be compatible for Android and iOS		US	2018-02-14
33	R	Allow use for several horses		US	2018-02-14
34	R	Allow use for several riders		US	2018-02-14
35	R	Allow for evaluation of feeling		US	2018-02-14
36	R	Allow for tracking information over time		US	2018-02-02
37	R	Allow for adding information	Such as treatments, special occasions, weather factors etc.	US	2018-02-02
38	R	Allow for importing information later	After ride, after charge, when connection available etc. See "use product without phone".	US	2018-02-02
39	R	Allow for importing information immediately	Real time during ride.	US	2018-02-02
40	W	Allow for exporting information		US	2018-02-02

3.8 Conclusion exploration

From the user studies it is apparent that 90-100% of all riders and trainers have experienced the problem of uneven force distribution between the reins. A clear majority of the respondents, riders and trainers, are positive or maybe positive about a potential product and only a small part of these have heard of, and a very small part used, a similar product. The central ambiguity about using such a product is that between technique creating insight and understanding, versus the importance of rider's feeling. There is a fear that the use of technology will prevent or impact the development of feeling, which is highly valued among both riders and trainers. In addition to the two main themes, increased knowledge and improved development, horse welfare, feeling vs technique, price and functionality are themes identified.

The main conclusion from the competitor analysis is that all analysed competitors express a feeling of expertise, which probably follows naturally due to the technique used for sensors and apps. The two

main focus areas for the brands are increased understanding, as well as improved performance. The challenge for a new product is to deliver these values and appear trustworthy, but at the same time stand out. One brand that does so is EquiSense who brings forward the love of the horse as a central value, and who combines this value with expertise and the values mentioned above. Another insight is that most brands combine their measuring technique/sensor with an app which conveys data into information for the user.

From the customer mapping, the daily use phase of a generic competitor product stands out in terms of its monotonousness and time comprehension. Together with the major negative experience at the end of life phase of a product, these two phases are concluded to have the potential to create a unique advance for a new brand, if altered successfully.

Hence, the users appreciate the product terms of being able to increase their understanding when riding, and because it might be a tool to improve their performance. This is also noted to be what the competitor brands promote on their websites. There is a match that is probably not accidental but consciously cared for by the competitor brands. This is something to be aware of and consider when developing a new product in the same category.


4

4. Creation

4.1 Aim creation

The aim of the creation phase is to generate ideas and concepts for a physical product, brand strategy and app, based on the identified requirements and customer mapping from the exploration phase.

Deliverables

- A few physical product concepts
- A clickable app concept
- A brand strategy suggestion

4.2 Process creation

The creation phase consists of three main parts: creation of physical product, app and brand strategy. App and brand concepts will be limited to suggestions, based on the insights from exploration, and not evaluated thoroughly in the next phase. This is to allow more time for evaluation of the physical product concept, which with its direct feedback stands out from the competitors.

For the physical product, creation is divided into three iterations following a divergent and convergent design process, producing a number of ideas (divergent) and narrowing down by evaluation (convergent). These iterations consist of different focus areas. The first iteration will focus on quantitative idea generation and concept creation, the number of concepts being narrowed down by theoretical evaluation. The second iteration will focus on technical development of concepts with a practical evaluation. The third iteration is the last step before the next phase and where communication details are added and the number of concepts cut down to just a few.

Parallel to the physical product creation, an app concept will be developed. Initially, there will be an idea generation of main functionality and sub-functions for the app, followed by the creation of wireframes and a practical realisation of the concept with graphics and a clickable prototype.

The third part of the creation phase, running parallel with the ones described earlier, is the creation of a brand strategy that will enclose both physical product and app.

All the different parts created in this phase will furthermore be presented in chapter 6, final update, with modifications based on the evaluations made in chapter 5, evaluation.

4.3 Physical product

The aim of the creation of a physical product is to produce a concept with prototypes ready for the following evaluation phase, by generating ideas, concepts and quickly evaluate these concepts towards the requirements. The concepts should include potential technical solution as well as suggestions on how and when to communicate information to the user. The physical prototype should illustrate the functionality of the concept.

The first iteration of the physical product consists of idea generation (through the methods brainwriting and collage, see section 2.8), concept creation (involving the morphological matrix method, section 2.8) and theoretical evaluation of the concepts (through the methods concept screening, pro/con list and

weighted matrix, section 2.8). The purpose is to generate a large amount of ideas and withdraw the strongest ideas through evaluation and thereby decrease the quantity.

The resulting concepts of the first iteration are brought into iteration 2, where focus lies on technical development, potential realisation and practical evaluation. The technical development consists of two different meetings with people with knowledge about sensors, electronics and certain materials considered relevant for the project. The evaluation in this phase is a practical one where mock-ups of the concepts are tested in a riding situation to explore strengths and problems in a practical application. The evaluation also serves to narrow down the number of concepts brought into the third and last iteration.

The concepts brought into the third iteration are considered to be realisable and therefore an idea generation on communication details are applied, limited by the concepts respective technical solution. The ideas on communication strategies are ordered into several concepts, including variations, and ready for evaluation in user tests.

The resulting concept of the three iterations are brought into the next phase for more extensive evaluation; evaluation through user studies, theoretical evaluation considering the requirements and a practical evaluation in a riding situation.

4.3.2 Result

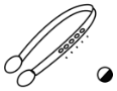
The results are presented for each iteration separately, the final concepts of each iteration being the base for development in the next iteration.

Iteration 1: Concept generation and theoretical evaluation

A morphological matrix (Ma et al., 2017) is used to create 14 concepts with the following sub-functions: continuous and occasional information, auditory, haptic and visual information and placement. The morphological matrix with sub-functions can be seen in appendix F.

The initial evaluation is made with a weighted matrix (Martin & Hanington, 2012) with the following criteria: main problem, environment, cognitive ergonomics, physical ergonomics/safety and attention/distraction. The criteria are general topics in the list of requirements and therefore the weighted matrix served as an initial guide to which concepts are closest to fulfilling the set requirements. The weighted matrix can be seen in appendix G. Seven of the 14 concepts receive high points and are transferred to the next part of the theoretical evaluation, the pro/con list. The pro/con list lists the general positive aspects with each concept, as well as the main negative ones. These can be seen, together with the respective concepts, in table 2. The concepts marked with "*" receives the highest points in the weighted matrix.

Table 2. Pro/con list for seven of the concepts.

Concept		Explanation	Pros	Cons
A		continuous steps	aesthetics easy to understand (+quick) integrated product	look down separate materials visibility specific reins
B		warning	small and lightweight adaptive aesthetics unspecific gear/tack	differentiate riders separate materials background noise
C		warning	easy to attach does not affect equipment potential icon	separate materials in the way disturb feeling
D		continuous steps	innovative and cool integrated product visibility (angle)	smart textiles expensive? complicated? unattractive colours visibility
E		warning	recognizable use/placement does not affect choice of gear	attach under clothes
F		continuous steps	recognizable design does not affect equipment small and lightweight	visibility x 2 look down competitor design
G		continuous stepless	innovative and cool easy to compare	no reference for max. force wear of materials understanding visibility smart textiles - complicated?

Based on the concept screening method, the seven concepts are given points depending on how well they fulfil 11 of the requirements that are considered most important. The concept screening matrix showing the requirements and points can be seen in appendix H. The four highest ranking concepts in this evaluation are chosen to be the resulting concepts of iteration 1 and brought into iteration 2. These four concepts are described below and shown in figures 14-17.

Concept A – Reins, consists of a pair of reins that communicates the measured data to the rider through led lights integrated into the reins (see figure 14). There will be continuous information conveyed to the rider in steps, with additional warnings. The main benefits are (potential) aesthetics, understandability and that the solution is integrated into a product already used, meaning no extra gear. The cons are the need to look down and thereby affect the stature, visibility, mixed materials from an environmental perspective and the need for specific reins.

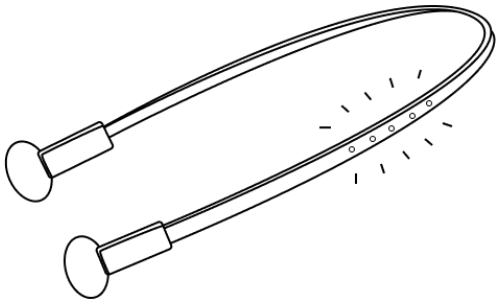


Figure 14. Concept A - Reins.

Concept C - Wristbands, consists of two wristbands that communicates to the rider through vibrations, with additional sensors for the reins (see figure 15). The information could be both in steps and stepless but will consist of warnings. The positive aspects are simplicity, ease of use and branding potential. Negative aspects are separation of materials, distraction through vibrations and potential interference with clothing and gear.

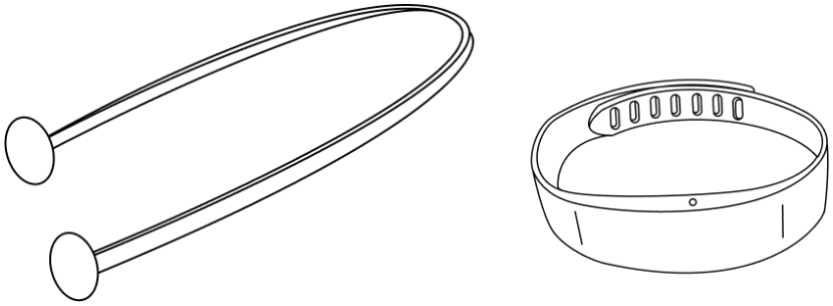


Figure 15. Concept C - Wristband.

Concept F – Units, consists of two units that are attached between the bit and rein on each side (see figure 16). The units contain both sensors and communication, the latter conveyed through led lights. The information could be continuous as well as warnings and be communicated both in steps or stepless. The main positive aspects are simplicity, size, recognition/branding potential and unlimited choice of gear. Negative aspects are visibility, the need to look down and thereby affecting posture, and competitor design being similar.

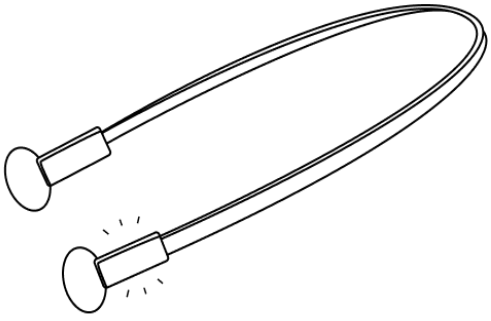


Figure 16. Concept F - Units.

Concept G – Gloves, consists of a pair of riding gloves where information is communicated continuously and through warnings to the rider, using light in either steps or stepless (see figure 17). Main pros are innovative design and ease of use. Cons are complication, wear of materials, the need to look down and thereby affect posture and a set choice of riding gloves.

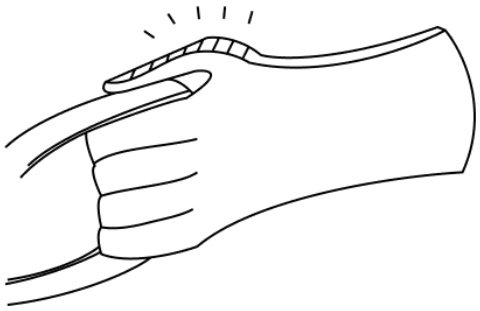


Figure 17. Concept G - Gloves.

Iteration 2: Technical development and practical evaluation

Technical development

A mapping of the technical components needed for measuring and communicating rein forces is formulated. The components that are needed for all concepts in general are, for each rein:

- A sensor with battery, microcontroller unit (MCU) and radio unit
- An actuator with battery and radio unit
- A smartphone

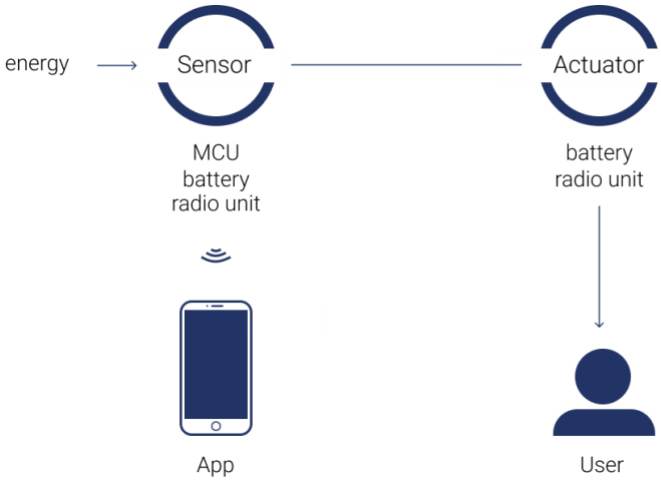


Figure 18. Mapping of technical components.

The sensors measure the force in each rein by transforming energy to a signal. The signal is transferred to the MCU which processes and logs the information and sends a new signal to the actuator. The actuator reacts to the signal and emits energy in a specific form, for example light or vibrations that can be read by the rider. The MCU also sends signals to a radio unit which can connect wirelessly with a smartphone, where the signal is received by the phone's radio unit. If the sensor and actuator are

connected wirelessly, the actuator need a separate battery and a radio unit to receive the signal sent by the MCU, while only one battery and radio unit is needed if the parts are connected with wire. Figure 18 shows the principal relation between the technical components and the information is retrieved from an interview with Peter Ljungstrand at RISE Research Institute of Sweden.

There are two different techniques considered for the sensor, either a piezoelectrical material or a strain gauge. The functionality of these two techniques can be found in section 2.5 (piezoelectric effect) and section 2.6 (strain gauge sensor). For the four concepts from iteration 1, technical implementations are shown in figures 19-22 and described below.

Regarding concept A - Reins, the sensors need to be placed between the grip and the bit, either integrated in the reins themselves or as an additional unit. The batteries, radio units and MCU:s are placed at the respective sensor, while the LED light actuators are placed at some distance from the other components, up along the reins. The actuators will be integrated in the reins and connected to the MCU:s with wire, therefore removing the need of an extra battery or radio unit.

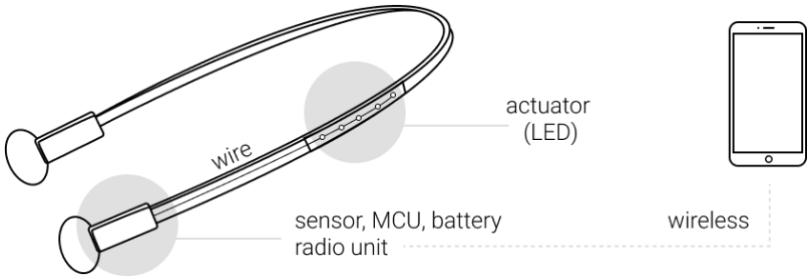


Figure 19. Technical implementation of concept A – Reins.

For concept C - Wristbands, the wristbands, the sensors, MCU:s, batteries and radio units are preferably placed together somewhere between the bit and grip as in the former case. Here the actuators are vibrating units in two wristbands, and because they are not connected to the reins there needs to be an extra battery and radio unit for each wristband.

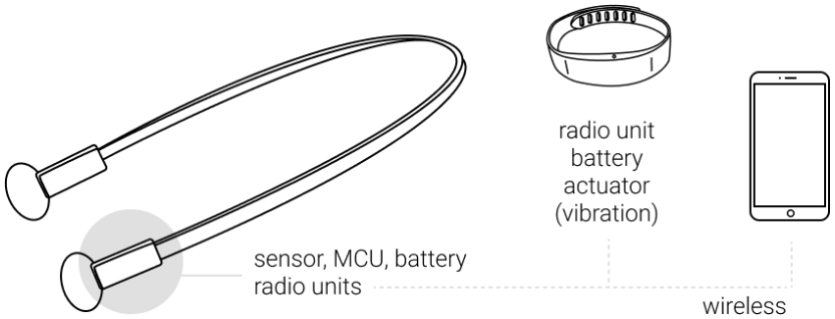


Figure 20. Technical implementation of concept C - Wristband.

In concept F - Units, all of the technical components are integrated into two units that are attached in between the reins and the bit. There need only be one battery and one radio unit per unit. The actuators are led lights on the units.

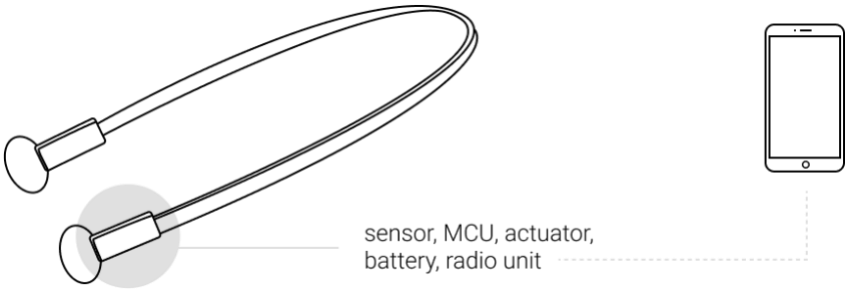


Figure 21. Technical implementation of concept F – Units.

Concept G – Gloves, differ from the other concepts in the way that the sensors are situated on the inside of the gloves and so can represent the force in a rein by measuring the force between the rein and the hand. The MCU:s, batteries, radio units and actuators are connected with wire. The actuator in this case are LED lights on top of the thumbs.

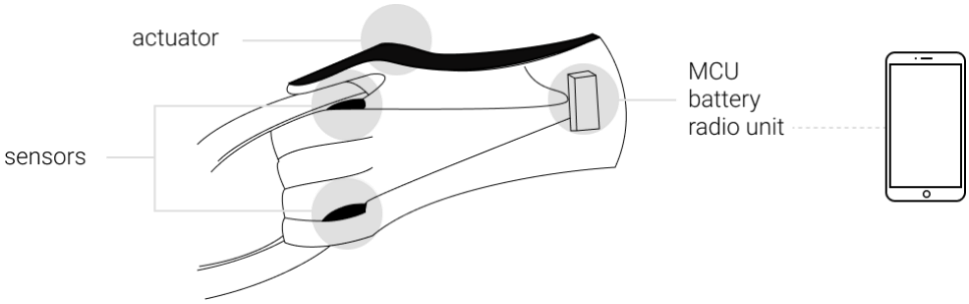


Figure 22. Technical implementation of concept G - Gloves.

Practical evaluation

The practical evaluation consists of riding tests with simple mock-ups, to test basic functionality and allow proceeding with the passing concepts. Initially, three general principles are tested: the use of led lights, optimal placement on the rein and potential impact from the sensor size and weight. Thereafter, each of the four concepts are tested.

The "LED light" concept is tested using bike LED lights attached to different places on the rein. The visibility of LED lights in daylight is good, both red and white, when placed according to the evaluation of rein placement (see below). There is a tendency to dazzle/distract the rider when reflected in mirrors, even from a long distance (<60m). The light is easily noticed with peripheral vision when looking straight ahead. Test setup can be seen in figure 23.

Figure 23. Practical evaluation of LED lights.

The "rein placement" concept is tested by placing rubber bands around the rein at different places and intervals. The optimal placement of visual communication on the reins naturally depends on the specific combination of horse, rider and reins. However, visibility seems to occur from about half of the horse's neck and towards the rider. The placement is limited from the other side by the grip of the rider, which leaves approximately about ten centimetres for placement (see figure 24).

Figure 24. Practical evaluation of rein placement concept.

The "rein placement" concept is tested by placing rubber bands around the rein at different places and intervals. The optimal placement of visual communication on the reins naturally depends on the specific combination of horse, rider and reins. However, visibility seems to occur from about half of the horse's

neck and towards the rider. The placement is limited from the other side by the grip of the rider, which leaves approximately about ten centimetres for placement (see figure 24).

Figure 25. Practical evaluation of sensor.

As in the case with optimal rein placement, the visibility of the concept A – Reins is tested with rubber bands around the reins (see figure 26), optimally placed according to the evaluation of rein placement above. Factors that appear to restrict visibility is long fur, mane and bend of the horse's neck, though they do not block it completely. A consequence of restricted visibility is a tendency for the rider to move the hand and rein outwards, away from the neck of the horse, a behaviour not desired. The number of communication spots (to be LED lights, in this case rubber bands) appears to affect how well the rider can read/understand when visibility is restricted. Five spots are hard to distinguish while three can be read and distinguished more easily.

Figure 26. Practical evaluation of concept A- Reins.

The mock-up of concept C – wristbands, consists of a normal wristwatch, occupying the space that a wristband would do, and a phone tied to the lower arm of the rider which vibrates in different rhythms when sent messages or being called (see figure 27). The physical wristband did not disturb the rider, who did not wear any other watches/wristbands at the time.

The vibrations are sometimes missed out, sometimes clearly noticed, which seems to depend on the type of vibration and is therefore considered possible to modify to a working concept. When noticed, the vibration is clearly distinguishable due to other vibration characteristics than the naturally occurring vibrations and motions when riding. This allows for a lower intensity of vibration, since it does not have to be strong to be noticed, it stands out anyways. The tested vibration does not disturb the rider negatively, neither mentally or physically.

Figure 27. Practical evaluation of concept C - wristbands.

Concept F – units, was tested with LED lights attached to the reins close to the bit (see figure 28). They are not visible due to placement (see evaluation of rein placement above) and the concept is therefore discarded.

Figure 28. Practical evaluation of concept F - units.

Concept G – gloves, is tested using tape on the thumbs of a pair of riding gloves, onto which different coloured dots are painted (see figure 29). The tape is clearly visible when looking down at the hands, even when hands are rotated inwards, and easy to read in all gaits. The top of the whip covers the top of the thumb. A consequence behaviour is that of tilting the head down to read the communication, which might affect riding position and is not desired, but is considered okay because of such short duration. Concept G gloves, is also tested attaching LED lights to the thumbs, which are clearly visible with peripheral vision when looking straight ahead. However, it is not possible to distinguish the two hands/LED lights from each other when looking straight ahead. Also, these LED lights are slightly disturbing when reflected in mirrors in the riding arena.

Figure 29. Gloves.

The concepts passing the practical evaluation are Concept A - Reins, Concept C - Wristband and Concept G - Gloves, while Concept F - Units is discarded due to no visibility.

As a late decision in the process, concept G - Gloves, is put aside due to technical complexity. The concept is still realisable but has a more complex way of measuring the rein force with several sensors in the palms of the gloves. It requires more time and effort to develop and create a prototype of when compared to the two other concepts with a single sensor in the rein. Therefore, the concept is left at this step of the development to give time and focus to the two other concepts.

Iteration 3: Communication details

One prerequisite requirement for the product is to communicate the measured rein force and, from the user studies, it is clear that there is a wish for the product to give both continuous information and warnings. Therefore, these two features work as a base for the third iteration and development of the concepts from iteration two. As the requirement list states, the product should not distract or disturb the rider, which applies to the continuous information. However, as distraction is the nature of a warning it needs to attract the rider's attention in particular situations.

As can be seen in the morphological matrix (see appendix F), continuous information is said to either be present all the time, at different time intervals, at different geographical places or at request. These factors have been considered during the concept development and concept A - Reins shows information at all times, the other occasions are therefore not considered.

According to the morphological matrix, warnings can be presented for either a total force in any rein, when the force is even in both reins or when the difference between the two reins is too big. The warnings considered in this iteration, following the earlier development, represent the total force and the difference between the reins.

Suggestions of various communication alternatives for reins and/or wristbands are created and evaluated through discussion. The communication concepts can be seen in figure 30.

Reins - continuous information
The first alternative, continuous 1a, is supposed to communicate increased rein force by adding lights to a scale. From no rein force symbolised with all lights turned off, to turning on lights up to a maximum number of lights when the rein force is increasing. The scale increases away from the rider to remind of a classic staple diagram with higher values above lower ones. In figure 30, the alternative is shown by a double scale, one for each rein, with communication illustrated on the left rein. Black dot indicates light off, white and red dot indicates light on.

The second alternative, continuous 1b works the same way as continuous 1a, but with the scale increasing towards the rider instead of away from the rider. The idea is that a bigger rein force could relate to the rider pulling more in one rein and that this type of scale would feel more natural. Alternative continuous 2a works similarly to continuous 1a, but with the difference of only lighting one light at a time (for each rein) instead of building up. The last alternative, continuous 2b, is an inverted version of continuous 2a, with the same motivation as for 1b being 1a inverted.

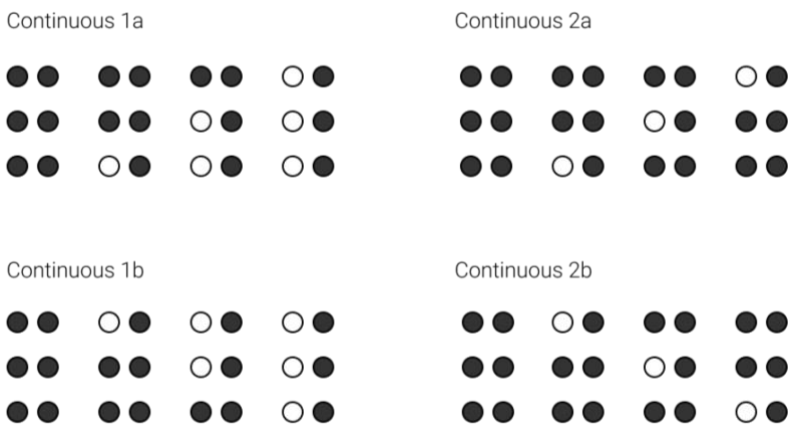


Figure 30. Communication alternatives for continuous feedback.

Reins – warning

Due to complexity, the LED light warning only appears when the force is too big in one of the reins, and not when the difference is too big. This is due to all communication being visual regarding these alternatives, both continuous and warnings, and therefore potentially confusing for the user. To lower the complexity in the single sense information, one type of warning is reduced. Around half of the concepts use red as a colour because it is an accepted colour to use when communicating a warning (see graphical guideline 7a, chapter 2.7). The other concepts use a neutral colour to not disturb the graphical uniformity of the product to more easily look good with other equipment used when riding. All warning concepts can be seen in figure 31.

The first alternative, warning 1a, aims to illustrate a warning by lighting the maximum number of lights. That is a possible scenario when using continuous 1a and therefore this warning does not break the pattern of continuous information. The second alternative, warning 1b, works as warning 1a but when a certain maximum rein force is reached the white light turns red and, thus, breaks the pattern of continuous information. In warning 2a, when maximum force is reached, an extra light of another shape and/or size enlightens. The warning 2b alternative works as warning 2a but with a red extra light. The warning 3a alternative works similar to warning 1a, but starts to flash when the maximum force is reached. Warning 3b works like warning 3a but flashes in red when the maximum force is reached.

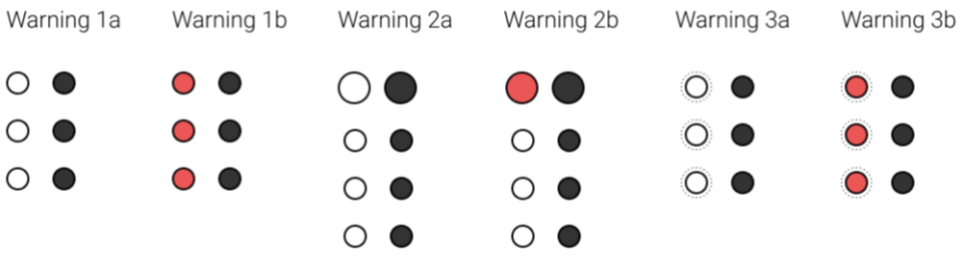


Figure 31. Warning alternatives.

Wristbands – warning

Since concept C, Wristband, does not communicate continuous information in a convenient way, this concept does not work on its own. However, it could be used as an additional feature to the Rein concept by replacing the visual warnings. This means that continuous information would be given through led lights on the reins and warnings through vibrating wristbands. This way, the warnings are perceived through another sense than the visual and therefore stands out more. It also means that the complexity of the warning could be higher, including warnings both for a total force too big in any of the reins and a difference between the reins being too big.

When the total force is too big in any of the reins, a distinct medium long vibration will occur in the corresponding wristband. An alternative to this idea is to let the total force be present for some time before the warning, to avoid nuisance warnings. The suspicion is however that the warning should be given in the exact moment that the force exceeds the limit and that accidental exceedance is uncommon and, when it is, the warning will not annoy or disturb the rider. The situations when a warning is needed in the exact moment is appreciated to outrun potential annoyance at a few situations.

When a certain difference has been present for some time, the suggestion is two short vibrations at the same time in both wristbands. The reason for communicating in both wristbands is that it might confuse the rider if vibrating in only one. Even if the cause of the warning is clear, a one-sided vibration might cause the rider to intuitively pull more or loosen the grip on the vibrating side. This effect is not desired since the cause of the uneven force distribution can be complex. By vibrating in both wristbands, the rider is pushed to analyse the situation and figure out a suitable action. An alternative to this concept is, as for the total force warning, wait until the difference has been present for some time. With the same motivation as above, the direct warning is favoured.

4.4 Brand strategy

The aim of this phase is to deliver a suggestion of a brand strategy based on the results from the competitor analysis in the exploration phase. The first step is to create moodboards with different themes of brand strategies and furthermore, brand platforms for each of the different moodboards are created. To create a suggestion of a brand strategy, the following steps will be performed:

4.4.2 Result

The result of the first step is eight different moodboards (see appendix I). One brand platform is created for each moodboard and the four most appropriate moodboards (see figure 32-35) are chosen after comparison and discussion around all the brand platforms. The four remaining moodboards and brand platforms are: elegance, sport, classic and Scandinavian since they all fit well into today's equestrian styles (see brand platforms in appendix J). Also, all four moodboards contain established equestrian fashion and trends, while being compatible with a new and innovative product.

Figure 32. Elegance theme.

Figure 33. Sports theme.

Figure 34. Classic theme.

Figure 35. Scandinavian theme.

Web-based poll

To decide on one branding strategy, a Facebook poll is constructed since it is a quick way of receiving a large amount of answers from the user group. The poll consists of the four moodboards seen in figure 32-35, presented with the respective names “sport”, “Scandinavian”, “classic” and “elegance”. The poll is presented in several Facebook groups and participants are able to vote on one alternative each, not voting in several groups. Most groups are representative of different parts of Sweden and one group is a large national buy and sell group for horse related products. In total, 950 people participated in the poll.

The result is 35% voting for “sport”, 30% voting for “elegance”, 25% voting for “Scandinavian” and 10% for classic (see figure 36). That means “sport” is the winning brand strategy and will lie as a base for the following customer journey and UX-curve to be found in the next phase, as well as the visual language for both physical product and app.

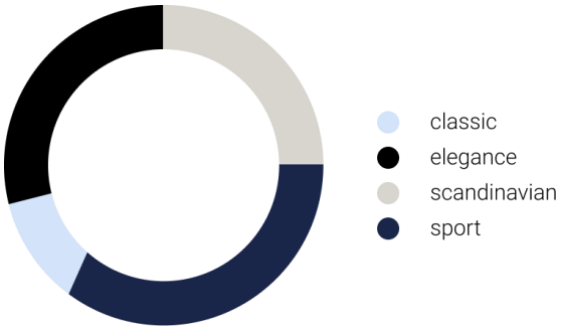


Figure 36. Distribution of votes in the web-based poll.

Sport

The sport brand strategy is refined and visuals such as logo, colour scheme and fonts are created. The archetype for the sport brand is expertise and belonging, where expertise means that the product is technical, innovative and can provide the user with detailed information. Belonging highlights, the close team, referring to both horse and rider, but also everyone in the rider´s surroundings sharing the love and passion for the sport. The target group of the brand is any rider, although main focus is on everyday users.

The six levels of the brand platform (see figure 37.) are updated by applying the insights from the competitor analysis and the web-based poll to fit the new sport brand. The *vision* of the sport brand is to improve knowledge and thereby increase performance and prevent injuries in both horse and rider. The *purpose* is to provide immediate feedback during ride as well as long-term feedback for evaluation. Moreover, the *role* is the dedicated user and the *relationship* is described as being part of the dedicated sport team around the horse and rider. The *differentiating competence* can be described by the words understandability and efficient communication, while the *differentiating personality* concerns competence, focus and pushing the edge. Furthermore, the d*ifferentiating rational/functional added value* of the brand is to involve immediate feedback during ride, while the *differentiating emotional added value* is to increase the customer's feeling of team spirit and determination. Last, the brand promise is "insight for performance".

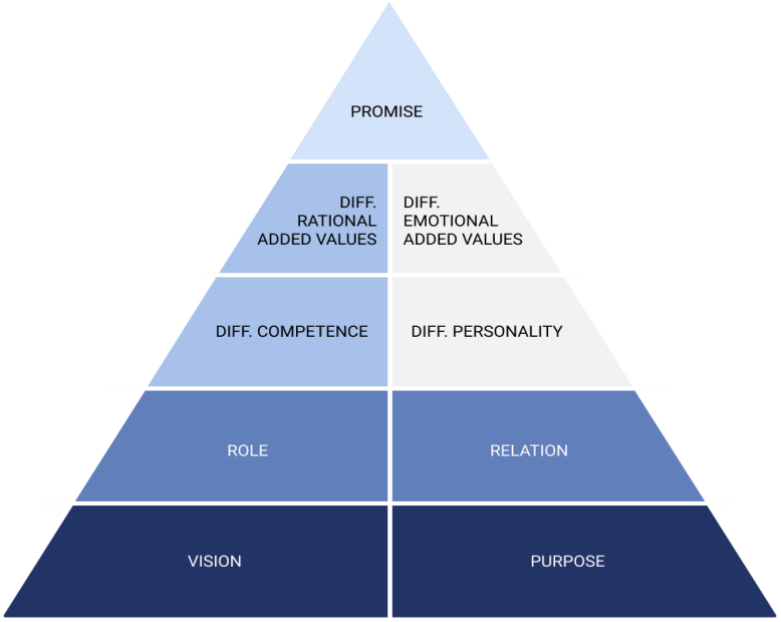


Figure 37. Sport brand platform

The name of the brand is Aspire, which means "direct one's hopes or ambitions towards achieving something" (Aspire, 2018). The name and its meaning fit well with the brand promise "insight for performance" which lets the customers know that their skills can be improved by using Aspire products.

> *Aspire — direct one's hopes or ambitions towards achieving something*

When creating the brand logo, pictures of different sport brand logos are gathered and compiled (see figure 38). A quick analysis of sport brands on today's market is performed and it is concluded that a sporty feeling with a unique style is desired. The logo of Aspire is illustrated by a sketch of a horse head together with the brand name in capital letters underneath it (see figure 48). The horse in the logo distinguishes Aspire from other sport brands since it informs the customer that the brand belongs to the equestrian sports segment.

Figure 38. A sample of brand logos for inspiration.

The graphics, including the colours, logotype and style of the Aspire brand, can be seen in figure 39. The colours include black, four shades of blue and one light grey colour. All colours are found in the sport moodboard and in various equestrian contexts, especially large equestrian sport events. Since team spirit and performance is key, the colours can be found in the riding jackets of the Swedish national show jumping team (as can be seen in the sport moodboard). The logo can be seen alone or with the brand name underneath it, depending on where it will be used. The logo can furthermore appear in the colours black, white or dark blue depending on the context.

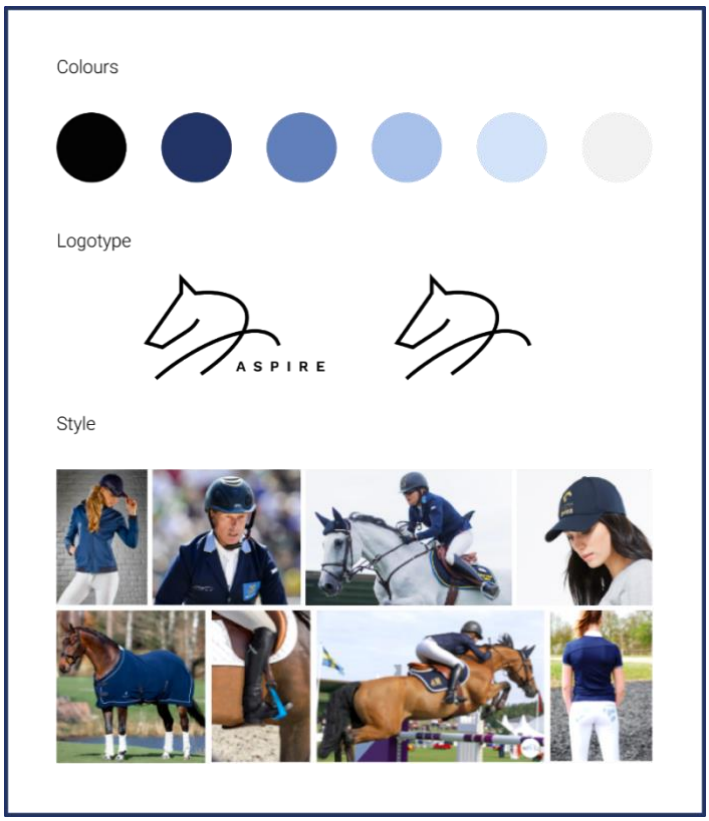


Figure 39. Graphics for the Aspire sport brand.

4.5 App

The aim of the app concept creation phase is to deliver wireframes with functionality based on the results from user studies and competitor analysis in the exploration phase. The first step is to generate ideas of main functionality and sub-functions for the app and then generate wireframes.

In all three steps, the list of requirements is used continuously to assure that all generated ideas meet the wishes and demands of the user group. Hence, no additional evaluation tool will be used to evaluate the ideas.

4.5.2 Result

The result of the first step is the main and sub functions. The following main functions are created: background, sessions, live, statistics and settings. The main functions are placed in the bottom navigation bar of the app and can be reached from the start page as well as from the respective sub functions' start pages. The sub functions *riders* and *horses* are placed under the main function *background*, where the user can add information about different riders and/or horses. From these sub functions, the users are allowed to go straight to a new/old session.

The next sub functions are found under the main function called *sessions*. In this page, the user starts by choosing a day/time and the session of the chosen date will appear. Information regarding the rider, horse, duration, discipline, rating and extra information will be visible and possible to edit.

The main function *live* is reached by pressing 'start session' on the front page. Live diagrams will then appear and display the current force in each rein during ride. This function is especially beneficial for the trainers as they can follow the changes of the rein forces continuously and simultaneously communicate with the riders.

The next main function *statistics* involve a variety of sub functions. The user can swipe between different type of data and receive information regarding: force/paths, track/time, track/force, force/session, gait/time and gait/force. By choosing one of these functions, a new page with graphs, data and additional information will be available. If the user has any troubles interpreting the data they can simply click on the question mark and an explanation box will appear.

The last main function is *settings*, which involves various settings such as: warnings, sensitivity, sensor battery and language. Each setting can be adjusted by pressing one of them. To make sure that the changes are saved after editing, the save button in the top right corner is used.

The result of the second step is wireframes (see figure 40-44) and the app can be seen in the *final update* chapter.

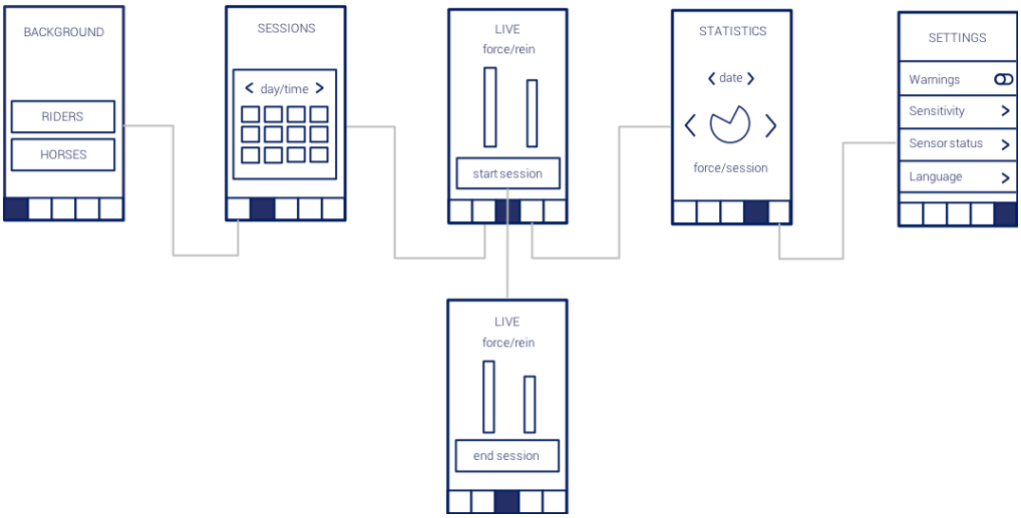


Figure 40. Wireframes showing the connection between the five main functions.

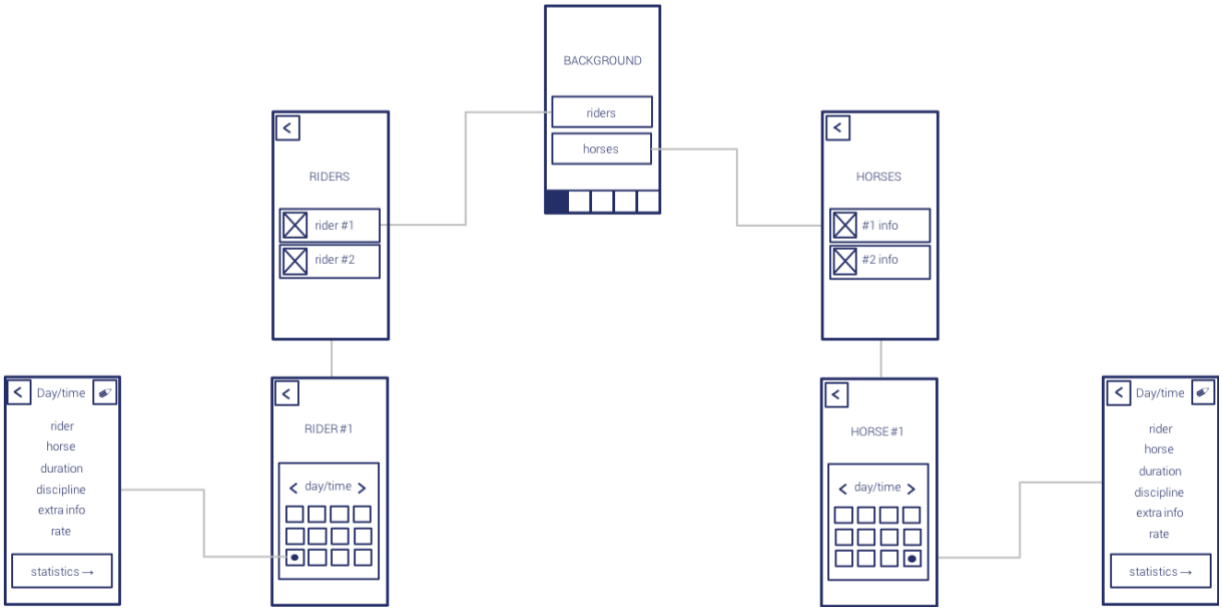


Figure 41. Wireframes showing the background function with its sub functions.

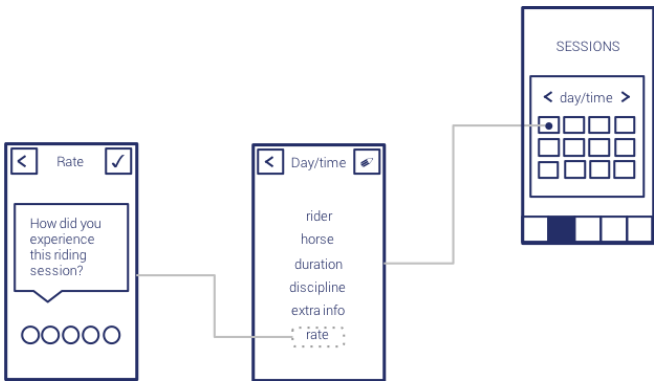


Figure 42. Wireframes showing the sessions function with its sub functions.

Figure 43. Wireframes showing the statistics function with its sub functions.

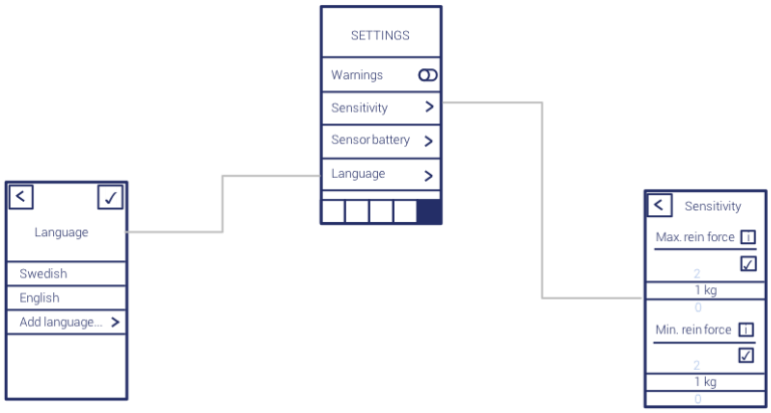


Figure 44. Wireframes showing the settings function with its sub functions.

4.6 Conclusion creation

One major concept is resulting from the physical product development process, as well as one concept passing as a compliment to the first concept. These two concepts are “reins”, which can communicate both continuous information and warnings, and “wristbands” which can communicate only warnings and therefore works in combination with continuous information from “reins”. Both concepts include a theoretical technical solution as well as concepts on communication that are to be tested in the following phase “Evaluation”. In addition, there is a physical prototype illustrating the functionality of the product. The aim of the brand strategy is to implement a thorough brand spirit and feeling.


5

5. Evaluation

5.1 Aim evaluation

The aim of the evaluation phase is to evaluate the concept (physical product, app and brand strategy) and ideas from the creation phase, to find possible improvements that can be performed before the final concept takes shape.

5.2 Process evaluation

The evaluation phase will be divided into three parts where the main focus will be on the physical product as stated in chapter 4, creation. It will be reviewed thoroughly through user tests, a practical evaluation and a theoretical analysis. The app and brand strategy suggestions from the creation phase will be evaluated lightly through the same theoretical analysis.

The user tests focus on the communication strategy of the physical product while the practical evaluation tests the practical use of the product in a lifelike situation. To make sure the product as a whole (including app, brand strategy and physical product) meets the user needs mapped in the initial exploration phase the fulfilment of each requirement will be graded. The theoretical analysis also includes a new customer mapping to be compared with the one created for a generic competitor product in the exploration phase.

5.3 Practical evaluation

The purpose of the practical evaluation is to confirm the use of the product in its true context and find potential problems.

5.3.1 Method practical evaluation

The practical test consists of a rider and a pony of 145cm training with three led lights attached to each rein, evaluating the visibility of the LED lights in different situations. The product mock-up in form of led lights consists of a battery driven unit with two led strips attached. These strips are shortened to a length of about 10 cm (as concluded suitable in the first practical evaluation, chapter 3.3.2) and adjusted as to show three lights per strip. The pony has short and thick mane and the weather for the evaluation session is foggy and light (middle of the day). The set up can be seen in figure 45.

Figure 45. Product mock-up with three lit LED lights.

Parameters tested are visibility of led lights in daylight, visibility of each side separately, the possibility to compare the two sides and respective number of lit led lights during ride in different gaits, and to confirm an optimal placement considering the rider's grip and visibility.

5.3.2 Result practical evaluation

From the test it is concluded that the intensity of the mock-up led lights are sufficient to be easily noticed in daylight. When riding in several gaits it is easy to count the number of LED:s on each side, and therefore also easy to compare the two sides. The pony used for the test have short and thick mane, and when the rein is placed below the mane the number of led lights are still countable. The placement suggestion from the earlier practical test (see chapter 4.3.2) appears convenient, that is about 10 cm just above half of the horse's neck. Therefore, both placement and number of lights suggested in the earlier practical test are confirmed.

The visibility of the LED lights from the rider's perspective is optimal when the hands are tilted inwards and reins slightly rotated. This is not a desirable hand position and when hands are held in a correct position the visibility of the LED lights are very restricted. The conclusion is that the placement of the LED lights on the outside of the rein is not sufficient.

When riding with a bent neck of the horse, for example on a bent track, the outer rein is not visible except just close to the hand. This is considered a problem.

5.3.3 Conclusion practical evaluation

The conclusion is that the placement of the LED lights, just above half of the horse's neck, and the number of LED lights, three, is suitable for the product. The placement of the lights on the outside of the rein is however not sufficient, and there is a restricted visibility of the outer rein on a bent track.

5.4 User tests

The aim of the user tests is to find communication alternatives that are intuitive, understandable and appreciated by the users.

5.4.1 Method user tests

User tests are performed to find the best way to communicate. Before starting the real tests, three pilot tests are arranged to find possible areas of improvements. Eight people from Chalmers in the ages 21-28 years are participants in the user tests one participant at a time and each test takes around 20 minutes. The participants are given instructions of the purpose and procedure of the test and, as a first step, they are shown a neutral setup on a laptop and given an explanation of what they see in the image. Several images with various communication alternatives are shown one at a time and the participants are encouraged to describe their thoughts and feelings regarding the various alternatives. It is pointed out that there are no right or wrong answers, though all answers are interesting.

The test is divided into three parts, one regarding continuous information, another regarding warnings and a last concerning general comments. The order of the different communication alternatives is mixed for all participants to avoid the learning curve effect. The test responses are documented using pen and paper and further compiled through discussion.

5.4.2 Result user tests

All participants are positive about using a rein measure product, mainly to find out unevenness in horse and rider and to follow up on the personal development, although one participant would not use the product if it is too expensive.

The participants mention that other positive aspects are that the product seemed relevant, simple and probably could work as a good reminder for all riders. A few participants think that vibrations through wristbands likely could work well, as the rider does not need to look down during ride. Another participant points out that the wristband can work as a good complement to the led lights in the reins. Furthermore, some comments refer to the product being intuitive and fun with different steps, also that it would be helpful when striving for equilibrium. One participant points out that it would be great to use an app as a complement to the reins.

Some concerns refer to that it might be hard to feel the vibration in the wristband during ride and that there is a risk of getting caught in something. There is also a risk that the horse feels the vibration, which is bad since the purpose is to only give feedback to the rider. A few participants believe that four lights can be confusing and that it can be difficult to see underneath the mane. Charging alternatives is another thing to consider, as well the interpretation of vibration patterns. Furthermore, twisted reins might make it hard for the rider to see lights and it can be difficult to know where to place the lights in order to see them properly. Last, the product needs to be robust and resistant to dust, water and dirt.

The alternative with steps wins because all participants understand the principle of less/more force and one option is favoured due to a feeling of “pulling” the force towards the rider. The dots alternative is discarded as many participants believed it is confusing and placement is perceived as an indicator of something else than force.

All participants believe that three white lights imply large or extremely large force in the reins. Some point out that such a scenario could happen when the rider is pulling the reins too hard or if the horse is pulling the reins quickly. Other participants mention that a situation with three white lights would feel bad, especially when riding straight ahead and that it then would be difficult for the horse to be relaxed.

Most participants believe that no lit lights imply very little, minimal or no force in the reins. Some also mention that it could implicate long or slacking reins. A few participants bring up that at least one lit light would be preferred to show contact, whereas another participant would not like lit lights all the time during ride but would rather prefer no light when riding with "optimal" force.

Red light is identified as better than white light and steady light is better than flashing light. Vibrating wristbands receive almost as much positive response as the LED lights on reins. Many participants do not perceive three white lights as a warning, it is further perceived less intuitive and perceivable than red light in a riding context. Flashing light is thought of as annoying, disturbing and embarrassing for horse and rider. Red light is perceived as "let go, now!" and as a bad situation because of connotation. Only one participant associates the red colour with mechanical error. Furthermore, about a third of the participants believes that wristbands would be a better and more aesthetic solution than led lights and that it would not disturb as much. Another third of the participants would rather have led lights since vibrations is considered unclear. The last third of the participants would prefer a combination of vibrations in wristbands and lights on reins, although a wish for keeping it simple and easy to use and understand is expressed.

5.4.3 Conclusion user tests

The alternative that is most favoured among the users is the scale of LED:s that goes from zero to three lit LED:s towards the rider, to communicate zero force to very much force (see figure 45) The appreciated warning is the one when the three white LED:s all turn to red to symbolize too much force where an action is required. This is the concept that will be brought further in the project. Since the wristband is appreciated by many users but cannot give continuous feedback on its own, it will be brought further as part of the concept but be presented for the customer as an optional component.

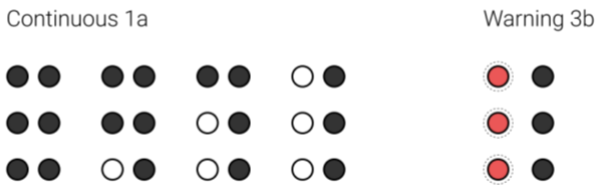


Figure 46. Visual information consisting of continuous information as well a warning.

5.5 Theoretical analysis

The theoretical analysis aims to verify the concept and ideas towards the requirements as well as to put them in a context of use to identify crucial user touchpoints. To find potential problem areas, as well as the strengths of the product/use, that can be analysed in relation to the competitors from chapter 3.

5.5.1 Method theoretical analysis

To verify the concept towards the requirement list, the level of fulfilment for each requirement is graded between 0 (not at all) and 5 (fully) where 3 and above is considered approved. The requirements graded 3 and below are discussed in the result below.

To evaluate the concept in a real use context, a customer mapping is performed the same way as in the exploration phase. Both customer journey and UX-curve are then compared to the ones made in the exploration phase for a generic competitor product. This allows finding customer touchpoints where the concept stands out in a positive way as well as risks. That is, focus is not on optimising all possible touch points but to compare the two user interactions.

5.5.2 Result theoretical analysis

List of requirements

Of the 40 requirements (some considered wishes rather than requirements), 31 requirements obtained a grade 4 or 5 and are therefore considered satisfyingly fulfilled. Four of the requirements are given a 3 which means they are approved but not satisfying and five are marked with a question mark. The requirements with a 3 or question mark are listed below with a comment associated.

Requirement 28 (wish) - "Allow for separation of materials and/or electronics"
This requirement is rated a 3 because from a macro perspective, the different parts such as electronics, plastics and metals will be possible to separate. However, on a more detailed level the separation of electrical components cannot be granted.

Requirement 29 (wish) - "Be easy to setup"
This requirement is rated a 3 because the initial setup requires a number of steps, repeated once since each component of the concept comes in a pair (two sensors, two LED units, two wristbands). The setup will require attachment for each component, a first synchronization between the components as well as personalizing the app settings. This is not considered an "easy setup" but it is not considered complicated or hard and is therefore still acceptable.

Requirement 26 - "Belong to economy tier and price range"
This requirement is rated a 3 because the product consists of multiple components which together add up to a higher cost. However, the technique used for the components is established and relatively simple (for example, the sensor only measures tension/force and no other parameters), something that limits the cost.

Requirement 20 - "Easy to attach"
This requirement is rated a 3 because of the number of components that need to be attached (listed in the section above), even though the individual attachments can be simple. However, it should be remembered that all components do not have to be removed and attached for each ride but can stay attached to the gear.

Requirements 15 - "Be possible to clean", 16 - "Consist of durable materials", 17 - "Withstand physical stress" and 18 - "Withstand long-term wear"

These requirements are given a question marks because materials and construction are not specified in detail. With experience from competitor products and similar technical solutions it can be said with confidence that it is possible to fulfil these requirements.

Requirement 7 (wish) - "Encourage rider's feeling"
This requirement receives a question mark because the outcome depends on the user behaviour. The product itself can encourage rider's feeling by verifying the rider's feeling with data, improving the rider's perception of their feeling. At the same time, this functionality can also make the rider depend a lot on the product and presented data and therefore forget to feel and judge for themselves. The outcome is hard to predict.

Customer journey

The customer journey for the physical product and app is presented in figure 47. The main phases are shown at the top and are the same as for the generic competitor product from the exploration phase. Most touchpoints under each main phase are also similar, since the product is within the same product category as the competitors. A number of the touchpoints are discussed below, either because they are strong and competitive or because they are considered potential risks.

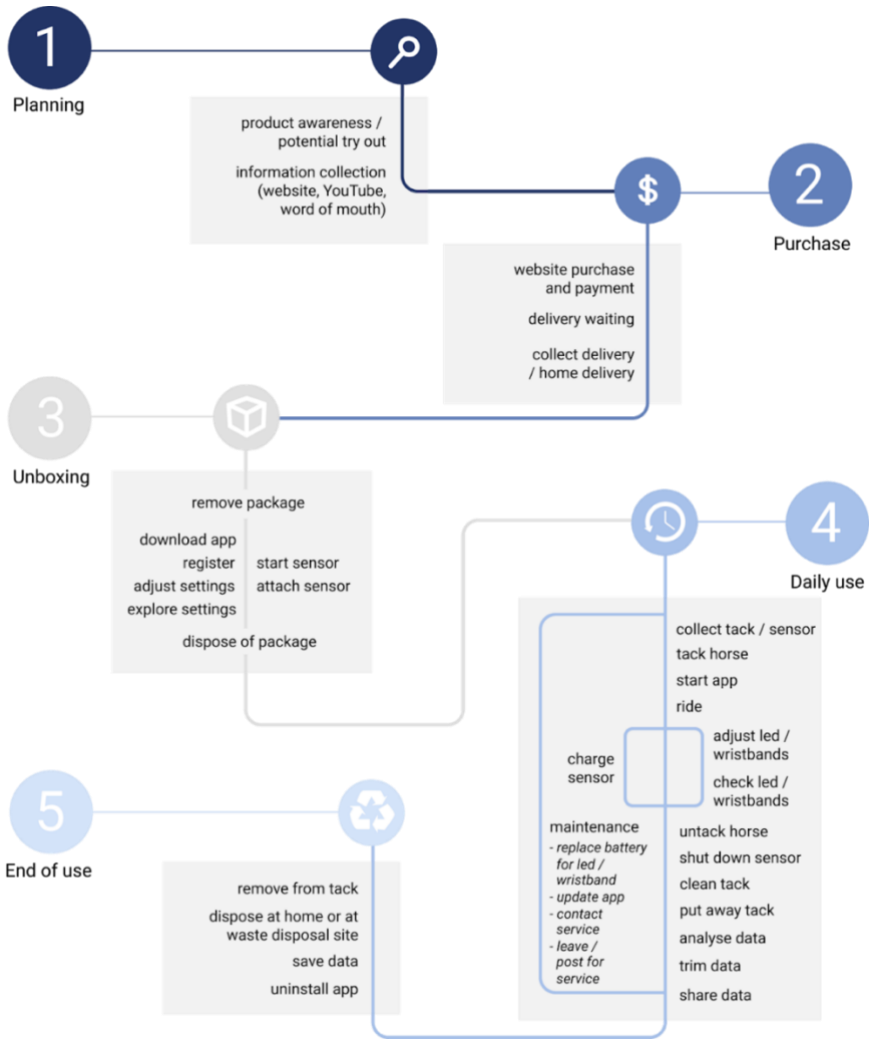


Figure 47. New customer journey.

Strengths
The major strength and also the most important touch point for the concept is the direct feedback feature because the competitors mainly focus on apps and long-term evaluation. This is present under the daily use phase and is captured "check LED/wristbands". This feature combined with an app is what the competitors do not have and therefore direct feedback has potential to become the unique selling point for this concept.

Another strength is focus on team spirit, that the physical product and app become part of the team around a horse and rider and strengthen it to perform better. The purpose of the brand strategy is to create the team feeling and therefore help achieve the brand vision, which is to increase insight and improve performance.

Potential problems
One risk is that the rider forgets to turn on or off the app. Since the app-sensor solution is similar to the competitor products, this is not a unique problem but still needs to be mentioned. The consequence if the rider forgets to turn on the app is that there will be no recorded data. It also means that the LED lights will not be activated and the chance that the rider notices their mistake is high. The larger risk is if the rider starts a session but forgets to end it afterwards. This means a specific amount of falsely recorded data that will affect the values and statistics presented in the app.

Another potential problem is the attachment of the sensor and LED units, as well as the wristbands. As mentioned in the requirement evaluation earlier, the number of steps are several. The sensor attachment will be similar to the competitors, but then there are two pairs of units extra to attach. Because of the already high number of steps performed when tacking a horse, this could be considered either a problem or not by exceeding an undefined limit or vanishing among the amount. Also mentioned earlier is that there is no need to remove and attach all components for each ride, so the problem might be occasional.

UX-curve

Since the user experience curve is based on the customer journey, describing the experience as each phase progresses with time, the curve is also similar to the generic competitor product's. The phase that does differ is the daily use phase, because of the direct feedback described in the section above. The daily use phase is the longest and also most monotone phase for a generic competitor product, since when the initial excitement has abated the experience is positive but flat. A flat curve means that the user does not become reminded of the product's existence during its lifetime, something that can weaken the relationship between user and product/brand. What the concept does that alters the experience during the daily use phase is that it offers direct feedback during ride and not only afterwards through an app. The immediate feedback increases the complexity of riding and evokes emotions during ride, altering the experience and, thus, creating waves during the monotone daily use experience (see figure 48). Because of the direct feedback being clearly visible and/or felt, the user is continuously reminded of the product's presence and therefore the brand relationship is active. Even though the overall experience might be on the same level or just slightly increased, the key is the actual variation which breaks the monotony. A comparison of the UX-curves can be seen in figure 48, where the generic competitor product curve is light grey and the change coming with the concept is illustrated in blue.

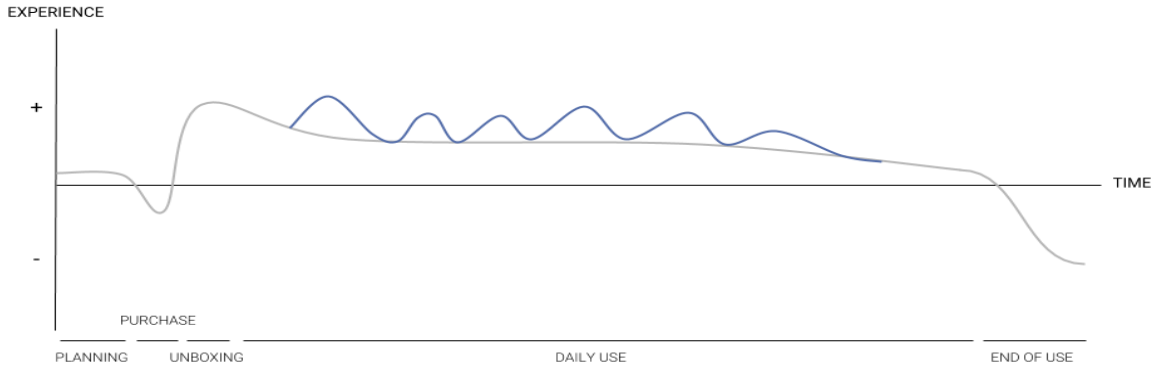


Figure 48. Comparison of competitor and concept UX-curves.

5.5.3 Conclusion theoretical analysis

One uncertain part of the concept is materials and specific construction and so the concept does not fulfil all requirements at the present time. Except the material and construction part, the concept fulfils all requirements.

The largest problem regarding use of the concept is the number of steps that need to be performed when tacking and untacking the horse, due to the number of components within the concept. Another problem is for the rider to remember to turn off the recording once finished with a session, so not to affect the recorded data with disturbing values.

The central benefit and unique part of the concept is the direct feedback, especially in combination with an app. This provides a combination of immediate and long-term analysis for the rider, which in combination can improve performance more efficiently than only one or the other.

5.6 Conclusion evaluation

The overall conclusion for the evaluation phase is that there is a favoured way of communicating the rein force; white LED: s going from zero to three lit LED:s with increasing rein force, all turning red when the force exceeds a set limit. This concept will be combined with an optional wristband that can give haptic warnings.

The visibility and use of the physical concept mock-up is in general approved. However, there is a problem with the outer rein not being visible when riding on a bent track/with a bent neck of the horse. Such situations occur often when riding and so is a problem crucial to solve.

The choice of materials and specific technical solution need to be specified to make sure the concept will work. With knowledge of competitor products and similar techniques on the market, it can be concluded that it most likely will work, but a suggestion or solution should be presented.

The strongest part of the concept is the provision of direct feedback, especially in combination with long-term feedback. The direct feedback allows for more insight and development for the rider and horse, and so is a competitive feature that should be emphasized.


6

6. Final update

This chapter presents the final concept of this project, with updates from chapter 4 based on the evaluation made in chapter 5. The final concept consists of a physical product with a theoretical technical solution, a prototype, an app and the overall brand strategy. The chapter will present the mentioned parts of the final concept in turn, with pictures and descriptions.

6.1 Aspire – the brand

The Aspire (see figure 49) vision is to create insight into riding and thereby elevate performance. Thus, the name; Aspire – to direct one's hopes or ambitions towards achieving something. To achieve a higher level of riding, Aspire believes that the team around the horse and rider is crucial. Whether it's simply the trainer, or a larger team that supports the rider in different ways, the united knowledge and effort create progress. Aspire wants to be part of that team. The rider should feel supported by the product, the direct feedback during ride and through the app in between rides on their journey.

Figure 49. Aspire brand spirit.

6.2 Physical product

The physical product consists of three components and for each side of the horse there is one sensor and two separate actuators – LED lights and the haptic wristband (see figure 50). These parts interact wirelessly and are controlled through the app, which includes sensitivity, warnings as well as when the data is recorded and not. The components are always turned on but not before the user starts the app does the sensor become active, sending information to the app and orders for the LED lights to light up and the wristband to vibrate. The same goes for deactivating the parts, which is done through the app. All parts (except the smartphone which is needed for the app, but not considered part of the project) are charged wirelessly and have a tiny light that indicates on/off mode, low battery and charging mode.

The sensors measure the force in each rein and sends that information to the app, LED lights and wristbands. There are three rows of LED lights, where one row equals one LED light as shown in the creation phase, and where one row at a time is lit up with increased force in the rein. When there is no or very little force in a rein, the LED lights on that rein are all turned off. Then there is an allowed interval of force which the rider adjusts, where one, two or three rows of LED lights indicate the amount of force in the rein with a white light. When the set upper limit of force is exceeded, all three rows of LED lights turn from white light to red as a warning. If desired by the rider, the visual warning can be combined with a haptic warning through the two wristbands. The wristband alerts the rider through a soft but distinct vibration on the corresponding side, something that allows the rider to use their vision

freely and not get stuck staring on the reins. The direct feedback of the LED lights and wristbands are then combined with an app that logs and compiles the data (see coming chapter 6.4).

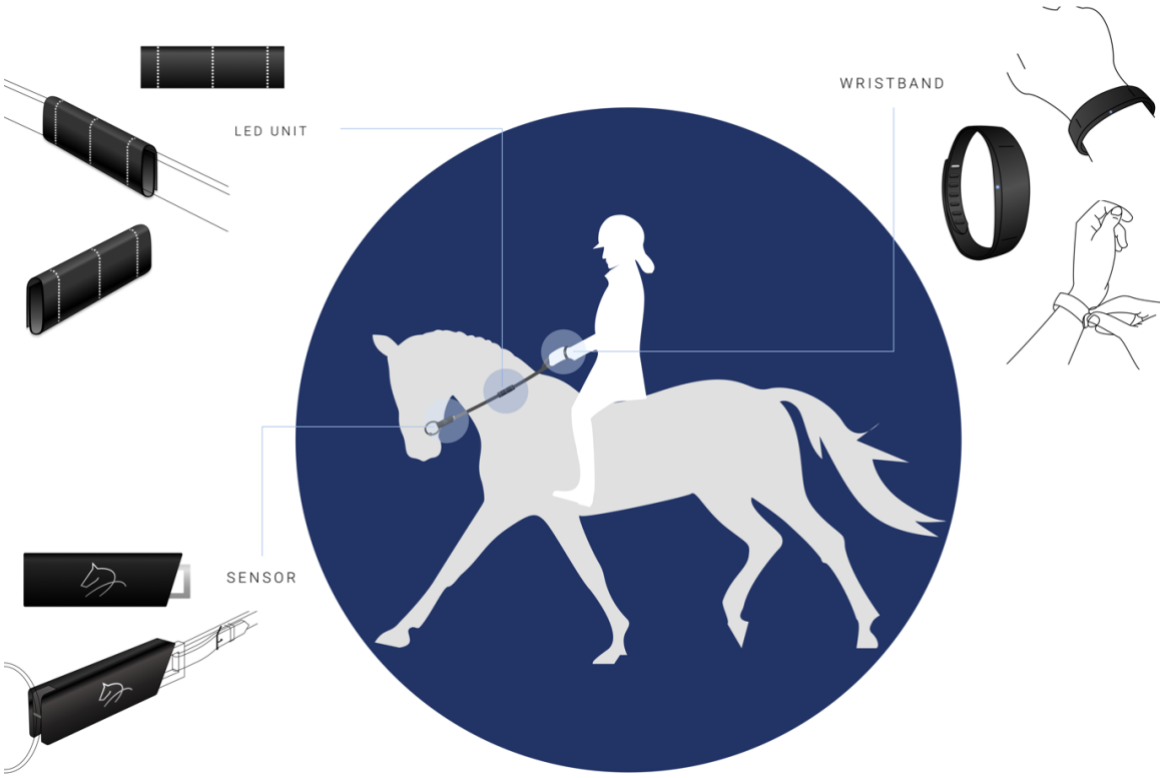


Figure 50. LED unit, wristband and sensor.

The reason to replace the three single LED lights discussed in the creation phase with three rows of LED lights the restricted visibility which occurred as an issue in the practical evaluation, chapter 5.3. By letting the LED lights cover the whole circumference of the rein visibility is increased, allowing the rider to alter angles of hands/reins and the mane to cover some parts of the rein without blocking all lights. Another major decision after the evaluation is to not integrate the LED lights into the reins but to make them a separate unit. This allows the rider to attach it to a place on the rein that suits them, their horse and the specific equipment. Since all riders, horses and equipment form unique combinations, this is considered a crucial feature which also meets visibility issues from the evaluation chapter. A separate LED unit also allows the rider to use their favourite reins and not buy a certain pair. It also eases cleaning of the gear and allows adjustment during ride. If the product were to break, the whole rein does not need to be replaced but only the LED unit. Also, the rider can choose to ride without direct feedback by only attaching the sensor.

The sensor consists of a plastic case, a sensor, a battery, MCU and radio unit. The sensor is made out of a metal plate with two attached strain gauges which create a current when the metal plate is stretched. The rein is directly fastened to one side of the plate, and since the other side of the plate is fixed by hooking into the plastic case, the rein force is transmitted to the plate. The bit is moved into the gap in the sensor and then locked with a loose metal cylinder that is moved along a groove (see figure 52). The choice of strain gauges rather than a piezoelectric material, discussed in chapter 4.3.2, is the availability today and simplicity regarding construction. It is also enough for the metal plate to stretch

minimally but still give a clear result, which is preferable both for the rider´s feeling, no stretch, and the durability of the metal plate, protection from plasticising. The plastic case encloses the components to protect from wear, weather and even if the tightness of the seals affects the stretch of the metal plate, a calibration will ensure correct values. The sensor with the metal plate attachments and placement can be seen in figure 52 and the components, size not defined, can be seen in figure 53.

Figure 51 illustrates a packaging suggestion for the Aspire product with the sport brand spirit implemented. The package has the typical Aspire blue colour on the outside and is white on the inside to really show the product. The package contains two wristbands, two rein sensors, two LED units and a start guide in order for the user to understand how to use and interpret the product.

Figure 51. Package of the Aspire product.

All components of the sensor (size not defined) can be seen in figure 52 and 53.

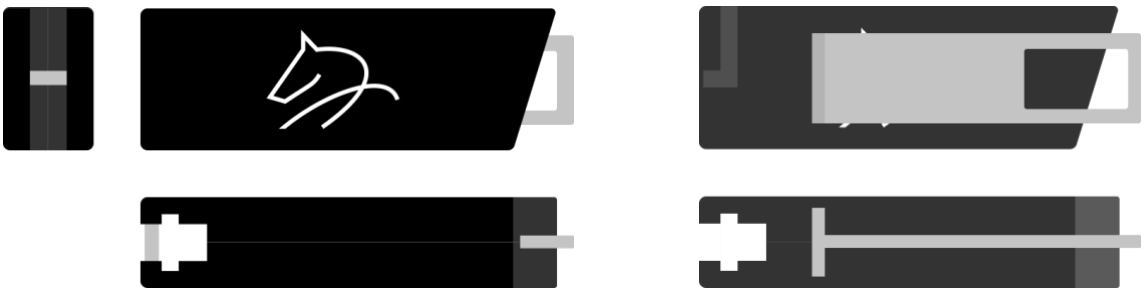


Figure 52. Side, bottom and front view of sensor as well as metal plate placement in relation to case.

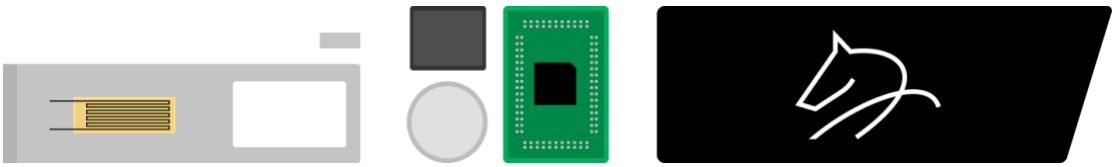


Figure 53. Sensor components.

The LED light unit consists of a double layer of soft silicone which encloses all electronics and withstands water, sweat and allows cleaning (see figure 54). There are three rows of LED lights that stretches from side to side of the sheet and thus cover the whole circumference of the rein when closed. To attach the unit to the rein, the sheet is wrapped tightly and attached with Velcro, the overlapping of the sheet allowing adjustments for slight rein variations. Velcro is a common attachment technique used within the equestrian world and allows quick and strong attachment. It is also possible to exchange if worn out. To ensure that the unit does not wrinkle when rubbed against the neck of the horse, sticklike elements will be enclosed within the unit. The unit will also include a battery and a radio unit, to receive signals from the sensor MCU. Based on a standard rein of 16 mm height and 5 mm width, as well as a convenient spread of the LED lights (see chapter 5.3 practical evaluation), the dimensions of the sheet are 50x100 mm. About 15 mm of Velcro loops on one side and 5 mm Velcro hooks on the other allows for slight adjustments.

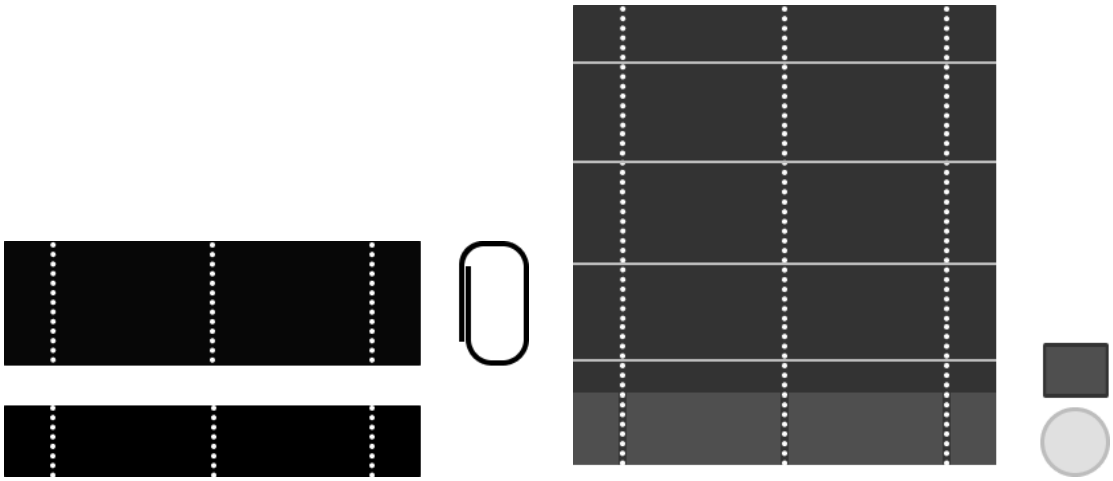


Figure 54. LED unit view from side, top and front as well as unfolded view with components.

The wristband (see figure 55) is made of a durable elastomer material, as in a runner's watch and has no external parts except attachment and a small indicator led as mentioned earlier in this chapter. This means the wristband is durable and withstands dirt, water and sweat and at the same time giving a smooth feeling on the skin of the rider. The wristband encloses the electronics which include a battery, a radio unit (to receive signals from the sensor MCU) and a summer that generates vibrations.

Figure 55. The wristband with components.

6.3 Prototype

The prototype aims to illustrate the function of the sensor and LED lights of the physical prototype. To engineer that when the sensor is exposed to a pulling force, the LED lights act according to the decided communication alternative. Initially no lights are lit, corresponding to no sensor stimuli, then with increasing force applying to the sensor there are first one, then two, then three LED lights turning on in white. Finally, when a certain amount of force is reached the three LED lights all turn red to communicate a warning (see figure 56).

Figure 56. The communication solution as preferred by users.

The prototype (see figure 57) consists of:

- One Arduino MCU
- Two breadboards
- Three 4-pin LED-lights (which can take any colour)
- One amplifier
- Wires and resistors
- A metal plate with attached strain gauge sensors

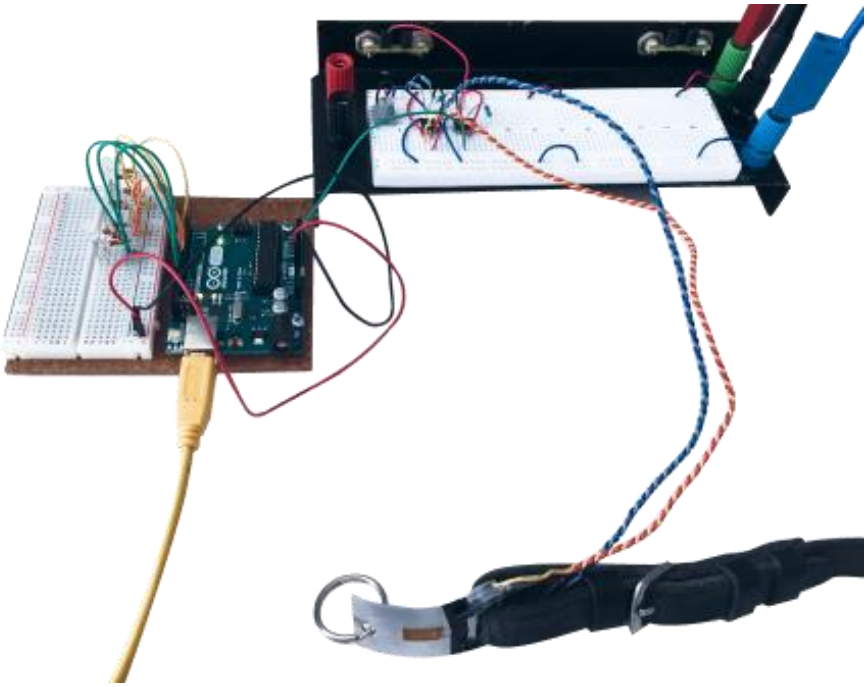


Figure 57. The prototype.

The metal plate with strain gauge sensors act as the sensor, which, when the plate arcs (from pulling or pushing its parts), gives an input to the MCU. The MCU is the computer that processes the signal from the sensor and send out signals to the three LED-lights on the breadboard, making them light up as described above. To achieve the correct behaviour of the LED-lights, the Arduino software is used to create a code (see appendix M) and adjust the force sensitivity and levels.

6.4 App

The app functionality, structure and hierarchy are the ones presented in creation. What is new is the graphics and the online clickable prototype. Naturally the clickable prototype cannot be presented here, but can be found and tested using the link below:

https://www.figma.com/proto/qm26x6xjxpqdAxGzGR5XAd/1.0-Prototyping?scaling=contain&node-id=218%3A3300&redirected=1

The graphics are based on the sport brand spirit and the key elements presented in the creation chapter, see section 4.4. The full app content can be found in appendix L and an extract from the app content will be presented below. Figure 58 shows the launch page of the Aspire app in a potential user's hand.

Figure 58. The launch page of the Aspire app.

The tab bar (see figure 59) shows the five main views which are, from the left: profile, sessions, live/recording, statistics and settings. These main views are (almost) always accessible by pressing the respective icon in the tab bar, from a top level as well as further into app.

The first page visible when the app has launched is the recording/live view, so to easily be able to start a new session at once (see figure 59). When a session is started, the recording is active even if the user wants to change view, and always easy to access by pressing the middle button in the tab bar.

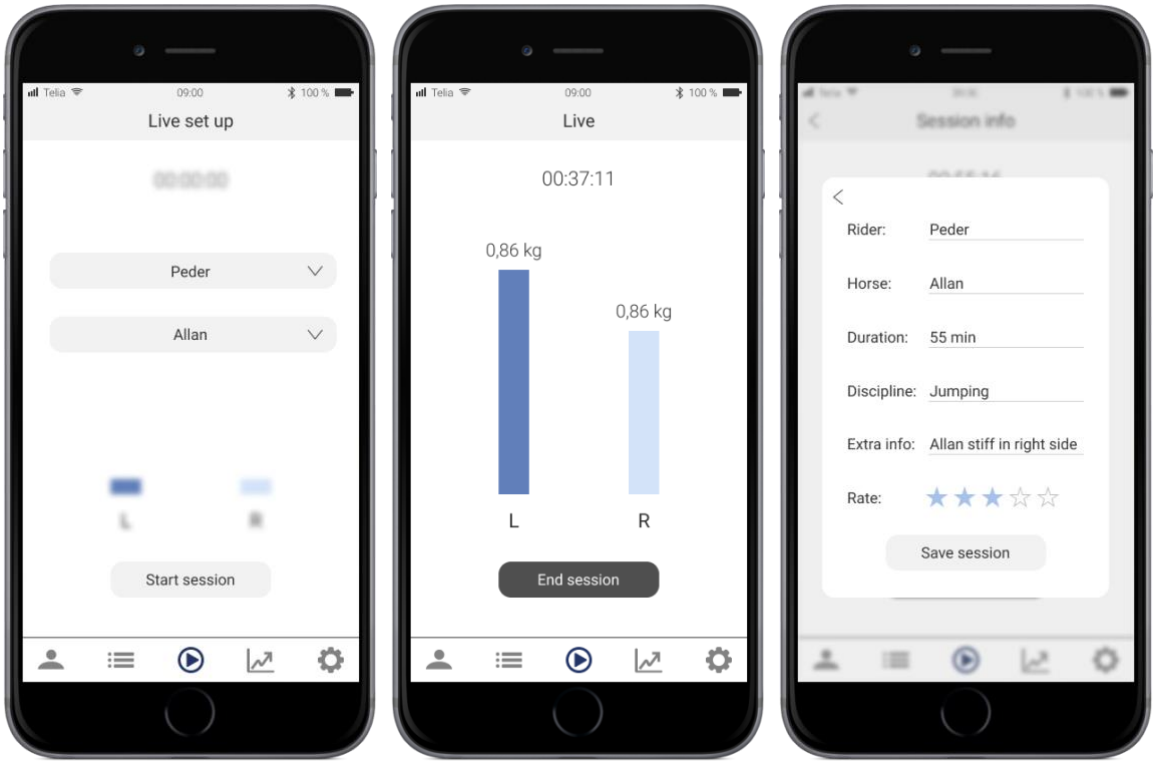


Figure 59. First page, active session page and save session page.

The most complex part of the app is the statistics view which consists of six different information sides that are desired by the users (see chapter 3.3, user studies). On a top level there are an overview and possibility to swipe between the different information sides while staying within the statistics view. Each side can be pressed to allow a more detailed display of the respective information. The detailed view contains data and diagrams for the chosen/present session, as well as a compilation of the respective data over the last week, month, three months etc. One of these detailed views differs from the other ones by showing the riding paths for the chosen session and the rein force distribution for a specific position in that path. The view is interactive and displays the time and corresponding paths by sliding a symbol along a linear scale that represents the whole session. Figure 60 shows one of the overviews and the corresponding detailed view, while figure 61 shows three examples of other detailed pages under statistics of which one the interactive riding path page.

Figure 60. One of six statistics overview and corresponding detailed view.

Figure 61. Three detailed pages of which the right shows the interactive riding path page.

The three remaining main views are shown in figure 62. Profile is where the user can add/edit which horses and/or riders the user wants to use for the product. Sessions is a view that compiles all rides saved in the app and also has a shortcut to statistics, once a specific date/session is chosen (not shown in figure 62). Settings contains standard app settings, as well as specific settings for the physical product: force sensitivity, warnings on/off and wristband haptic intensity.

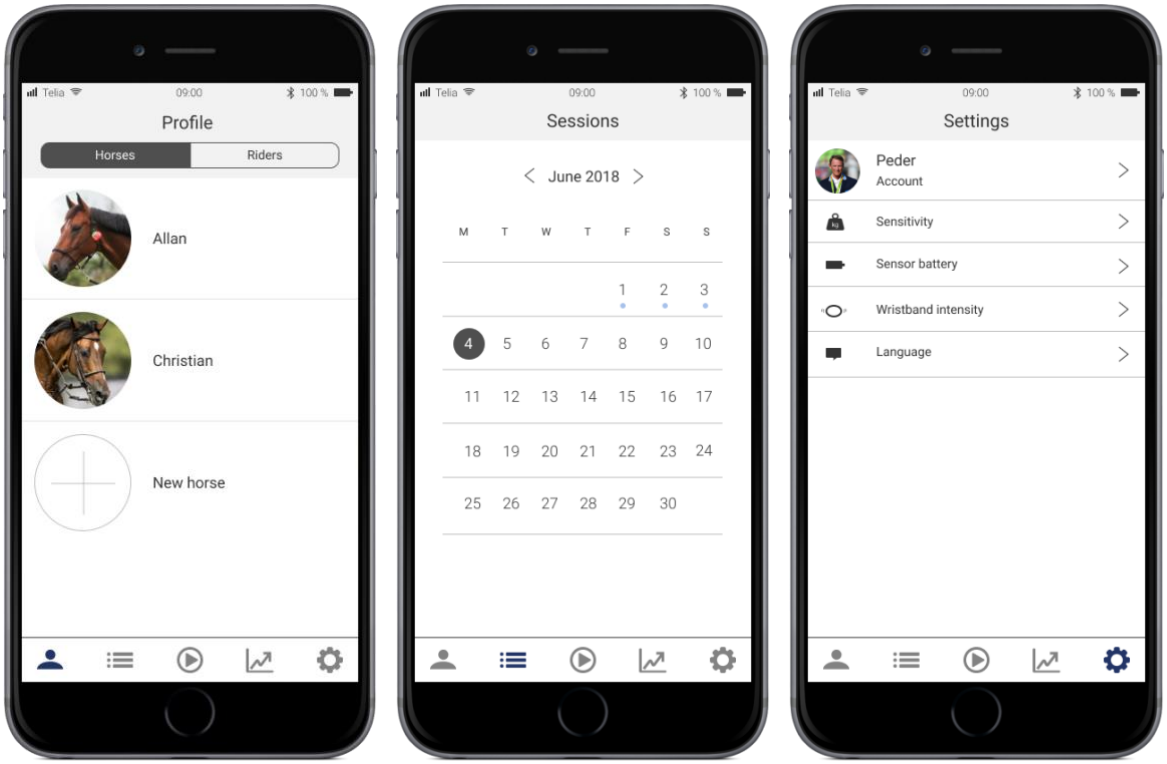


Figure 62. Profile, sessions compilation and settings.


7

7. Discussion

The initiative behind the project is based on a wish to help a rider and their horse to perform better. To make training more efficient, to develop faster and to prevent discomfort and injuries. The aim of the project is to develop a product that can measure and communicate the force in the reins to give the rider more insight, since it is believed that such a product can contribute to better performance. This follows the knowledge about laterality in horses and riders, how unevenness is an important factor in how well a horse and/or rider can perform. As became clear from the user studies performed in this project, the issue of uneven distribution of force in the reins is exceptionally common. Many also stated that they have tried to solve the issue but failed. Even though riding is complex and the communication through the reins are only one part of a whole, it is an important piece. To create insight into how force applies to the two reins in different situations can help improve the whole. The project concept does this in several ways; The rider can receive direct feedback to check on their feeling during ride and be allowed to instantly change details to improve training. They can also track their development or any changes over time, something that allows them to discover trends or patterns.

The concept of this project also contributes to the wish for more technique within the equestrian sports and world. Other sports in general are further ahead regarding the use of technical tools, while the equestrian world often values the traditional methods and emphasises horsemanship and rider's feeling. One reason for that being the situation is that, compared to other sports, there is a living being involved. The use of the horse in the interest of humans brings many ethical aspects and questions that other sports does not need to consider. What is okay to do with a horse for humans to be able to train, compete and enjoy themselves? There is a belief that the use of technique impacts the horse's welfare and the core of the sport, which is (or should be) the love of the horse. That is clear from the user studies in this project – many voiced a warning about such products impacting rider's feeling and therefore horse welfare. It is a strong jargon within the equestrian world, and any rider that appears to welcome new technique are perused and discussed among others, something that contributes to the conservative situation. But, does technique need to compete against rider's feeling and horsemanship? Can technique possibly contribute to horse welfare and be used with the horse's interest first?

The project concept comes with a sport brand spirit, emphasising insight and performance. The reason is one, because the users desired it, but also to legitimise riding as a sport. To give equestrian sports a chance to be equalised with other technique. But important to remember is that the project concept is not only for rider's wishing to compete and even more not to forget the horse. The belief of the project is that increased insight into the components of riding is beneficial to any rider, and, any horse. Laterality does not only affect professionals and competitive advance, but the everyday life and relation for horse and rider. The possibility to work on laterality and strive towards evenness will decrease physical discomfort for both horse and rider. Less discomfort, together with improved performance during everyday training will probably strengthen the relationship between horse and rider because of increased mood and satisfaction. And the ongoing discussion of feeling versus technique might not be as relevant when regarding that the physical perception does not always equal reality. As stated in the introduction does the perception differ between favoured hands of the rider. So, if the technical product presents non-subjective data on the force in each rein, the rider can control their perception towards reality. This would make the rider improve their feeling and so technique and feeling does not compete but work together.

The ethical question of the project is already voiced and there are different opinions on whether a product such as this project's concept is good or bad for the horse welfare, even though a positive

opinion is expressed. When regarding the societal factor there are several factors to discuss. From a larger perspective it is of interest to modernise and make equestrian sports equal other sports. This would give more focus, time and money to the sport and legalise it in society. It is a sport that has many practitioners on all levels, of all ages and locations. Not until recent years have equestrian sports started to become the spotlight of media and societal benefits, and a modernisation and sportification of the sport would contribute to the societal ranking. From another perspective, such sportification and the use of technique could make the sport less accessible for everyone. Today already, the sport is expensive due to the nature of keeping and tending to large animals. This excludes people with less money to indulge in the sport and a possible career within it, even though everyone can enjoy the equestrian world on any level. To introduce even more technique and gadgets might not exclude people totally but increase the gap between people who can afford more technique and people who can't. The gap is present today regarding the number of available horse's, quality of horses, trainers and care for the horse(s). Technical gadgets are one more aspect that can improve performance for those who can afford it.

From an ecological perspective, more equipment means more materials, manufacturing and waste in circulation. Even though these aspects can be optimised holistically, the equation will most probably be negative when compared to no process at all. It all comes down to if the product can be motivated, if it is worth a negative environmental impact. What was the core of the concept? Well, to increase insight and improve performance, but also to prevent injuries. The insight helps the rider detect negative patterns and discover problems earlier than without the product. Less discomfort for the horse as well as the rider, together with an increased everyday wellbeing is enough to motivate the product for many. However, it might also decrease the need for treatments. Veterinary investigations are often complicated and long, treatments include surgery, antibiotics and other medications which is well known to come with risk both for humanity but also nature and animals. Often the horse needs to be transported long distances to a special veterinarian, more than once, which contributes to emissions and the need for fuel. So, all in all there are both ups and downs regarding the environmental perspective and there is no clear answer to whether the concept is motivated or not. It most probably varies from case to case, and it is up to each person to decide on their belief.

Future improvements

A major area that needs to be developed regarding the project concept is materials. These are vaguely specified and motivated with desired characteristics but not looked into deeply. Also, the prototype works to illustrate the practical functionality but the exact dimensions, materials and construction is not valid for a product to be safely and lastingly used in riding and stable contexts. This is a limit drawn consciously since focus has been on efficient user communication and a full perspective of the concept. When developing a more realistic prototype, it needs also be tested more thoroughly during ride to validate both communication, visibility and ease of use. Naturally, the app also needs to be connected and tested with the users.


8

8. Conclusion

The project concept consists of a sensor that measures the force in each rein and communicates the measured force to the rider in three ways. There is direct feedback that consists of continuous information through a LED light scale, indicating in steps how much force there is in each rein on a scale set by the rider. There is also a warning when the force exceeds a specific limit, which is conveyed both visually and (optionally) haptic to ensure the rider's attention. Then there is long term information which is provided through an app, an app that can present recorded data live during the ride but especially provides compilations and statistics over time. The combination of these communications is in writing moment unique when regarding the competitive market.

The combination of instant and long-term insight into habits and patterns for a horse and rider's training can ensure that negative impact is avoided and therefore prevent wear and injuries on both horse and rider. Also, as is the core of the concept and also communicated through the brand spirit is that increased insight into the art of riding can make training more efficient and therefore improve development and performance. That is, Aspire – insight for performance.

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Appendix A - Questionnaire riders

Do you ride the same horse(s) regularly?

- ❑ Yes
- ❑ No

How often do you ride the same horse?

- ❑ More than 5 times / week
- ❑ 2-4 times / week
- ❑ 1 time / week
- ❑ Less than 1 time / week

What disciplines(s) do you practice? (please choose all applicable answers)

- ❑ Dressage
- ❑ Jumping
- ❑ Other…

How old are you?

- ❑ Younger than 10 years old
- ❑ 10-20 years old
- ❑ 21-31 years old
- ❑ 31-40 years old
- ❑ 41-50 years old
- ❑ 51-60 years old
- ❑ More than 60 years old

Where do you live?

- ❑ Sweden
- ❑ Other…

How would you rate your level as a rider?

- ❑ Beginner
- ❑ Lower intermediate
- ❑ Higher intermediate
- ❑ Advanced
- ❑ Professional

Have you experienced a feeling of unevenness in the reins when riding?

- ❑ Yes
- ❑ No

If yes, have you tried to work towards a more even feeling over time?

- ❑ Yes
- ❑ No

If yes, did it work?

- ❑ Yes
- ❑ No

- ❑ Sometimes

If there was a product that could show you the force in each rein while riding…

...would you use it?

- ❑ Yes
- ❑ No
- ❑ Maybe

Why? Why not?

……

If yes, what would you mainly use it for?

- ❑ Long-term evaluation
- ❑ Direct feedback
- ❑ Both

If the rein forces could be stored in an app, what features would you like to have?

- ❑ Statistics
- ❑ Diagrams
- ❑ Profiles for different horses
- ❑ Rein forces connected to riding paths
- ❑ Other…

What potential benefits do you see for such a product, including an app?

……

What potential problems do you see for such a product, including an app?

……

List top three most important aspects for you to use such a product

……

……

……

Have you heard about such a product before?

- ❑ Yes
- ❑ No

Have you used such a product?

- ❑ Yes
- ❑ No

Appendix B - Questionnaire trainers

Do you ride the same rider(s) and horse(s) regularly?

- ❑ Yes
- ❑ No

How often do you train a rider? (Please choose all applicable answers)

- ❑ More than 5 times / week
- ❑ 2-4 times / week
- ❑ 1 time / week
- ❑ Less than 1 time / week

In what disciplines(s) do you train students? (please choose all applicable answers and add more disciplines if necessary)

- ❑ Dressage
- ❑ Jumping
- ❑ Other…

How old are you?

- ❑ Younger than 10 years old
- ❑ 10-20 years old
- ❑ 21-31 years old
- ❑ 31-40 years old
- ❑ 41-50 years old
- ❑ 51-60 years old
- ❑ More than 60 years old

Where do you live?

- ❑ Sweden
- ❑ Other…

How would you rate the level of your students? (Please choose all applicable answers).

- ❑ Beginner
- ❑ Lower intermediate
- ❑ Higher intermediate
- ❑ Advanced
- ❑ Professional

Have you experienced students and horses struggling with keeping the same force in both reins?

- ❑ Yes
- ❑ No

If yes, have you tried to help them towards a more even feeling either directly over time?

- ❑ Yes
- ❑ No

If yes, does it normally help?

- ❑ Yes

- ❑ No
- ❑ Sometimes

If there was a product that could show you the force in each rein of the rider and horse that you are training…

...would you use it?

- ❑ Yes
- ❑ No
- ❑ Maybe

Why? Why not?

……

If yes, what would you mainly use it for?

- ❑ Long-term evaluation
- ❑ Direct feedback
- ❑ Both

If the rein forces could be stored in an app, what features would you like to have?

- ❑ Statistics
- ❑ Diagrams
- ❑ Profiles for different horses
- ❑ Rein forces connected to riding paths
- ❑ Other…

What potential benefits do you see for such a product, including an app?

……

What potential problems do you see for such a product, including an app?

……

Please list top three most important aspects for you to use such a product.

……
……
……

Have you heard about such a product before?

- ❑ Yes
- ❑ No

Have you used such a product?

- ❑ Yes
- ❑ No

Appendix C - Data from riders' questionnaire

Do you ride the same horse(s) regularly? **(391 answers)**

Yes: **97,4%**
No: **2,6 %**

How often do you ride the same horse? **(390 answers)**

More than 5 times / week: **53,3 %**
2-4 times / week: **43,1 %**
1 time / week: **11,8 %**
Less than 1 time / week: **4,1 %**

What disciplines(s) do you practice? (please choose all applicable answers) **(388 answers)**

Dressage: **83,5 %**
Jumping: **39,9 %**
Other… **10,5 %**

How old are you? **(391 answers)**

Younger than 10 years old: **0,3 %**
10-20 years old: **21,5 %**
21-31 years old: **30,2 %**
31-40 years old: **17,1 %**
41-50 years old: **18,9 %**
51-60 years old: **10,2 %**
More than 60 years old: **1,8 %**

Where do you live? **(390 answers)**

Sweden: **97,4 %**
Other… (Finland, Norway, Åland, France, Denmark, Spain): **2,6 %**

How would you rate your level as a rider? **(391 answers)**

Beginner: **0,3 %**
Lower intermediate: **12,5 %**
Higher intermediate: **68,8 %**
Advanced: **16,6 %**
Professional: **1,8 %**

Have you experienced a feeling of unevenness in the reins when riding? **(391 answers)**

Yes: **89,3 %**
No: **10,7 %**

If yes, have you tried to work towards a more even feeling over time? **(363 answers)**

Yes: **96,7 %**
No: **3,3 %**

If yes, did it work? **(353 answers)**

Yes: **40,5 %**
No: **2,3 %**
Sometimes: **57,2 %**

If there was a product that could show you the force in each rein while riding…

...would you use it? **(390 answers)**

Yes: **35,9 %**
No: **13,3 %**
Maybe: **50,8 %**

Why? Why not? **(208 answers)**

See compilation of answers in the report.

If yes, what would you mainly use it for? **(320 answers)**

Long-term evaluation: **15,3 %**
Direct feedback: **24,1 %**
Both: **60,6 %**

If the rein forces could be stored in an app, what features would you like to have? **(351 answers)**

Statistics: **70,9 %**
Diagrams **49,9 %**
Profiles for different horses: **68,7 %**
Rein forces connected to riding paths: **56,1 %**
Other… **9,9 %**

What potential benefits do you see for such a product, including an app? **(194 answers)**

See compilation of answers in the report.

What potential problems do you see for such a product, including an app? **(174 answers)**

See compilation of answers in the report.

List top three most important aspects for you to use such a product **(173 answers)**

See compilation of answers in the report.

Have you heard about such a product before? **(388 answers)**

Yes: **74 %**
No: **26 %**

Have you used such a product? **(388 answers)**

Yes: **4,4 %**
No: **95,6 %**

Appendix D - Data from trainers' questionnaire

Do you ride the same rider(s) and horse(s) regularly? **(34 answers)**

Yes: **97,1 %**
No: **2,9 %**

How often do you train a rider? (Please choose all applicable answers) **(34 answers)**

More than 5 times / week: **2,9 %**
2-4 times / week: **38,2 %**
1 time / week: **64,7 %**
Less than 1 time / week: **35,3 %**

In what disciplines(s) do you train students? (please choose all applicable answers and add more disciplines if necessary) **(34 answers)**

Dressage: **88,2 %**
Jumping: **44,1 %**
Other… **26,1 %**

How old are you? **(35 answers)**

Younger than 10 years old: **0 %**
10-20 years old: **2,9 %**
21-31 years old: **34,3 %**
31-40 years old: **20 %**
41-50 years old: **28,6 %**
51-60 years old: **8,6 %**
More than 60 years old: **5,7 %**

Where do you live? **(35 answers)**

Sweden: **100 %**
Other…

How would you rate the level of your students? (Please choose all applicable answers). **(35 answers)**

Beginner: **48,6 %**
Lower intermediate: **85,7 %**
Higher intermediate: **71,4 %**
Advanced: **22,9 %**
Professional: **2,9 %**

Have you experienced students and horses strugglings with keeping the same force in both reins? **(35 answers)**

Yes: **100 %**
No: -

If yes, have you tried to help them towards a more even feeling either directly over time? **(35 answers)**

Yes: **100 %**
No: -

If yes, does it normally help? **(35 answers)**
Yes: **37,1 %**
No: -
Sometimes: **62,9 %**

If there was a product that could show you the force in each rein of the rider and horse that you are training…

...would you use it? **(35 answers)**
Yes: **57,1 %**
No: **5,7 %**
Maybe: **37,1 %**

Why? Why not? **(18 answers)**

See compilation of answers in the report.

If yes, what would you mainly use it for? **(31 answers)**
Long-term evaluation: **3,2 %**
Direct feedback: **19,4 %**
Both: **77,4 %**

If the rein forces could be stored in an app, what features would you like to have? **(32 answers)**

Statistics: **78,1 %**
Diagrams: **56,3 %**
Profiles for different horses: **62,5 %**
Rein forces connected to riding paths: **46,9 %**
Other… **9,3 %**

What potential benefits do you see for such a product, including an app? **(18 answers)**

See compilation of answers in the report.

What potential problems do you see for such a product, including an app? **(18 answers)**

See compilation of answers in the report.

Please list top three most important aspects for you to use such a product. **(17 answers)**

See compilation of answers in the report.

Have you heard about such a product before?

Yes: **17,1 %**

No: **82,9 %**

Have you used such a product?

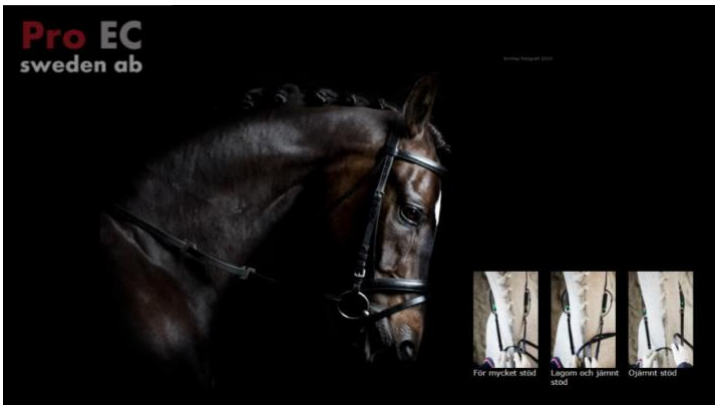
Yes: -

No: **100 %**

Appendix E - Competitor brand analysis

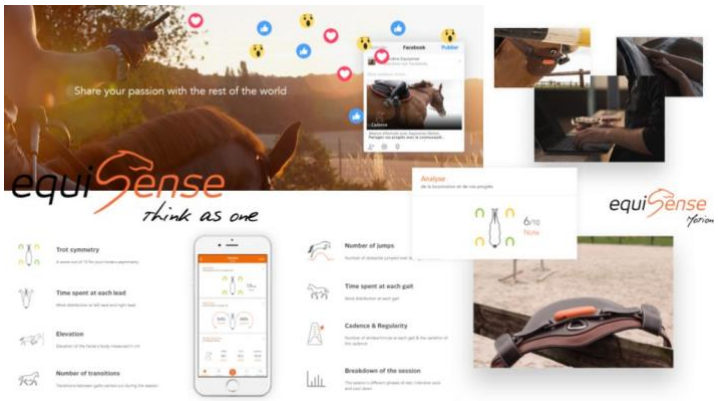
	FreeSense Solutions	IPOS	EquiSense	ProEC
Archetype	**Expertise** **Freedom**	**Expertise** Freedom Belonging	**Expertise** Freedom Dominance	**Dominance** Expertise Belonging
Target group	Sports interested, modern/adaptable to new technology.	Advanced riders, professional riders, competition.	Any rider.	Any rider.
Vision	Better and sustainable performance in sports or health through biometric sensing, e-coaching and feedback from social network.	Improve performance.	To better understand our horses, consciousness.	Get the most out of every rider and horse.
Purpose	Provide wearable sensing technology and white-label products to previously untapped sports.	Create insight in communication with horse to improve skill and accelerate performance.	Help riders progress.	Create smart and functional solutions in daily life with a horse.
Role	The early adapter, innovator.	The expert and guru, in control.	The passionate rider, horse lover.	The doer, hands on.
Relationship	Helping hand. Connection. Allows customer to reach IoT, connectivity.	The team leader that the customer listens to and follows.	Friend, on the same level.	Teacher, says what is right and what to do.
Diff competence	Connectivity, IoT.	Details, insight in many hidden factors.	Width. Displays "normal" factors in an efficient way that makes everyday training pictureable.	Simplicity.
Diff rat/func added values	App.	Look and design of rein device.	Exercise suggestions! Youtube channel with exercises.	Simple mechanical gadget easy to attach.
Diff personality	All-knowing helper.	Leader.	Friend, passionate horse lover.	?
Diff emotional value	Achievement.	Control.	Relationship with the customer.	Trust? Mechanical gadget.
Brand promise	None? Challenge your performance. Freedom, fast & flexible.	"We improve your riding performance"	"Think as one"	None? "We see possibilities and make them true"


FreeSense
Solutions
The unknown is stunningly clear


Pro EC
sweden ab
För mycket stöd
Lagom och jämnt stöd
Ojämnt stöd


Team
Training Schedule
Soundness
Rhythm
Straightness
Contact
Lightness

IPOS


Share your passion with the rest of the world
equiSense
think as one
equiSense
Trot symmetry
Time spent at each lead
Elevation
Number of transitions
Number of jumps
Time spent at each gait
Cadence & Regularity
Breakdown of the session

Appendix F - Morphological matrix

The morphological matrix consists of part functions stated in the left column. Next to each part function, horizontal rows of part solutions are placed. Some part solutions are further combined into 14 different combinations, hence the numbers in each box represent the combination of which they belong to.

Part functions	Part solutions									
continuously	 time intervals	 geographically	 request	all the time						
			5	1 4 7 8 9 11 12 14 14						
warning	 diff-erence	 total	 even							
	2 3 6 10	2 3 6 10	10 13							
auditory	 in-ear	 speaker								
	13	2 5								
haptically	 vibration	 heat	 texture	 rotation	 trans-lation	 shape	 weight			
	3 6									
visually	 led	 part of rein	scale	 intensity	 color	 screen				
	1 8 10	4	7 9 11	4 12	4 8 10	11 14 15				
placement	 rein	 device	 bracelet	 helmet	 gloves	 shoulder + arm	 saddle	 mane	 glasses	 wall
	1	2 10	3	5 13	12 14	6	7 8	9	15	11

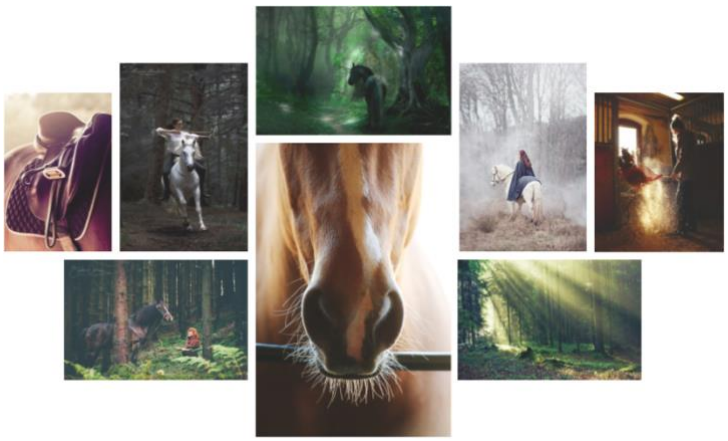
Appendix G - Weighted matrix

Solution	Main problem	Simplicity	Cost	Environment	Cognitive ergonomics	Physical ergonomics	Attention/Distraction	Score	Comment	Winners	New name
0	✓	✓	x	x	✓	x	x	3	complicated, expensive		
1	✓	✓	✓	?	✓	✓	✓	6	look down, separate parts?	☆	A
2	✓	✓	✓	?	✓	x	✓	5	differentiate sides, separate parts	☆	B
3	✓	✓	✓	?	✓	✓	✓	6	-	☆	C
4	✓	✓	x	?	✓	✓	✓	5	smart textiles expensive?	☆	D
5	✓	✓	x	?	x	x	✓	3	"help!" no visual interface		
6	✓	x	✓	?	✓	✓	✓	5	attach under clothes	☆	E
7	✓	✓	?	x	x	✓	✓	4	energy consumption		
8	✓	✓	?	?	x	✓	✓	4	saddle = legs?		
9	✓	✓	?	?	x	x	✓	3	fall off		
10	✓	✓	✓	?	✓	✓	✓	6	visibility?	☆	F
11	✓	✓	x	x	✓	✓	x	4	complex solution, distract horse and rider		
12	✓	✓	x	x	✓	✓	✓	5	wear, understanding	☆	G
13	✓	✓	✓	?	x	✓	x	4	fall out?		
14	✓	✓	x	x	✓	✓	x	4	distraction, complexity		

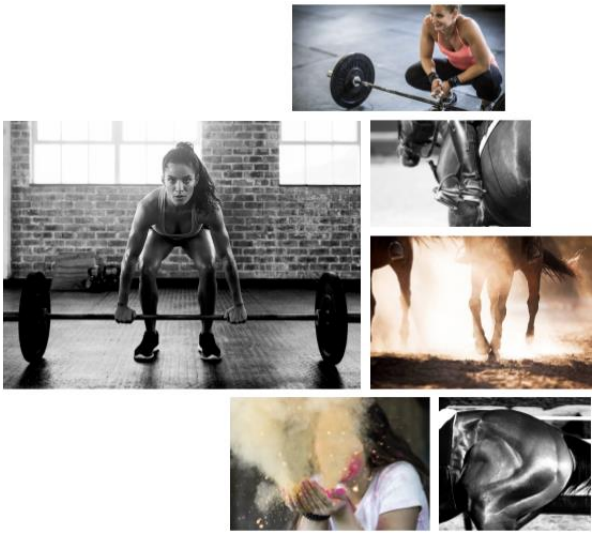
Appendix H - Concept screening matrix

Requirement	Weight	A	B	C	E	F	G
Be adaptable for different horses and/or riders	**1**	1	1	1	1	1	1
Not disturb horse and/or rider physically	**2**	2	1	2	2	2	2
Be possible to read information from a riding position	**2**	1	1	2	2	1	2
Be possible to handle with riding gloves	**1**	2	2	2	1	2	2
Be possible to clean	**1**	1	1	2	2	2	1
Withstand physical stress	**1**	2	2	2	2	2	1
Withstand long term wear	**1**	1	1	2	2	1	1
Easy to attach	**1**	2	2	2	0	2	1
Aim for medium economy tier	**1**	1	2	1	1	2	1
Allow for separation of materials and/or electronics	**1**	1	1	1	1	1	1
Provide an iconic product	**1**	2	2	2	0	1	2
Total 0		0	0	0	2	0	0
Total 1		6	6	3	4	5	7
Total 2		5	5	8	5	6	4
Total sum (sum of weight x point) out of 26		19	18	23	18	20	19
Rank		**3**	4	**1**	4	**2**	**3**
Develop further?		**Yes**	No	**Yes**	No	**Yes**	**Yes**

Appendix I - Moodboards



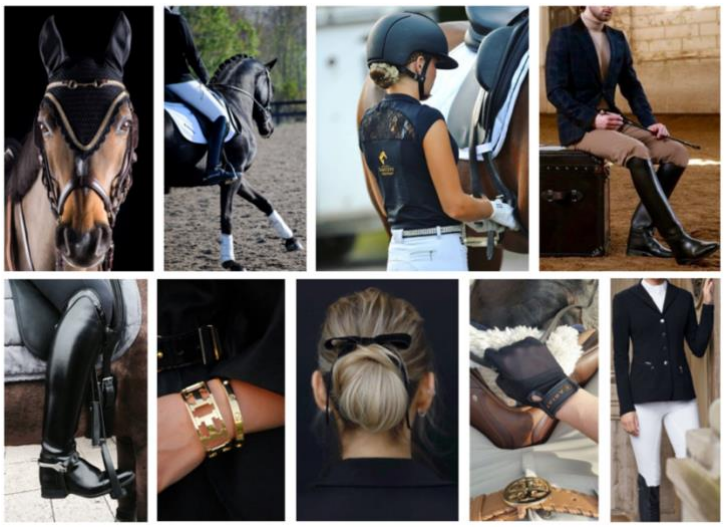
Saga theme.



Power theme.

Scandinavian minimalism theme.

Sports theme.



Elegance theme.

Classic theme.

English hunting theme.

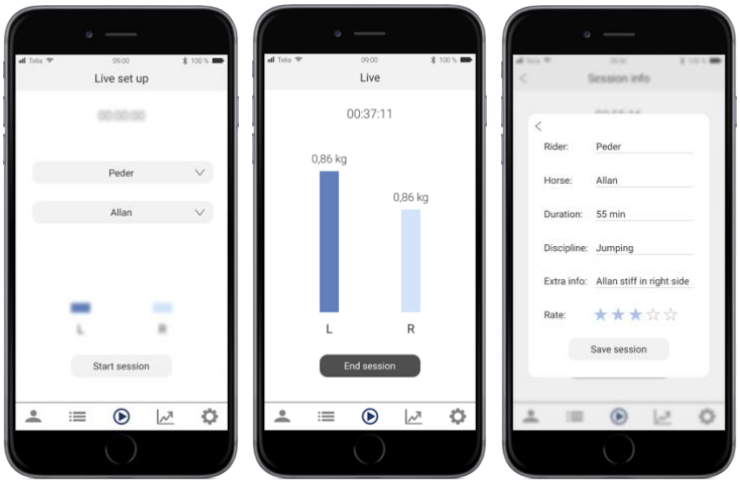
	Saga	Power	Scandinavian minimalism	Sport	Elegance	Classic	English hunting
Archetype	Freedom Belonging	Dominance	Freedom Expertise Cautiousness	Freedom Expertise	Freedom Dominance	Belonging Dominance	Belonging
Target group	Any rider but focus on everyday riders.	Any rider but focus on everyday riders.	Any rider but focus on everyday riders.	Any rider but focus on everyday riders.	Any rider but focus on everyday riders.	Any rider but focus on everyday riders.	Any rider but focus on everyday riders.
Vision	Improve knowledge and thereby increase performance and prevent injuries in both horse and rider.	Improve knowledge and thereby increase performance and prevent injuries in both horse and rider.	Improve knowledge and thereby increase performance and prevent injuries in both horse and rider.	Improve knowledge and thereby increase performance and prevent injuries in both horse and rider.	Improve knowledge and thereby increase performance and prevent injuries in both horse and rider.	Improve knowledge and thereby increase performance and prevent injuries in both horse and rider.	Improve knowledge and thereby increase performance and prevent injuries in both horse and rider.
Purpose	Provide immediate feedback during ride as well as long-term feedback for evaluation.	Provide immediate feedback during ride as well as long-term feedback for evaluation.	Provide immediate feedback during ride as well as long-term feedback for evaluation.	Provide immediate feedback during ride as well as long-term feedback for evaluation.	Provide immediate feedback during ride as well as long-term feedback for evaluation.	Provide immediate feedback during ride as well as long-term feedback for evaluation.	Provide immediate feedback during ride as well as long-term feedback for evaluation.
Role	The dreamer.	The determined.	The balanced.	The dedicated.	The tasteful.	The reliable.	The conservative.
Relationship	Makes you dream.	The pushing and almost aggressive trainer that never lets you rest.	Being a passive and calm assistant, always there to support but making no noise.	One in the dedicated team around the horse and rider as a sports team.	The paid agent supporting your choices.	The childhood friend that you know thoroughly.	The close relative you take for granted.
Diff competence	Understandability.	Understandability.	Understandability.	Understandability.	Understandability.	Understandability.	Understandability.
Diff rat/func added values	Immediate feedback during ride.	Immediate feedback during ride.	Immediate feedback during ride.	Immediate feedback during ride.	Immediate feedback during ride.	Immediate feedback during ride.	Immediate feedback during ride.
Diff personality	Open minded, imaginative.	Confident and determined.	Confident and thorough, yet humble and attentive.	Competent, focused and pushing the edge.	Proud and independent.	Established, respected and genuine.	Genuine, generous and honest.
Diff emotional value	Customer feeling uplifted and spirited.	Customer feeling strong and in control.	Customer feeling safe, calm and in control.	Customer feeling increased team spirit and determination.	Customer feeling fulfilled, superior.	Customer feeling safe and respected.	Customer feeling relaxed and confident.
Brand promise	We make your dream come true.	We make you perform.	We have got your back.	Insight for performance.	We are the cherry on the top.	We are the safe card.	We are the loyal friend.

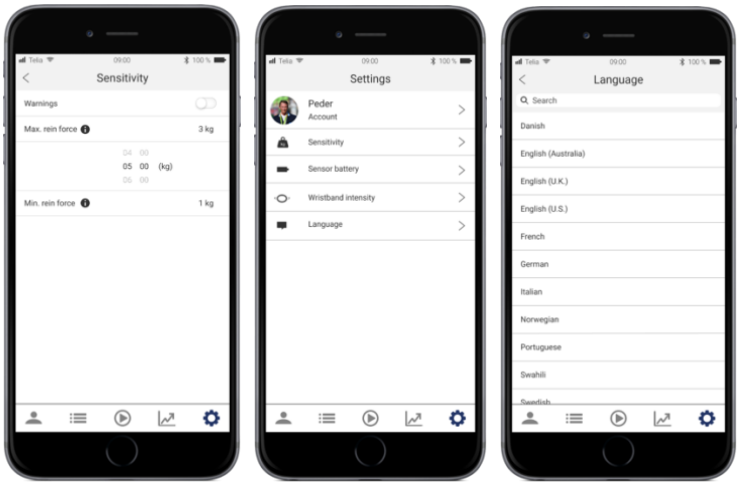
Appendix K - Requirement fulfilment

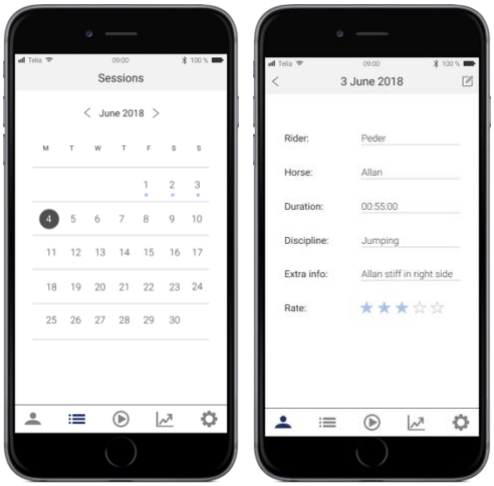
No	R/W	Requirement	Explanation	Fulfils
		Main requirements		
1	♕	Measure the force in each rein		5
2	♕	Communicate the measured force		5
		General		
3	R	Allow immediate feedback	Rider and/or trainer should be able to read information in real time during ride.	5
4	R	Store information	Rider and/or trainer should be able to read information post ride.	5
5	R	Be adaptable for different horses and/or riders	One rider might ride several horses, or one horse might be ridden by several riders.	5
6	R	Not disturb horse and/or rider physically	Neither affect movements, distract or hurt.	5
7	W	Encourage rider's feeling	Not constrain plus communicate that product is compliment to basic horse knowledge.	?
8	R	Allow for reading real time information without app		5
9	R	Be possible to read information from a riding position		4
10	R	Be possible to read information from a distance of <20 m	For trainers.	5
11	R	Be possible to adjust from a riding position	If adjustable.	5
12	R	Be possible to adjust from the ground	When dismounted and/or for trainer.	5
13	R	Be possible to handle with riding gloves		5
14	R	Ensure safe product-user interaction	Handling of product should not impact the present safety level.	5
15	R	Be possible to clean	Product should withstand leather soap, conditioner and disinfectant.	?
16	R	Consist of durable materials	Product withstand for example rain, wind, humidity, dust, cold, heat, sunshine, mud and sweat.	?
17	R	Withstand physical stress	Such as vibrations, bumps and direct forces.	?
18	W	Withstand long-term wear		?
19	R	Fit all English standard equipment		5
20	R	Easy to attach	Regarding time, number of steps, technique and understanding.	3
21	R	Allow use by ages 10+		5

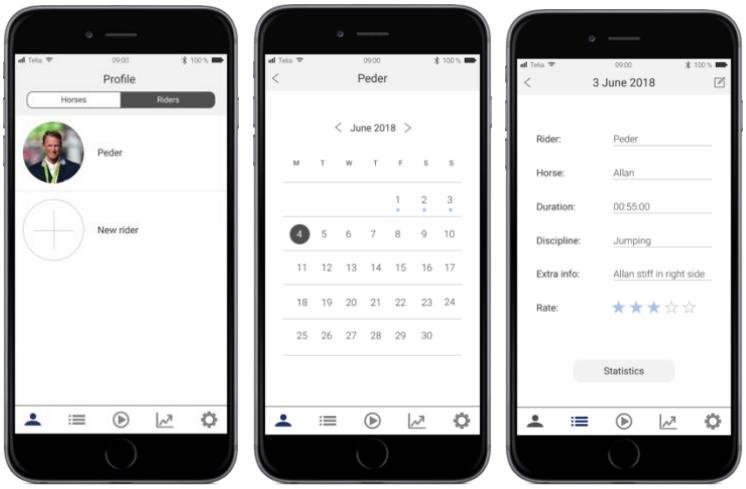
22	R	Provide Swedish and English language options	For international use.	5
23	R	Allow storage		5
24	R	Allow transportation	By foot, bike and in car.	5
25	R	Belong to economy tier and price range	To be used by everyday riders, wide target group	3
26	W	Have exchangeable parts	For longer lifetime, easy maintenance.	4
27	W	Allow for separation of materials and/or electronics	For sustainable disposal.	3
28	W	Be easy to setup	Regarding time, number of steps, technique and understanding.	3
39	R	Follow graphical guidelines	See graphical guidelines in section 2.7	5
30	R	Be communicated uniformly	Graphically for app, brand strategy and physical product.	5
31	R	Have a differentiating factor	Concerning the competitors and the present market.	5
		App specifics		
32	R	Be compatible for Android and iOS		5
33	R	Allow use for several horses		5
34	R	Allow use for several riders		5
35	R	Allow for evaluation of feeling		5
36	R	Allow for tracking information over time		5
37	R	Allow for adding information	Such as treatments, special occasions, weather factors etc.	5
38	R	Allow for importing information later	After ride, after charge, when connection available etc. See "use product without phone".	5
39	R	Allow for importing information immediately	Real time during ride.	5
40	W	Allow for exporting information		5

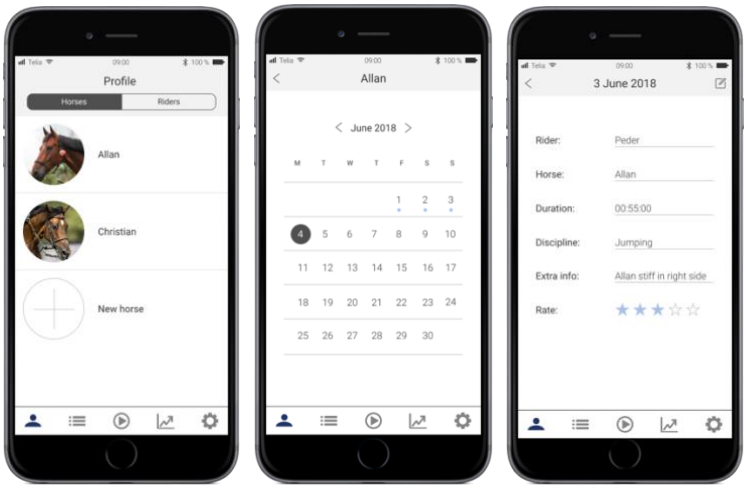
Appendix L - App

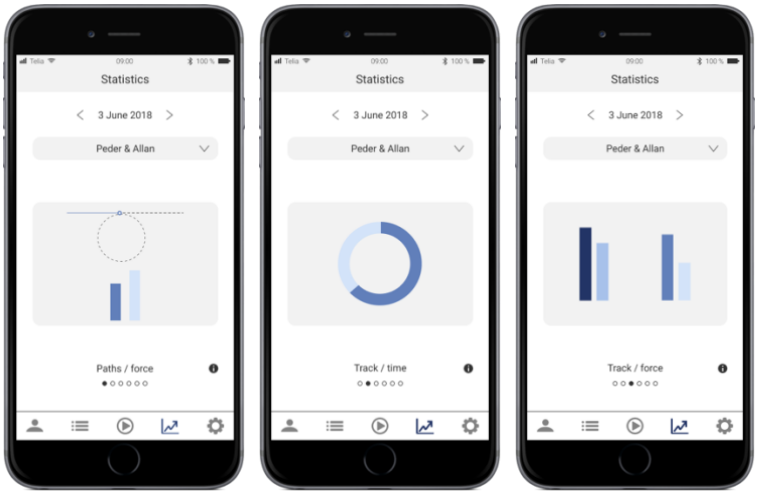


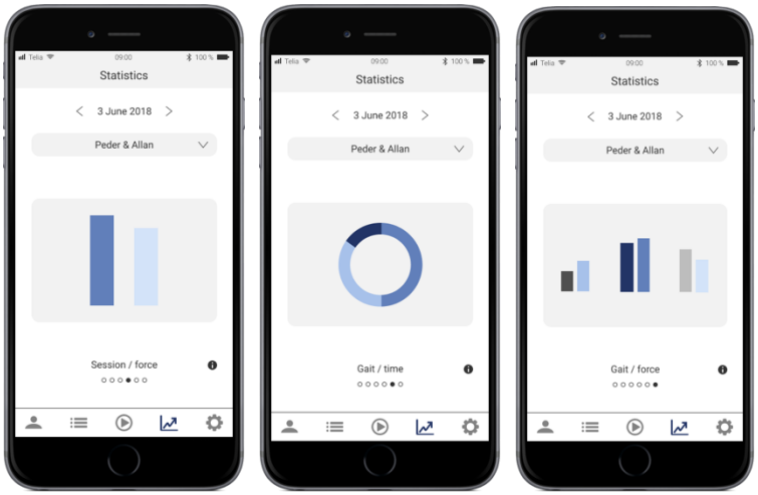



Sessions
June 2018
3 June 2018
Rider: Peder
Horse: Allan
Duration: 00:55:00
Discipline: Jumping
Extra info: Allan stiff in right side
Rate:


Profile
Horses
Riders
Peder
New rider
Peder
June 2018
3 June 2018
Rider: Peder
Horse: Allan
Duration: 00:55:00
Discipline: Jumping
Extra info: Allan stiff in right side
Rate:
Statistics


Profile
Horses
Riders
Allan
Christian
New horse
Allan
June 2018
3 June 2018
Rider: Peder
Horse: Allan
Duration: 00:55:00
Discipline: Jumping
Extra info: Allan stiff in right side
Rate:


Statistics
3 June 2018
Peder & Allan
Paths / force
Statistics
3 June 2018
Peder & Allan
Track / time
Statistics
3 June 2018
Peder & Allan
Track / force


Statistics
3 June 2018
Peder & Allan
Session / force
Statistics
3 June 2018
Peder & Allan
Gait / time
Statistics
3 June 2018
Peder & Allan
Gait / force


3 June 2018
Riding paths and forces
00:15:00
00:55:00
Rein forces (kg)
3 June 2018
Riding paths and forces
Hi!
Slide one of the dots to choose a precise time and position of your riding path.
See the rein forces connected to the chosen path at the bottom section.
3 June 2018
Distribution of track time
Left track
40%
Right track
60%
This week
3 June 2018
Rein forces for each track (kg)
Left track
Right track
This week


3 June 2018
Rein forces during session (kg)
0,89
0,62
L
R
This week
kg
1
0,5
M T W T F S S
3 June 2018
Distribution of gaits
Canter
30%
Walk
50%
Trot
30%
This week
%
100
50
M T W T F S S
3 June 2018
Rein forces for each gait (kg)
0,30
0,40
0,65
0,70
0,60
0,50
L R
Walk
Trot
Canter
This week
kg
1
0,5
M T W T F S S

Appendix M - Prototype Arduino code

```
const int sensorPin = A0;

void setup(){
   Serial.begin(9600); //open a serial port
   for(int pinNumber = 2; pinNumber<11; pinNumber++){
     pinMode(pinNumber, OUTPUT);
     digitalWrite(pinNumber, LOW);
   }
}

void loop(){
 int sensorVal = analogRead(sensorPin);
 Serial.print("Sensor Value: ");
 Serial.print(sensorVal);
 // convert the ADC reading to voltage

 float voltage = (sensorVal/1024.0) * 5.0;
 Serial.print(", Volts: ");
 Serial.print(voltage);
 Serial.print(", degrees C: ");
 //convert the voltage to temperature in degrees
// float temperature = (voltage - .5) * 100;
 Serial.println(voltage);

 if(voltage <= 0){
   digitalWrite(2, LOW);
   digitalWrite(3, LOW);
   digitalWrite(4, LOW);
   digitalWrite(5, LOW);
   digitalWrite(6, LOW);
   digitalWrite(7, LOW);
   digitalWrite(8, LOW);
   digitalWrite(9, LOW);
   digitalWrite(10, LOW);

 }else if(voltage > 0 &&
    voltage <= 1.5){
   digitalWrite(2, HIGH);
   digitalWrite(3, HIGH);
   digitalWrite(4, HIGH);
   digitalWrite(5, LOW);
```

```
  digitalWrite(6, LOW);
  digitalWrite(7, LOW);
  digitalWrite(8, LOW);
  digitalWrite(9, LOW);
  digitalWrite(10, LOW);

 }else if(voltage > 1.5 &&
  voltage <= 3){
  digitalWrite(2, HIGH);
  digitalWrite(3, HIGH);
  digitalWrite(4, HIGH);
  digitalWrite(5, HIGH);
  digitalWrite(6, HIGH);
  digitalWrite(7, HIGH);
  digitalWrite(8, LOW);
  digitalWrite(9, LOW);
  digitalWrite(10, LOW);

  }else if(voltage > 3 && voltage <=4.5){
  digitalWrite(2, HIGH);
  digitalWrite(3, HIGH);
  digitalWrite(4, HIGH);
  digitalWrite(5, HIGH);
  digitalWrite(6, HIGH);
  digitalWrite(7, HIGH);
  digitalWrite(8, HIGH);
  digitalWrite(9, HIGH);
  digitalWrite(10, HIGH);

   }else if(voltage > 4.5){
  digitalWrite(2, LOW);
  digitalWrite(3, LOW);
  digitalWrite(4, HIGH);
  digitalWrite(5, LOW);
  digitalWrite(6, LOW);
  digitalWrite(7, HIGH);
  digitalWrite(8, LOW);
  digitalWrite(9, LOW);
  digitalWrite(10, HIGH);
  }
delay(1);
```