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Exxentric Strength Row

Investigating the usefulness of an add-on product for flywheel-based strength training

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by

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Exxentric Styrkerodd – Undersökning av användarbarheten hos en tilläggsprodukt för svänghjulsbaserad styrketräning

Jonathan Henriksson

Godkänt	Examinator	Handledare
2018-10-08	Claes Tisell	Teo Enlund
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	Exxentric AB	Fredrik Correa

Sammanfattning

Intresset för svänghjulsträning har på senare år ökat avsevärt bland idrottare och tränare världen över på grund av de fördelar det medför jämfört med traditionell viktträning. Företaget *Exxentric* tillverkar svänghjulsbaserad styrketräningsutrustning och undersökte möjligheterna att utöka antalet övningar som gick att utföra med deras enheter. Främst sittande styrkerodd hade identifierats och det fanns ett intresse att utveckla en tilläggsprodukt (add-on) för att utöka deras kBox-plattform.

För att undersöka om det var möjligt för *Exxentric* att styrka sin verksamhet genom en add-on för sittande styrkerodd så utforskade detta arbete användbarheten hos en sådan add-on produkt. Detta gjordes genom att, på ett användarcentrerat sätt, utveckla en prototyp samt genom att utveckla en uppsättning riktlinjer för produktdesign som implementerades på konceptet för prototypen.

Förundersökningen bestod av marknadsanalyser, enkätundersökningar, platsobservationer samt åtta stycken intervjuer. Data analyserades därefter i tre omgångar för att generera insikter vilket slutligen kunde sammanställas till fem huvudkategorier att ta hänsyn till- och utvärdera mot under konstruktionsarbetet. Kategorierna var: justerbarhet, stabilitet, hållbarhet, hanterbarhet och prestanda.

Konstruktionsprocessen utfördes därefter med kategorierna som utgångspunkt och fokuserade på att designa en sits, fotstöd, höjdjustering, balk, stödben samt ett gränssnitt mot kBoxen.

Det slutgiltiga konceptet för add-on produkten var 2212 mm långt och 593 mm högt i monterat skick. Förutom att förse användare med bättre möjligheter att utföra en sittande styrkerodd än någon befintlig enhet i sortimentet så var det även möjligt att utföra ytterligare fyra övningar på den.

Under konstruktionsarbetets gång så behövde flertalet avvägningar göras för att anpassa add-on produkten för kBoxen vilket påverkade både funktionaliteten och den övergripande designen. Det borde undersökas om add-on produkten kan tillföra värde och uppfylla ställda användarkrav i större utsträckning om den skulle konstrueras för den horisontella enheten i *Exxentrics* sortiment snarare än den vertikala. Med användarnas krav på produkter inom det valda segmentet, elitidrottare, borde även möjligheten att konstruera en egen enhet för sittande styrkerodd övervägas eftersom antalet avvägningar som behöver göras skulle minska och därmed bidra till en bättre styrkerodd.

För att besvara vare sig *Exxentric* kan styrka sin verksamhet med en add-on produkt för sittande styrkerodd så rekommenderas det att företaget utvecklar en beta-prototyp som kan användas vid ytterligare tester med den tilltänkta målgruppen. När väl användbarheten för en sådan produkt fastställts så bör den utvärderas gentemot de olika kundsegmenten samt existerande och framtida produkter.

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Jonathan Henriksson

Approved	Examiner	Supervisor
2018-10-08	Claes Tisell	Teo Enlund
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	Exxentric AB	Fredrik Correa

Abstract

Flywheel resistance training have in recent years become increasingly popular among athletes and coaches globally due to the advantages it provides over traditional strength training with weights. *Exxentric*, a company developing flywheel-based equipment for strength training and was looking to further increase the number of exercises that could be performed with their devices. Primarily, seated strength row exercises had been identified as a gap and there was a desire to develop an add-on product to extend their kBox device platform.

To see if *Exxentric* could strengthen their business with an add-on for seated strength row, the thesis aimed to investigate the usefulness of such an add-on product. This was done through a user-centered design approach constructing a prototype and by developing a set of product design guidelines to be implemented on the prototype concept.

The research for the user-centered design included market analyses, site observations and eight semi-structured interviews. Research data was analysed for three rounds to gain insights, ultimately generating five main themes to consider and evaluate against during the construction process. The main themes were *adjustability*, *stability*, *durability*, *manageability* and *performance*. With the themes in mind, the construction process was carried out for the add-on with focus on designing a seat, foot support, height setting, beam, leg and an interface towards the kBox.

The final concept for the add-on measured 2218 mm long and 593 mm high when assembled. In addition to providing better possibilities for seated strength rows than any existing device within the product line, it also allowed for an additional four exercises to be performed with it.

During construction, several trade-offs had to be made to adapt towards the kBox, affecting the overall functionality and construction of the product. It should be considered if the add-on could provide value and fulfil user needs to a higher degree if it is developed for *Exxentric's* device for horizontal exercises rather than its machine for vertical exercises. Furthermore, considering the high standards of the chosen user segment, performance sports athletes, it could also be considered to develop a stand-alone device for seated strength rows, thus decreasing the number of trade-offs needed to be made when adapting to an existing device.

To properly answer if *Exxentric* can strengthen their business with an add-on for seated strength row, it is recommended that *Exxentric* develop a beta-prototype which can be used to further evaluate the usefulness of an add-on for seated strength row. Once the usefulness of the add-on to the kBox have been established, its place in the product line should be considered with regard to the different user segments as well as existing- and future devices.

Foreword

This project has been carried out as a Master of Science Thesis project in Industrial Design Engineering as a part of the degree programme Design and Product Realisation at KTH Royal Institute of Technology in Stockholm, Sweden.

During the course of this project, many have contributed with their time, knowledge and assistance. Given the opportunity, I would therefore like to thank a number of people for the contribution that they made.

Everyone at Exxentric, with special thanks to the entire R&D team and my supervisors, Fredrik Correa and Salli Carlfjord.

I would also like to thank all participants in the interviews, especially Daniel Landin, Madeleine Hagberg and Dennis Ulfsmar.

Last but not least I thank Teo Enlund, my supervisor at KTH, for the guidance he provided throughout the entire project.

Thank you!

Jonathan Henriksson

Stockholm, October 2018

Nomenclature

Add-on	An additional piece of equipment.
Cardio rower	Exercise aimed at increasing a person's stamina.
Concentric motion	Contraction that shortens the muscle.
Design Platform	A document containing information and guidelines for product design.
Drive Belt / Belt	The belt that is attached to the shaft of a flywheel device.
Eccentric motion	When an active muscle is lengthening under load.
Flywheel	Revolving wheel specifically designed to store rotational energy.
Form language	Visual perception of an object.
Inertia	Resistance of an object to any change of its velocity.
kBox	Exxentric's main device for vertical exercises.
kPulley	Exxentric's device for horizontal exercises.
Kinetic energy	The energy of an object in motion.
Performance sports	Sports that can be performed at an elite level.
Persona	Fictional character that act as a representation of a customer.
Proof-of-concept	Prototype that demonstrates that a design concept is feasible.
Pulley	Rotational wheel over which a belt or rope is pulled.
Sheet metal	Metal formed into thin sheets that can be cut and bent.
Strength row	Exercise aimed at increasing a person's strength.
User-centered design	Design process involving the intended user during the development.
User	The person using the piece of equipment.

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Appendices

1 Introduction

This thesis report describes the investigation into the usefulness of a flywheel-based add-on product for seated strength row that was carried out at Exxentric AB in Stockholm, Sweden. This chapter introduce the background, purpose, delimitations and methodology of the project.

1.1 Background

Strength training, also known as weight- or resistance training, is beneficial for people of all ages to perform. This physical activity aims to enhance muscular fitness and is proven to benefit the heart, bones, balance as well as weight loss. Muscle strength is imperative for athletes in performance sports, during rehabilitation after an injury and to simply make day-to-day tasks easier. Muscles grow stronger by training them specifically against an external load, creating a resistance that can be provided by free-weights, weight machines, the user's body weight or the inertia of a flywheel (Iliades, 2018).

Flywheel resistance training have in recent years become increasingly popular among athletes and coaches globally due to the advantages it provides over traditional strength training with weights. The history of flywheel training dates back as far as a century when physiologists at the University of Copenhagen began studying its effects. However, it was not until the 1980's that a proper use was found for flywheels in resistance training when scientists tried to solve the issue of muscle atrophy during space travel (Correa, 2018).

Exxentric is an international company founded in 2011 which develops flywheel-based methods and equipment for strength training. The kBox was the first product released by *Exxentric* and is still the most eminent in their product line. It has been continuously improved upon and have been released in several different models with the kBox4 Pro as their premium flywheel device currently being sold on the market (Correa, 2018), see Figure 1.1.

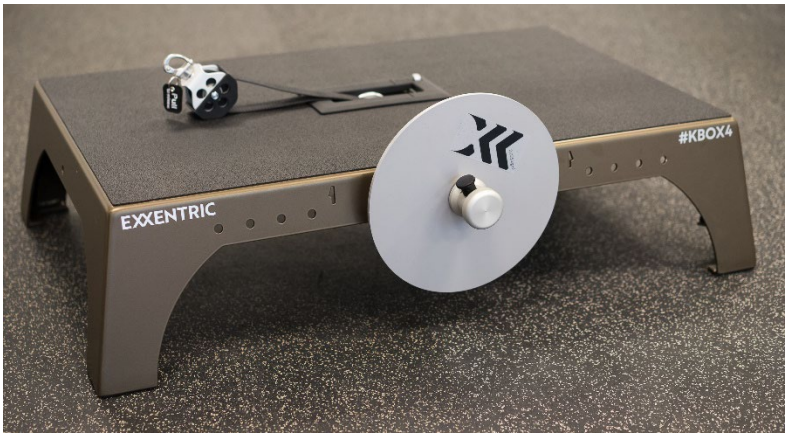

Figure 1.1. Exxentric's premium flywheel device, the kBox4 Pro.

1.1.1 Vertical motion

The kBox4 is sold in three variants, for different customer segments: kBox4 Pro, Lite and Active, which differ in size, price and performance. The Pro model is the largest, most versatile and highest priced device and is compatible with the widest range of flywheel inertia. The Lite model differs from the active mainly by being lighter and its capability to hold more flywheels (Exxentric, 2018), see Appendix A. All kBox devices are optimised for vertical exercises and allows for a vast number of exercises for both the upper- and lower body and is compatible with a range of accessories (Exxentric 2018), see Figure 1.2.

Figure 1.2. Deadlifts being performed on the kBox4 Pro with the kBar accessory.

When the kBox4 is shipped, a tool kit is included in the shipment for the customer to use for assembly upon arrival or for repairs if worn out parts needs to be replaced, see Figure 1.3.

Figure 1.3. Tool kit included in with every kBox 4 shipment.

1.1.2 Horizontal motion

The kPulley is Exxentric's device optimised for horizontal exercises, it is mounted on a wall or a rack and works with the same flywheels as the kBox. The position to pull from is adjusted with a knob on the sliding pulley part, allowing users to adjust the height for different exercises or change the optimal settings for users of various height (Exxentric, 2018), see Figure 1.4.

Figure 1.4. User performing a horizontal exercise with the kPulley.

1.1.3 Accessories

In order to allow for a wider variety of exercises being performed on the flywheel devices, *Exxentric* manufactures a range of accessories. Handheld accessories include the kBar and kGrips, see Figure 1.5.

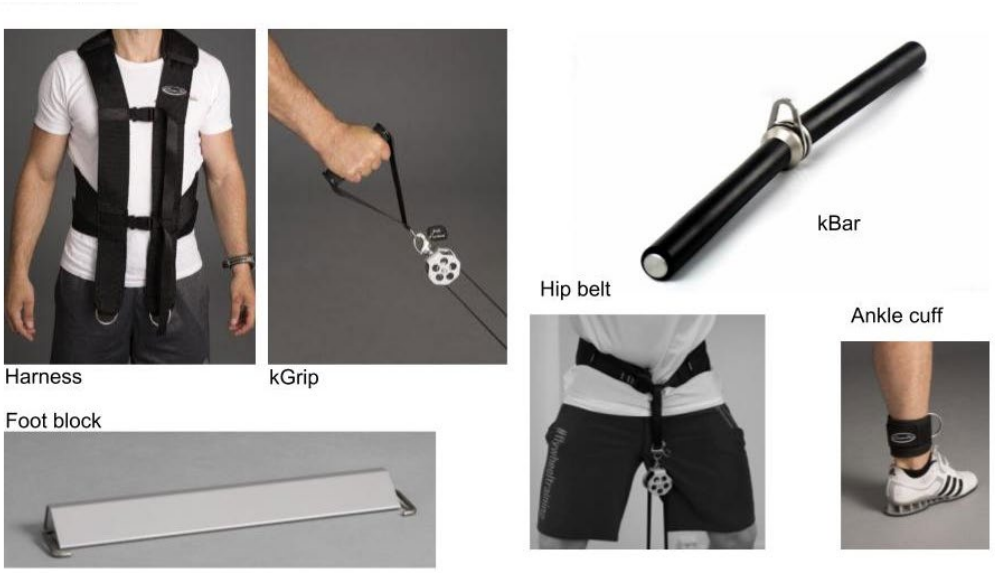

Figure 1.5. The main accessories in Exxentric's product range.

Furthermore, it includes some which are worn on other parts of the body and does not need to be held by hand, such as a harness, hip belt and ankle cuffs, see Figure 1.5.

An additional feature exists within the product range in the shape if a feedback device called the kMeter. All devices, apart from the kBox4 Active, are equipped with a kMeter system which provides users with direct feedback of their training. As the resistance in flywheel training cannot be measured by a weight being lifted, the kMeter monitors power and energy based on the inertia of the flywheels and gives an estimate of the force during training (Exxentric, 2018).

1.1.4 Further development

Apart from the existing devices and accessories in *Exxentric's* current product line, flywheel training would be beneficial for several exercises for which the current devices not are optimised for. Primarily, seated strength row exercises have been identified as a gap and the desire exists within the company to develop an add-on product to extend the kBox platform by enabling these types of exercises, see Figure 1.6.

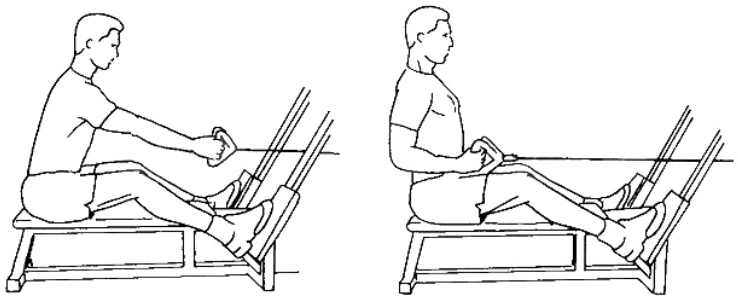

Figure 1.6. The principle motion of a seated strength row exercise.

In addition to developing further products that enable more exercises to be performed in flywheel training, *Exxentric* also aims to strengthen their brand through the implementation of a deliberate visual brand language in their product line. Rather than intuitively making design decisions for individual products, a standardized way of designing could create further recognition and provide benefits for further market growth (Chiu, 2016).

1.2 Purpose

The overall question to be answered concerning the add-on product was if it was possible for *Exxentric* to strengthen their business by introducing such a product, allowing for seated strength rows to be performed on the kBox4. Thus, to properly answer this question, the main objective for this thesis project was to investigate the usefulness of a flywheel-based add-on product for seated strength row. This in order to see to what extent it can fulfil user needs and how it will fit into *Exxentric's* current product line, see Figure 1.7.

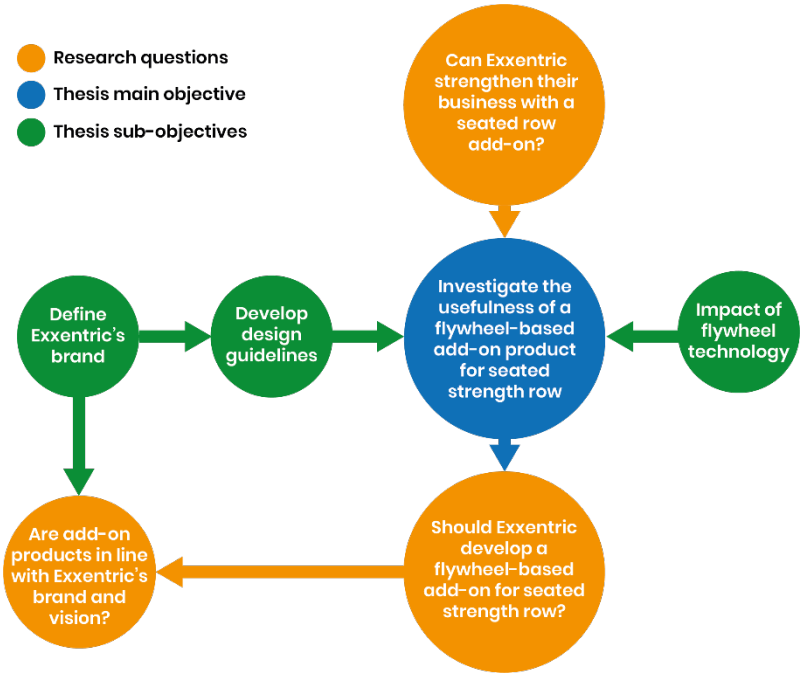

Figure 1.7. The project outline originating from the question if it is possible for Exxentric to strengthen their business by introducing a seated row add-on in their product line.

Once this investigation is completed, and if the conclusion is that *Exxentric* can strengthen their business with an add-on product for seated rows, then it needs to be considered if *Exxentric* should develop the product for the market. Which in turn can be answered by deciding if add-on products are in line with the company's brand and vision, see Figure 1.7.

To ensure that the main objective provides a basis good enough to build upon for the future work of fully answering the research questions, some sub-objectives were included as part of the thesis. With *Exxentric's* desire to implement a visual brand language, sub-objectives to define the brand and to build a set of design guidelines from this was included as well as to explore the impact of flywheels in seated strength row, see Figure 1.7. With the overall purpose in mind, this thesis therefore aimed to investigate:

- What should a visual brand language for *Exxentric* communicate and how should it manifest in product design?
- How can a flywheel add-on product for seated strength row be designed to fulfil user needs?
- How should the visual brand language of *Exxentric* be implemented in the product design of such an add-on product?

1.3 Delimitations

The company's scope was to fully investigate if this product should be developed and launched on the market. However, the time frame for the thesis project was set to 20 weeks, which limited the project delivery to conduct the investigation of the product's potential usefulness and to provide a conceptual suggestion for the development of a next generation prototype. Furthermore, the conceptual suggestion for a prototype should not require any changes to be made on any existing devices and the project of was to be performed without rethinking the current design of the kBox4.

A rough proof-of-concept prototype existed at the start of the project and was used as a base to evaluate the add-on concept against other possible way to perform seated strength rows on *Exxentric's* devices. Thereafter, to ensure that the final delivery did not lock towards existing norms within the company, the development work was carried out mostly independently from already existing prototypes and ideas. The sole exception being to reuse the metal beam structure of the proof-of-concept as a base to build the new prototype on.

With regard to *Exxentric's* confidentiality, the full Design Platform containing the product branding and design guidelines will not be presented. Some insights and results from the development process of the Design Platform will be presented. However, the visual material from the design guidelines is confidential and only key points from the guidelines will be presented. The final concept for the add-on product will be presented, where listed key points from the guidelines will highlighted to exemplify how the implementation of the guidelines impacted the result.

Although it was possible to perform several additional exercises on the add-on product apart from seated strength row, it was kept as the principal exercise to optimise for throughout the project. In some cases when an additional exercise benefitted from a feature to be designed a certain way, and it did not conflict with the functionality of the add-on as a strength row or with the design guidelines, it was considered for implementation.

1.4 Methodology

Throughout the thesis included three main stages of development was carried out. The work did not occur in chronological order as some aspect were overlapping and carried out simultaneously. The three stages could be described as:

- Development of a Design Platform, including product branding and design guidelines.
- User-Centered design- and construction of the add-on product aimed at enabling seated strength row on the kBox.
- Implementation of the design guidelines the add-on product.

Conducting the research for the product branding and researching the rower market was to some extent carried out in parallel with each other as some input from either area of research generated insights for both the branding as well as the construction. After both research phases were concluded, the insights generated for the user-centered design phase was compiled and the Design Platform was created before the construction phase was initiated.

Thereafter, the construction and user-centered design phase of the add-on was carried out together with the implementation of the design guidelines for a more integrated development process.

1.4.1 Survey

As a part of the research for defining *Exxentric's* brand, two brief survey enquiries were launched using Google forms. One was sent out in-house at the company and the other was sent to resellers of *Exxentric*. The surveys were kept brief in order to generate a high response rate and anonymous to encourage honest answers. They consisted of four questions for the in-house survey which generated 14 answers and three questions for the reseller survey, generating 11 answers.

In-house, the survey enquiry focused on how employees would describe the company- and its products using three words, defining what the company was selling and to answer which products two products they associated the most with the company, see Appendix B.

Resellers answered similar questions using three words to describe the company *Exxentric* and its products respectively. They were likewise asked to name the two products they mostly associated with the company, see Appendix C.

The results from the two surveys were used to strengthen the understanding of how *Exxentric's* brand was currently perceived and the differences that might exist between how the company is viewed internally and externally. Furthermore, the results were used as a base for discussions with parts of *Exxentric's* management for process of defining the brands outspoken vision and mission.

1.4.2 User-centered design

The methodology of user-centred design includes design processes being based on a deep understanding of user needs and environments. It is an iterative process in which users' needs act as the basis of requirements for products (usability.gov, 2018).

This process was used throughout the thesis and started with user studies to generate insights and to create and understanding of the context. This later made it possible to specify product requirements based on user needs which was considered when solutions were constructed or designed. After which the solutions could be evaluated together with intended users and against the established user needs. From the results of the evaluations, further iterations occurred until results of the solutions were satisfactory, consistent with the user-centered design approach (Hudson, 2018), see Figure 1.8.

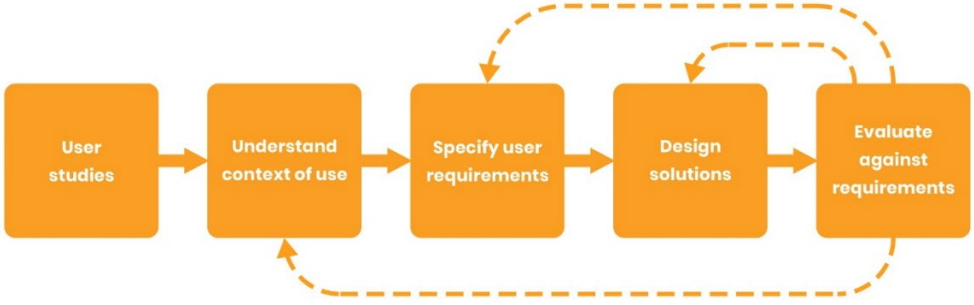

Figure 1.8. Illustrates the iterative user-centered design process during the project.

The user studies for this project consisted of eight semi-structured, contextual interviews (Milton, Rodgers, 2013) carried out in a gym environment with respondents ranging from end-users to gym owners according to:

- Four experienced people in training. *
- Three licensed personal trainers.
- One gym owner.

** The people interviewed during their training sessions all had a minimum four years of prior experience in strength training and experience using strength row machines and cardio rowers.*

The interviews were carried out in four different gyms in the Stockholm region and focused on exercise techniques during rowing exercises, opinions on existing equipment and how, when and why rowing exercises was performed as part of the respondents- or their clients training, see Appendix D. They information gathered was used partly for the research for the Design Platform and mainly for the rower add-on research.

In addition to the interviews, two observational sessions of three hours each, in two different gyms was carried out. During the observations written notes were taken and the focus was on users performing seated rowing exercises on strength row machines or cardio rowers. 34 User's posture, equipment, movements, motions and actions during the different phases of performing the exercise was observed for 3- 10 minutes each, varying with each individual.

Key behaviours observed, and opinions expressed during interviews were written on post it notes and clustered according to common themes to gain insights from. Post-it notes were rearranged for three iterations with the first round focusing on gaining insights regarding different features. The second round focused on actions performed and potential risks associated with the exercise and the possible addition of a flywheel resistance whilst the final round was mapped linearly and focused on gaining insights of points to consider for an add-on product aimed at seated strength rows.

1.4.3 Collaboration with Exxentric teams

Information was also gathered through interviews, workshops and discussions with key individuals at *Exxentric*. Several decisions could be made based on information obtained during these interactions by utilizing the already existing knowledge within the company. This included:

- Workshops, exercises and discussions with 1-7 participating members of the Research & Development team.
- Interviews, meetings and discussions held with 1-4 members of the management team.
- Interviews, discussion and through documentation provided by the Sales & Marketing team.

2 Frame of reference

The theoretical framework on which the thesis was based is presented during this chapter. It includes an introduction to flywheel training and some of the benefits flywheel training provide over traditional strength training with weights. Moreover, it covers the basics of two different types of seated rowing exercises: Seated strength row and seated cardio row. Lastly, it covers what a visual brand language is, and why it is important.

2.1 Flywheel in training

Flywheel training is a training form during which the inertia of a spinning wheel or disc is used to create the resistance rather than lifting weights towards the gravitational pull (Boije, Jönsson, 2015). The wheel accelerates as the body part connected to the strap unwinds it from the axis during the concentric phase of the movement. Once the movement is completed, and the strap fully extended, the flywheel continues to rotate, thus rewinding the strap around its axis which forces the person performing the exercise to deaccelerate the wheel during the eccentric phase of the movement (Berg, Tesch, 1996), see Figure 2.1.

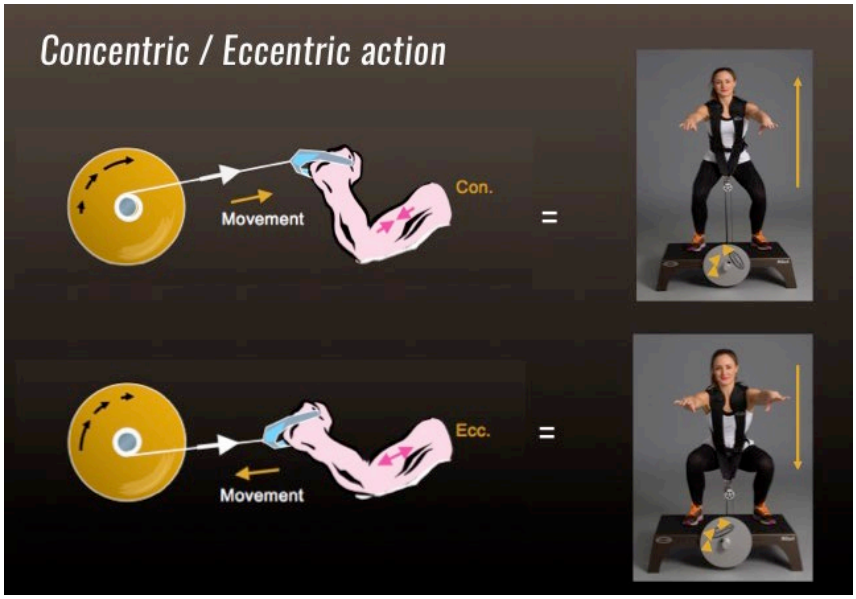

Figure 2.1. The unwinding (concentric phase) and winding (eccentric phase) of a strap connected to the axis of a flywheel during training.

The muscle force used to accelerate the flywheel is stored as rotational energy, or kinetic energy, in the flywheel. This means that the kinetic energy loaded during the concentric phase of the motion determines the force necessary for the deacceleration of the flywheel. In other words, the force the user pulls with is the same as the flywheel pulls back with (Exxentric, 2018).

Figure 2.2. Illustrates the flywheel workout zones depending on the level of inertia in the flywheel and speed of the motion.

The two things determining the kinetic energy stored in the flywheel are the angular velocity and the inertia of the wheel. Inertia is best described as *"The moment needed to reach a desired angular acceleration around a given rotational axis."* (Boije, Jönsson, 2015) and is in turn varying with the mass and radius of a disc (Boije, Jönsson, 2015). Therefore, the level of inertia is what determines the resistance during flywheel training and can be altered using different sized flywheels depending on the goal with the exercise, see Figure 2.2.

Muscles are generally stronger during the eccentric phase of a motion compared to the concentric phase. During traditional weight training with weights it is, however, problematic to achieve a high enough resistance to maximize the effects during the stronger eccentric phase as users often are limited by what they can lift during their concentric phase (Maroto-Izquierdo et al., 2017).

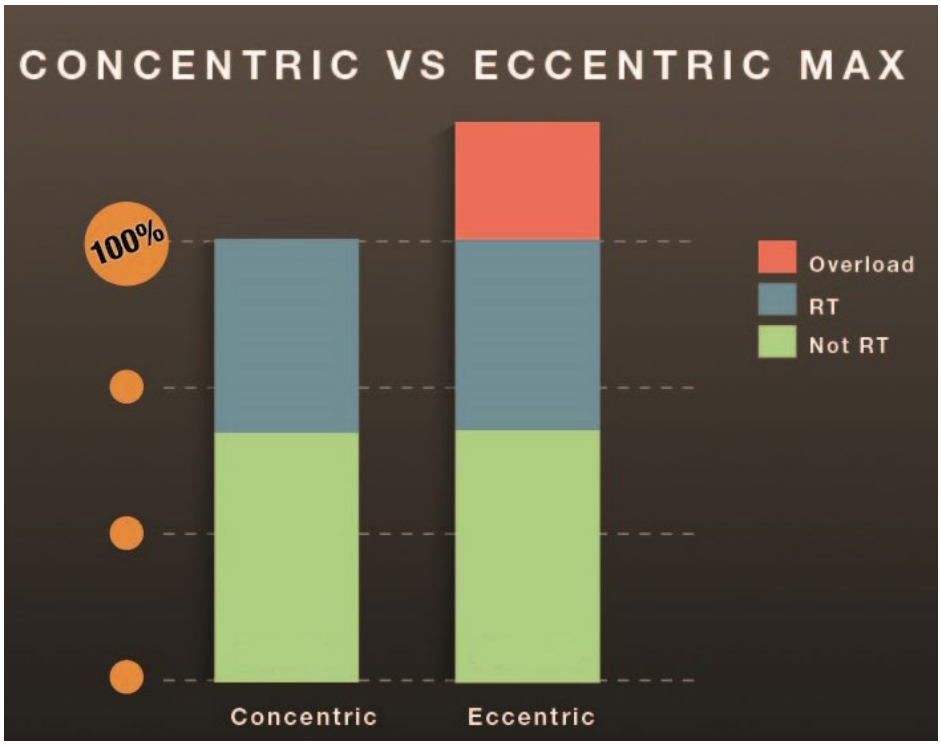

Figure 2.3. By counteracting all the stored kinetic energy loaded during the concentric phase for a shorter part of the eccentric motion it is possible to create an eccentric overload.

A unique feature of flywheel training is that the stored energy in the flywheel can be disposed freely during the eccentric phase of a motion. The user can, without assistance, refrain from deaccelerating the flywheel during the initial part of the eccentric motion, thereby acquiring a larger resistance during a brief period when the eccentric force exceed the concentric force, i.e. eccentric overload (Norrbrand et al., 2010), (Berg, Tesch, 1996), see Figure 2.3.

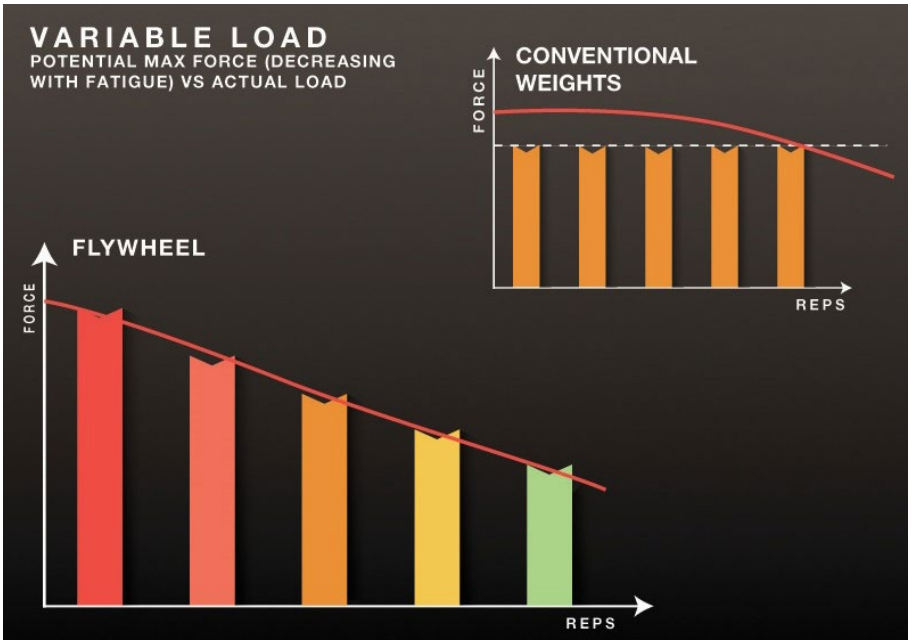

Figure 2.4. Every repetition during an exercise can be maximal with flywheel training due to the variable resistance, unlike with conventional weights.

Another key feature when training with flywheel devices is that it enables varying resistance between repetitions. When the user's own force decides the level of resistance during the motion, every repetition can be performed at max force for a user. Whilst multiple repetitions with conventional weights require the use of a weight less than the user's maximum in order for the user to perform multiple repetitions (Correa, 2018), see Figure 2.4.

2.2 Seated rowing exercises

When it comes to performing seated rowing exercises there are two basic types of machines it can be performed on. Both machines are designed to allow for a similar pulling motion and are commonly found in most gyms.

2.2.1 Seated strength row

Seated rows are part of the basis for many athletes training programs. It is an effective strength-training exercise for the back muscles which primarily engages the latissimus dorsi, rhomboideus, posterior deltoids, biceps brachii and trapezius (Nolte, 2013), see Figure 2.5.

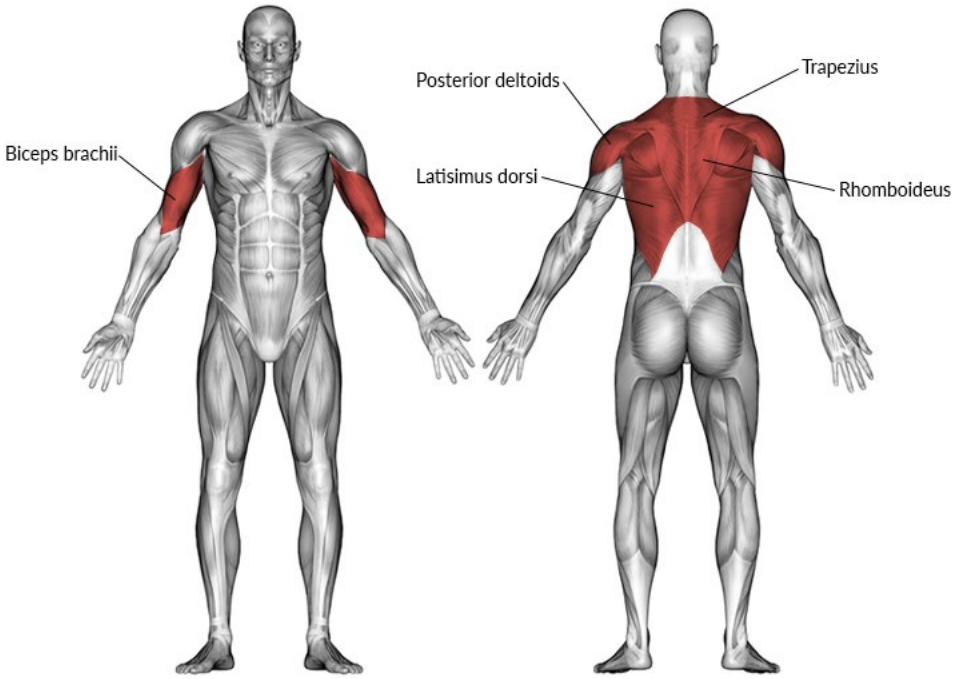

Figure 2.5. Muscles primarily activated during seated rowing training.

The movement is performed in a seated position with the feet placed on a foot plate and the legs kept in a locked position, slightly bent throughout the motion. At the start of the motion the person training holds the grip with straight arms and the upper body tilted forward, see position 1, Figure 2.6. From the starting position, a rowing motion is performed by raising the back straight up followed by a pull with the elbows until the grip reaches the torso (Richter, 2016). as in position 2, see Figure 2.6. Repeat until the desired number of repetitions is reached and the set is finished.

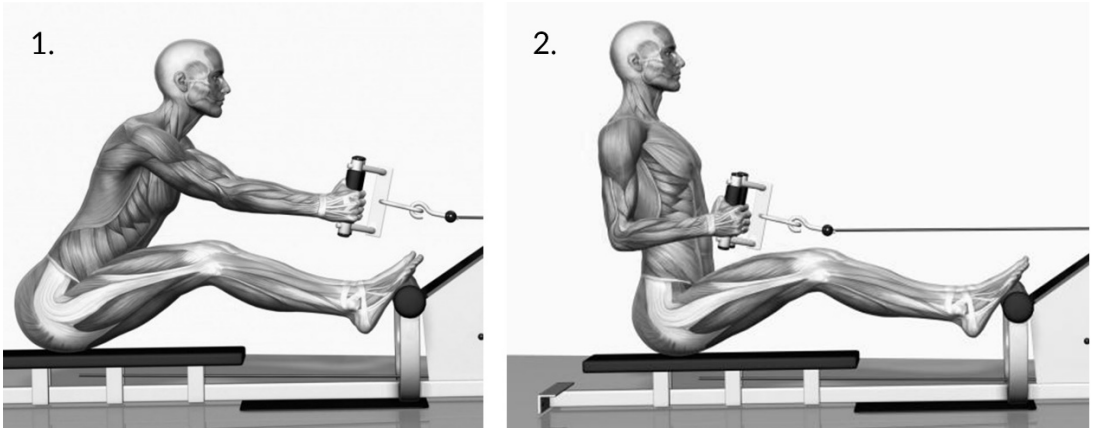

Figure 2.6. Lean forward until position 1 is reached, thereafter raise the back and drag the arms towards the body, as in position 2, and the movement is completed.

2.2.2 Seated cardio rowing

Most cardio rowers aim to simulate the movement and feel of sweep rowing on water. It is a similar motion to the strength row exercise, however, it activates a larger part of the body in comparison due to the sliding seat which enables a pushing- and pulling motion with the legs as a part of the overall movement in the exercise (Baum, 2017), see Figure 2.7.

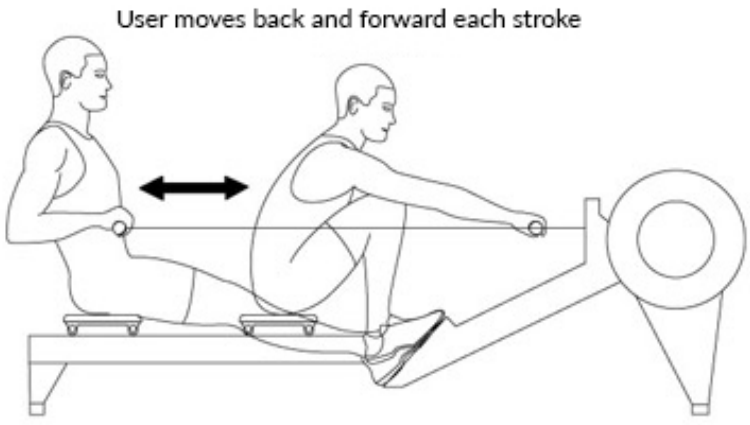

Figure 2.7. The feet are fixed, and the seat is moving along the frame during the movement.

Unlike seated rowers with weight stacks, cardio rowers do not offer sufficient resistance to be considered strength training devices. Instead the main objective for using a cardio rower is to increase the overall level of cardiovascular fitness (Mulrooney, 2017).

As the thesis project aimed to investigate the usefulness of an add-on product for strength training, the purpose of a seated cardio rower, to mainly increase the level of cardiovascular fitness was not prioritized. However, a flywheel-based device has differences compared to a weight-based device for strength row. Therefore, it was of interest to study certain features of the seated cardio rower such as the motion and construction in order to keep an open mind and not to lock towards existing norms with the seated strength row.

2.3 Visual Brand Language

A company's brand can be described as the gut feeling a person have regarding the company. When enough individuals have the same gut feeling of a company, the company have a brand (Neumeier, 2005). By extension, a brand is not defined by the company but by people viewing it. The company, however, can influence people's perception of the brand through their communication and products.

A visual consistency, which is linked to a company's brand values, is important in a product line as the physical products of a company acts as an extension of the brand itself. The visual brand language is used to create a resemblance between products and too differentiate within a market and often includes product's shapes, materials, colour and composition (Chiu, 2016).

The visual aspects of a brand language are based on the company vision and brand promise. Thus, it is necessary to first define what the company vision and brand stands for. Therefore, before creating the visual brand language, the brand needs to be defined to know what to communicate. Vision, core values, market, identity and target audience are all important to define as parts of the brand (Chiu, 2016).

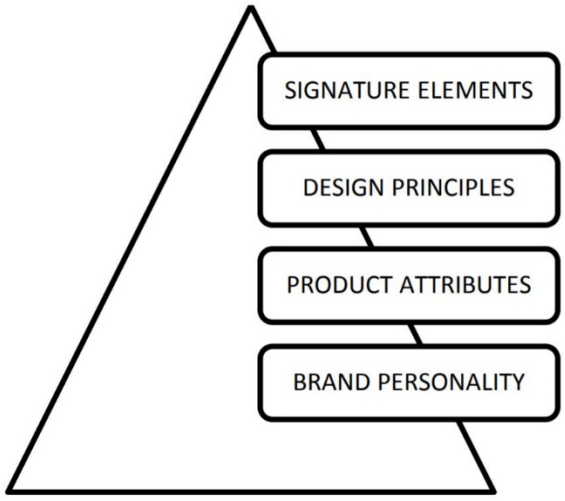

Figure 2.8. Value hierarchy depicting the creation of a visual brand language.

Design elements are based on principles and product attributes which in turn are derived from the brand personality of the company, see Figure 2.8.

3 Defining the brand

In order to create a visual brand language for Exxentric, a Design Platform was developed to be used as a tool when designing Exxentric's physical products. It consisted of two parts, where the first part covered the brand and was aimed at communicating the overall feeling of what Exxentric is. It ensured that products communicate what Exxentric, as a company, stands for and acted as a reference to evaluate products against to see if they were in line with what Exxentric stands for. The full presentation of Exxentric's brand included in the Design Platform is confidential. However, the process, of defining Exxentric's brand, is presented throughout this chapter.

3.1 Market analysis

The form language and visual appearance of companies' products on the flywheel- and rower (strength and cardio) market was analysed in six different categories. In five categories, conclusions were made based on objective observations and the last category was subjectively assessed. The categories were:

Objective:

- Material
- Colour
- Branding
- Coherence
- Aesthetics

Subjective:

- Perceived feeling of form language.

A more general analysis was made of products on the gym machine market and on the rower market, strength and cardio alike. Additionally, for the gym- and rower analysis, information gathered from the interviews during the user studies provided further insights and was used as part of the analysis.

3.1.1 Flywheel training market

In total, seven companies active in the flywheel training market was analysed. Some of the companies analysed had products similar to *Exxentric's* in which case the *Exxentric* product line was used as a reference to distinguish the separation and similarities of the companies' products, see Appendix E.

Material

A majority of the analysed brands used metal as the main material in their flywheel products. It is functional to use metal for the base as it is durable and strong enough since the devices need to be able to handle high loads and force during training. Aluminium and steel are the most prominent metals and were often used in their "raw" form, untreated or uncoated. The top part that users, in most cases, stand on was always coated or enforced with another material, like a rubber carpet or in some cases another metal sheet with a structured surface. To cover the top part could also have been functional as metal surfaces tend to be slippery, especially when wet and transfer vibrations more clearly than with an absorbing layer in between.

Colour

The general trend is to work with basic colours for frames and larger surfaces, such as black and grey thus drawing attention to highlighted features with visible colours like red, orange or bright blue, see Appendix E.

Figure 3.1. Desmotec uses grey for frames and highlight elements with red.

For example, *Desmotec* uses grey metal frames and surfaces and highlight the base, flywheel and pulleys with red, see Figure 3.1.

Branding

There were a lot of emphasis on the flywheel in devices designs. *Spacewheel* used it for their signature hypnosis pattern while *Desmotec*, *nHance* and *isoinercial* highlight it with their respective signature colours. Additionally, it is a common place for logos to be placed, see Appendix E.

Figure 3.2. Proinertial allows the conical shaft to be in focus of their device rather than the flywheel.

When it came to flywheel devices using a conical shaft in favour of a straight shaft, the main focus tended to be put on the cone rather than the flywheel in order to differentiate from the straight shafts, see Figure 3.2.

Add-ons such as handlebars and harnesses were often similar in shape with slight variations in colour and materials used. Logos were often placed on them and in some cases the company's signature colouring took place as well, see Appendix E.

Coherence

Coherence was created using framework and colouring mostly. Companies used the same shape, thickness and colour on frames. Some used the same recurring shapes in their designs. For example, *Desmotec* had a chamfered profile and *Proinertial* used half-circles to round corners, see Figure 3.3.

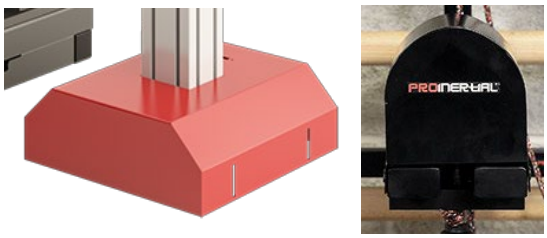

Figure 3.3. The shapes used by Desmotec (left) and Proinertial (right) to create coherence within the product portfolio.

Aesthetics

In general, there was a boxy look over several of the flywheel devices (stacked boxes, low boxes, elevated boxes) causing them to look heavy. They looked stale with sharp edges and chamfered or straight corners.

Subjective

The products often gave an overall feeling of being technological and looked closer to prototypes than user-friendly products. They were unintuitive as to how to use them and had an industrial look and feel. Many looked like workshop machines more suited for manufacturing than a gym or sports facility. By colouring the flywheels with clearly visible colours, the main focus was put on the flywheels to convey performance and to make the hard and tough as possible besides that, see Appendix E.

3.1.2 Gym machines

Concerning gym machines aimed at strength training, there were some general trends of using metal framework with welded corners and colouring being used to make certain features stand out more, see Appendix F. Some products that conveyed strength, stability and power by using broad metal frames with key areas highlighted in colour and designs putting a lot of emphasise on the weight being lifted, see Figure 3.4.

Figure 3.4. Gym machine with wide beams, highlighted key areas and weight that need to be put on manually.

There was also a segment of more discrete gym machines that enclosed the weight stack, had more rounded corners and more discrete colouring looking more inviting and more suited for rehabilitation centres for example, see Figure 3.5.

Figure 3.5. A more discrete gym machine with rounded features and hidden weight stack.

During the interviews, it was stated that rowing machines, both for strength and cardio, were perceived as industrial, dull or boring when there was too much grey metal surfaces. On the other hand, darker units, usually black, were perceived as more elegant, tougher and cleaner. Cleaner machines, without too many visible components appeared to be attractive as it looked more serious when it was perceived as a single unit rather than a system of components, see Figure 3.6.

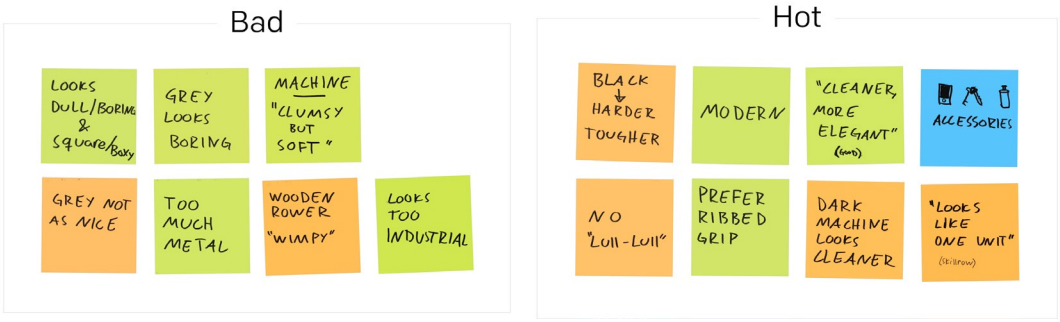

Figure 3.6. The negative and positive opinions on rowing machine appearances expressed during interviews.

3.2 Positioning

During a workshop with the Research and Development team at *Exxentric*, the company's position on two different markets, the "Strength business" and the "Flywheel business", was analysed in order to investigate the company's unique selling points. The results from the workshop was thereafter analysed to gain insights that could be used to inform product design.

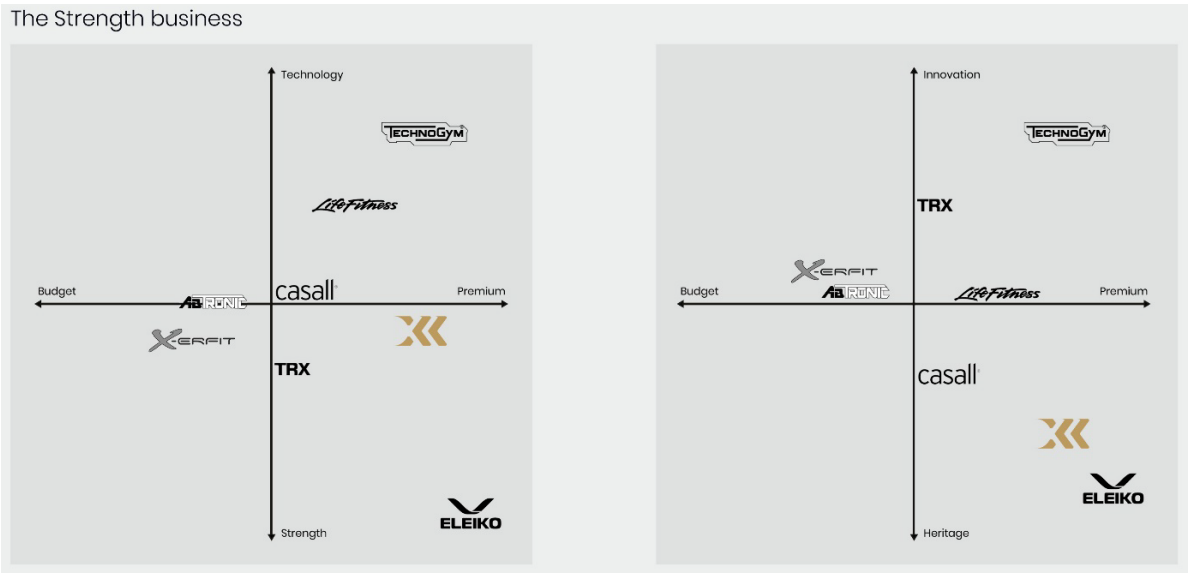

Figure 3.7. Exxentric's position in the Strength training business on a Budget- Premium/ Strength/ Technology map and a Budget- Premium/ Heritage- Innovation map.

Compared to other companies in the strength business on a Budget- Premium/ Strength- Technology map, *Exxentric* was considered a premium brand and a strength brand with a technological aspect to it in the form of the "flywheel technology" and the kMeter in their devices. It was considered to be associated with a heavy workout among people who know the brand and have used the product, see Figure 3.7.

Eleiko was an example of a brand with a richer heritage and a higher premium stamp, see Figure 3.7, towards which *Exxentric's* competitive edge lied within the flywheel technology. Therefore, the flywheel itself should be considered an integral part to be addressed in the design guidelines. However, *Exxentric's* products must not necessarily compete in an either/or way with the likes of *Eleiko*. Rather, it can be a great compliment to traditional weight training,

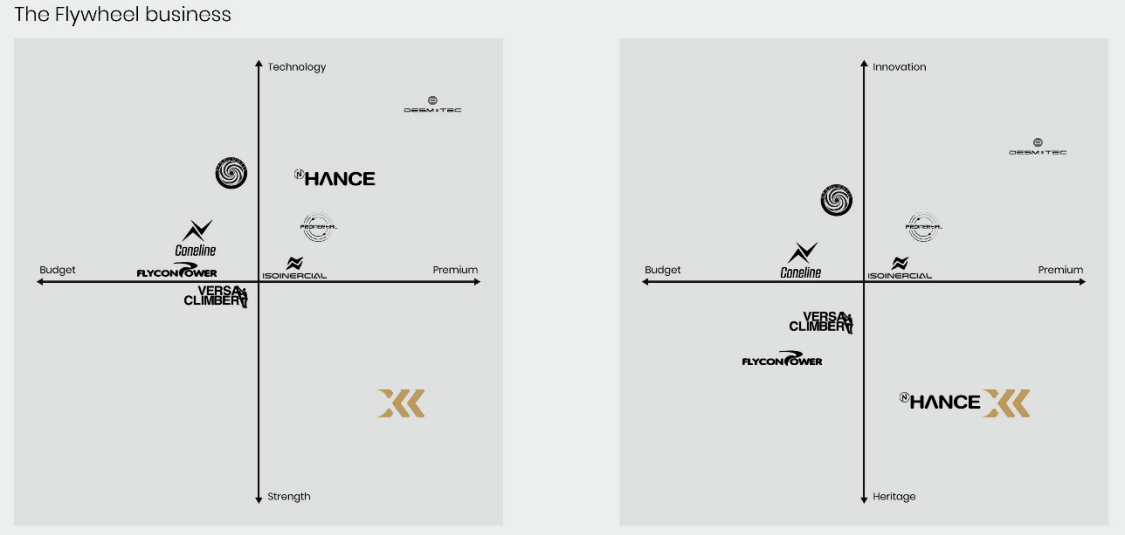

Figure 3.8. Exxentric's position in the Flywheel training business on a Budget- Premium/ Strength/ Technology map and a Budget- Premium/ Heritage- Innovation map.

For the second round of the workshop, the context was changed from the strength- to the flywheel business. Among flywheel companies, *Exxentric* was considered to currently hold an unchallenged position as the only flywheel company having a brand which was considered both premium and strength. Although it was not considered the most premium brand, it was still regarded as a high-quality brand, see Figure 3.8.

Exxentric was one of the few brands with some form of flywheel heritage. *FlyconRower* had an Italian heritage but not really a flywheel training backstory. *nHance* and *Exxentric* have a very similar heritage and backstory but were separated by *Exxentric* being considered more of a strength brand whilst *nHance* was perceived as more technological, see Figure 3.8. *Exxentric* gained legitimacy from its relatively rich heritage of developing flywheel training devices compared to its competitors.

3.3 Survey comparison

To further strengthen the understanding of how *Exxentric's* brand was perceived, a two-piece investigative survey enquiry was conducted. One was sent out in-house at the company, which received 14 answers and the other was sent to resellers of *Exxentric* that received 11 answers.

3.3.1 Survey results

Given the narrow selection of responses, there were still some results that stood out. "Innovative" was the most widely mentioned word in both surveys when describing *Exxentric* as a company. Employees of *Exxentric* also associate the company with "Strength" and "Premium", two words absent among the reseller's descriptions of the company, see Figure 3.9.

Figure 3.9. Word clouds depicting words mentioned in surveys to describe Exxentric as a company.

Concerning *Exxentric's* products, there was a clear perception of them being "Effective". Furthermore, *Exxentric's* employees associated their own products with "Quality" and "Premium" whilst the resellers viewed them as more "Functional" and connected to "training" besides being effective, see Figure 3.10.

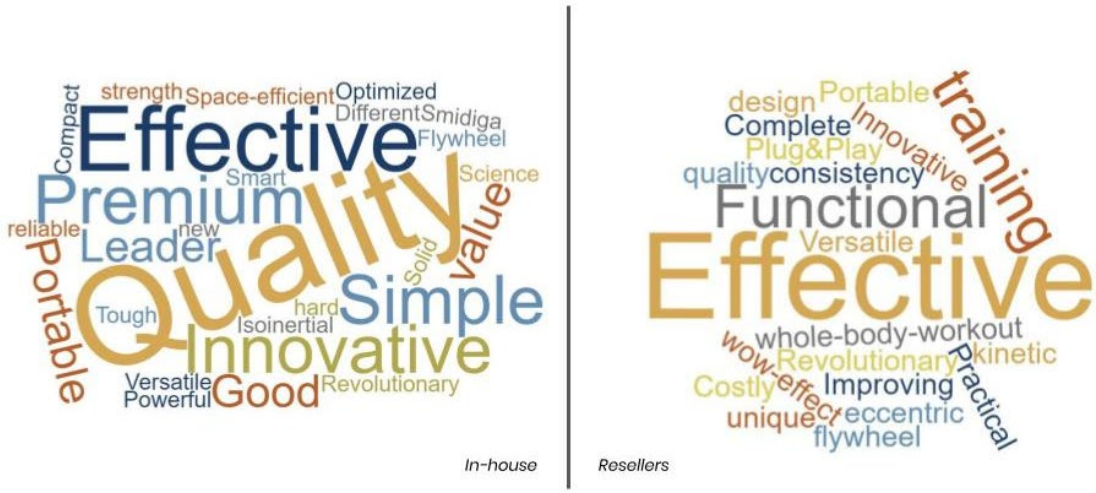

Figure 3.10. Word clouds depicting words mentioned in surveys to describe Exxentric's products.

The kBox, counting all different variants, was basically the only product associated with *Exxentric* worth mentioning. Asked to name two products associated with *Exxentric*, 100% of the respondents in-house named some variant of kBox as one of the two. Some chose to name two different variants of the kBox over other products in the product line. Similarly, the responses from the resellers showed that 93, 4% was answers was some variant of the kBox, see Figure 3.11.

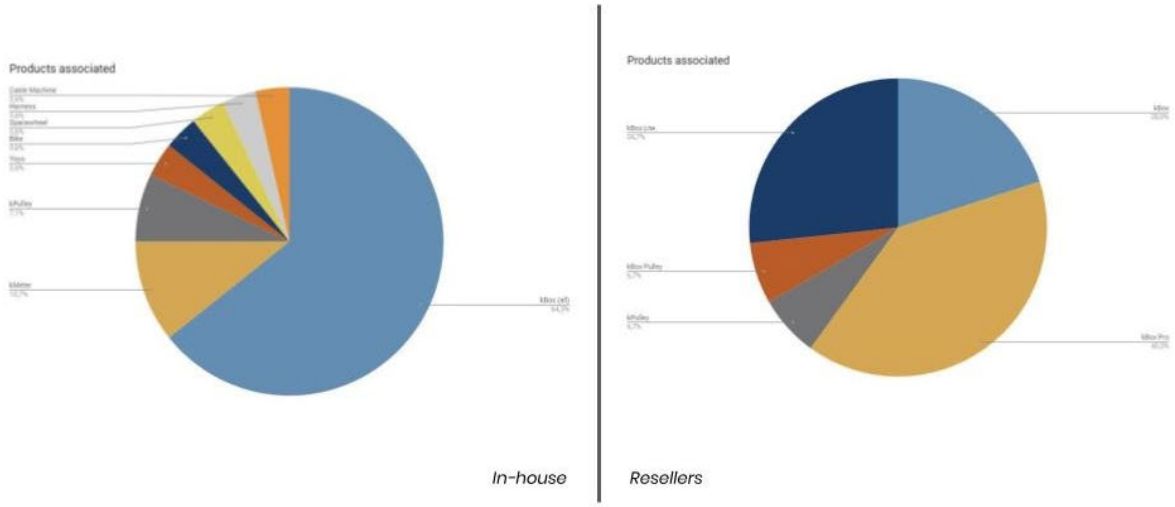

Figure 3.11. The kBox (all variants) was the most associated product with Exxentric.

3.3.2 Survey analysis

Being innovative appeared to be an important part of how *Exxentric* is perceived both internally and externally and was considered an important association to carry on into the design guidelines. If *Exxentric* wished to be more associated with strength and premium, like the in-house responses suggested, then these features would also be important to communicate through the product design.

Furthermore, products were viewed as qualitative and premium in-house but not necessarily externally. If a high quality and premium stamp is desired as a part of the brand, then it would be crucial that this was communicated through product design.

Existing product features contributing to the company's products being perceived as effective would need to be identified and carry on into the design guidelines. Additionally, effectiveness can be expressed and perceived in multiple ways depending on the user.

Currently holding an unparalleled position as the most recognizable product of *Exxentric*, the kBox is an important brand carrying product. It is mainly desired features from this device that should be analysed and carried on into the design guidelines. Any changes being made on the kBox would, in addition, also have a greater impact on the brand compared to other products in the product line.

3.4 Users

By analysing the customers in *Exxentric's* three segments: Performance sports, Health & fitness and Rehabilitation, through discussions with *Exxentric* Management- and Sales and Marketing team, three different personas could be developed. These personas acted as a visual representation of who the users of *Exxentric's* products are, and by extension, who to design for:

- **The college athlete**
  - Competitive edge.
  - Often trains with a coach.
  - Experienced in physical training.
  - Get stronger and injury prevention.
- **The personal trainer**
  - Functional training.
  - Multiple exercises.
  - Increase strength.
- **The weekend warrior**
  - Rehabilitation and pre-hab.
  - Controlled movements.
  - Intuitive training methodologies.
  - Time effective training.

The users of *Exxentric's* products were seen as people who wanted to become stronger. The reason as to why users had this desire varied with the different personas, as did their approach to training, see Appendix G.

3.5 Benefits

There existed several channels of communication between *Exxentric* and its customers through social media, the webpage, PR, marketing and sales regarding different benefits of the products. Yet no set guides existed within product development on what the physical products should communicate with regard to what benefits was communicated to the users and customers.

Figure 3.12. The key benefits Exxentric's physical products should incorporate and communicate.

By analysing and screening the communication within different customer segments and thereafter breaking it down into key words, the key words could be used to create five categories. These categories described the key benefits of *Exxentric's* physical products being communicated outwards and outlines what products beneficially should communicate, see Figure 3.12.

For example, being innovative was decided to be an important part of *Exxentric's* brand, however, it was possible to express innovation in a multitude of ways. To guide the product design process at *Exxentric*, physical products should communicate "innovative" by looking *New*, *Modern*, *Science-based* or *Exciting* when being reviewed. As discussed in sub-chapter 3.2 Positioning, two key features to consider lifting in the product design to achieve this was the technological aspects of the flywheel technology and the kMeter integrated in the devices.

3.6 Exxentric's brand

Through an iterative writing- and evaluation process involving the *Exxentric* Management during evaluations, it was possible to establish a company profile by asking four questions:

- Who are we?
- What do we do?
- How do we do it?
- Why does it matter?

By discussing these questions with *Exxentric's* Management team, insights arose making it possible to establish a DNA for the company which could be used to translate values into design guidelines. In addition, a mission and vision statement for the company was created.

The full presentation of Exxentric's brand included in the Design Platform cannot be presented due to the company's confidentiality. However, the developed company profile can partly be described as:

At Exxentric we develop innovative, science-based equipment for strength training.

We believe in making people stronger. Having the strength to overcome obstacles and to succeed is important not only in order to perform, but in life as well.

Guided by our beliefs, we recognize that getting stronger is hard work. Seeing that everyone is different, our driving force is to make effective training more accessible and enable everybody to achieve their goals.

By staying user-centered and focused on what people really need, we innovate in order to provide people with the tools to succeed. We are dedicated doers and pride ourselves in making our products functional, versatile and easy to use.

Through the use of flywheels, we provide methods and equipment to users worldwide. All to make strength training both efficient and effective.

4 Design guidelines

The second part of the Design Platform consisted of concrete design guidelines for how Exxentric's products should be designed. It was aimed at allowing for creative freedom to make sure products were functional and effective yet specific enough to ensure that the product line maintained coherent and that physical products act as a prolongation of Exxentric's brand.

In this chapter, no visual material from the design guidelines will be presented as it is under confidentiality. It will partly be presented how the product branding affected concrete design guidelines. As will key points from the guidelines be, where it does not compromise the confidentiality.

4.1 Layout

As *Exxentric* was considered one of the few companies in the flywheel business a genuine heritage during the positioning workshop, it was important to allow for that heritage to be visible in the product design development. The kBox was the most prominent product of *Exxentrics'* according to the survey enquiry. Therefore, some elements of the current kBox4 design was carried on into the design guidelines to create a consistency over time and a bridge between current- and future products, see Figure 4.1.

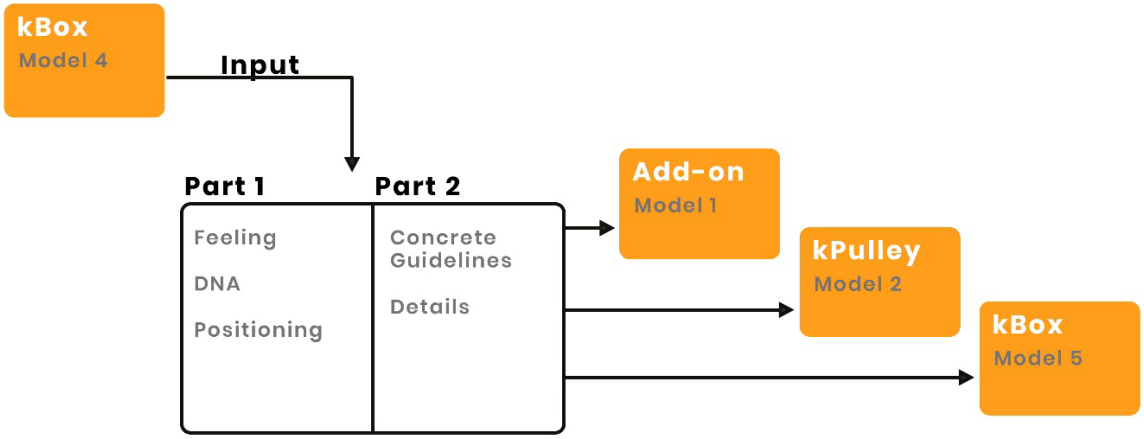

Figure 4.1. Showing the process of how the design guidelines interact and affect the product development process.

The design guidelines aimed to cover most aspects of physical product design and offer guidance for overall shapes of the products, enforced with examples of which features of current products to use complemented with the new features reflecting *Exxentric's* brand. Furthermore, guidelines were created for details, assembly features, what materials to use, which colours, how to handle logos and stickers as well as the accessories to the devices, see Figure 4.2.

Figure 4.2. Extract of the content included in the Design Platform.

4.2 Shapes

Tight radiuses and a clear change of direction on outer edges over chamfers or curves keeps products more inviting and modern. Outer surfaces are kept straight to give it a more stable and cleaner look which was in line with what *Exxentric's* products beneficially should communicate, see sub-chapter 3.5.

The visual design guidelines for curves, edges and surfaces are confidential.

4.2.1 Beams

When beams are used it was preferable to use rectangles over square beams. It created less of an industrial feeling and provided the opportunity to work with a more stable impression when orientated correctly.

The visual design guidelines for how to work with beams are confidential.

4.2.2 kBox features

The cut-out shape of the kBox was chosen as a feature to change and to be carried on to new products whilst preserving the outer shape of the kBox for resemblance purposes. A variety of design options was developed and evaluated against what it was desirable for products to communicate, see Appendix H.

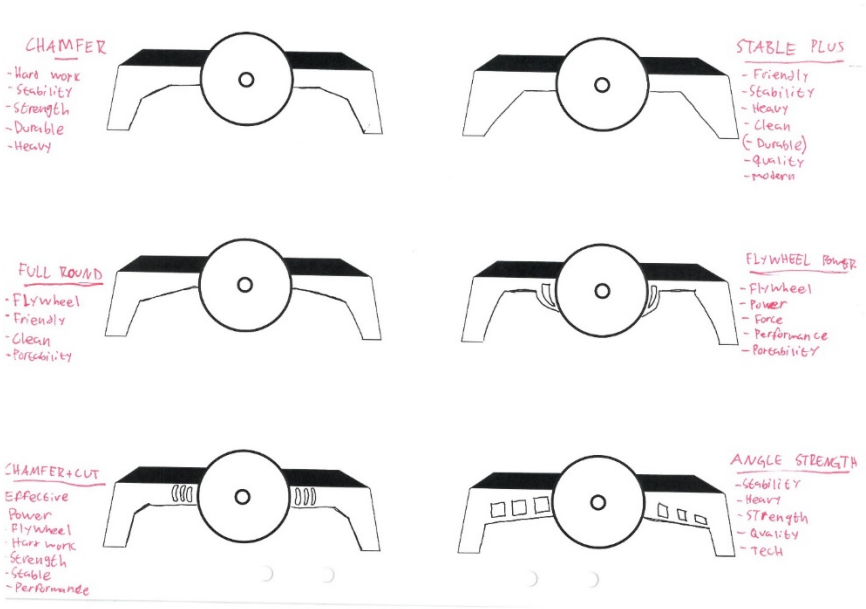

Figure 4.3. Examples of kBox cut-outs and what they communicate through their shape.

The most prominent cut-out shapes were analysed with regard to what benefits that *Exxentric's* products should communicate and how they were represented in each shape, see Figure 4.3. Thereafter the shapes were evaluated against what best reflects the company's brand. Based on the evaluation, a shape was chosen to continue working with and to optimise.

The final cut-out profile is confidential.

4.2.3 Additional shape guidelines

In the Design Platform, the design guidelines also included how to work with showing the main devices, express portability, create contrasts to highlight certain features, communicate stability and handle symmetry.

The results and visual design guidelines are confidential.

4.3 Details

Design guidelines for components that always are part of the main devices and yet stand out enough to be considered as signature elements in terms of usage and design included:

- Over dimension additive features with a purpose to make products appear more premium, durable and powerful.
- Keep it manageable with one limb.
- Make subtractive features small to make products appear more rigid and ensure the function of them is obvious to make it more user-friendly.

The visual design guidelines of how to further design details and significant components are confidential.

4.4 Assembly features

From the in-house survey it was clear that the company saw themselves and their products as premium and of high quality. To ensure products express and communicate the same some of the key assembly and manufacturing features to consider decreasing visibility of in products were:

- Avoiding visible weld lines.
- Avoiding clear gap transitions between too similar surfaces.
- Avoiding certain visible bolts, nuts and screws unless they are treated in a certain way.

The visual design guidelines for the assembly features are confidential.

4.5 Materials

To create a coherence within the product line it was considered important to work with the same texture and compositions of materials used in products. The most important materials to be used while designing *Exxentric's* products included:

- Powder coated metal surfaces instead of bare metal.
- Brushed metal components for certain features that need to express durability and high quality.
- Nylon belts with the same stitching and mesh.
- Rubbers with varying roughness and texture depending on where it is applied.
- Plastics, preferably black.

The visual design guidelines and where to use certain materials are confidential.

4.6 Colour

The kBox was used as a reference for exploring new colour options. Different variations were developed digitally (Photoshop CC, 2018) and evaluated based on what it communicated. The digital testing was followed by comparisons and evaluations of RAL colour-coded test pieces. Using colours to differentiate between different segments of the product line showed promise with darker colours beneficially being used for more premium devices whilst lighter colours proved suitable to be used on products aimed at rehabilitation clinics or for home users.

The colours chosen for the design guidelines are confidential.

4.7 Logos

Guidelines for priority, placement and size of logos and stickers for main devices, accessories and add-on products were developed and included:

- Placement of main text logo.
- Placement of main symbol logo.
- Placement and priority of safety stickers.
- Placement and priority of flags.
- Exceptions to the rules for small or large devices.

The visual design guidelines for the placement and prioritization of logos and stickers are confidential.

5 Research for the rower add-on

This chapter address the research performed specifically for the investigation into the usefulness of the add-on product for seated strength row. It included an analysis of the rower market as well as an evaluation against Exxentric's current products. The field research in the shape of interviews and observations and how the gathered material was used to gain insights is also presented. Moreover, it explored the intended users and what to consider during the user-centered construction process.

5.1 Project Initiation Document

The starting point for the construction of the add-on was the Project Initiation Document (PID) for the, by the time, called kRower. It stated the need to facilitate heavy strength row exercises and that an add-on device would be developed, allowing the kBox to be turned into a seated strength row to fulfil this purpose, see Appendix I.

Based on the PID, a requirement specification had been developed before the thesis project begun, outlining what must- and should be fulfilled by such an add-on product. It was stated that products must be possible to ship in packages no larger than for the kBox4 Pro, as shipping small and light packages via parcel service with international carriers was desired to keep shipping costs and time to a minimum according to Exxentric's management team. Additionally, it stated requirements regarding the add-ons dimensioning, technicality and functionality, see Appendix J.

5.2 Rower market analysis

There were mainly two types of rowing machines on the existing market: Strength row- and Cardio rowing machines. A market investigation was conducted to analyse the state of the art in both segments as well as the less developed market of flywheel rowing.

Figure 5.1. State of the art for rowing machines.

5.2.1 Cardio rowing machines

Among cardio rowing machines *Concept2's* Model E was considered the best on the market and was the model used for the rowing machine World Cup (Bäst-i-test, 2018) in addition to be the standard model used in crossfit competitions worldwide according to an interviewee. One of the newer devices on the market in the premium segment of cardio rowing machines was *Technogym's* Skillrow which has focused on the design of the machine and an upgraded electronics system, see Figure 5.1.

5.2.2 Strength row machines

When it came to strength rows, they were mostly equipped with a weight stack, consisted mainly of metal framework, had fixed seats and foot plates, see Figure 5.1. There occurred some variations in design, however, there was no industry ideal as with the cardio rowing machines. One of the main differences found between strength row machines and cardio rowers was the seat, where cardio rowers had a sliding seat whilst strength rows had static seats.

5.2.3 Flywheel rowers

There was a limited range of flywheel devices aimed solemnly at rowing exercises. The ones that existed were relatively expensive compared to other flywheel-based machines. They were, for most parts, similar to cardio rowing machines by design, see Figure 5.1.

5.3 Field research

A total of eight semi-structured, contextual interviews were conducted in four different gyms in the Stockholm region focusing on exercise techniques, opinions on existing equipment and why rowing exercises was good to perform, see Appendix D. The interviews together with two observational sessions made the basis of the field research for the user-centered design process.

Key behaviours observed, and opinions expressed during interviews were written on post it notes and clustered into groups in order to make conclusions and gain insights which could be used for the construction of the add-on. Post it notes were colour coded depending on where the information came from, see Figure 5.2.

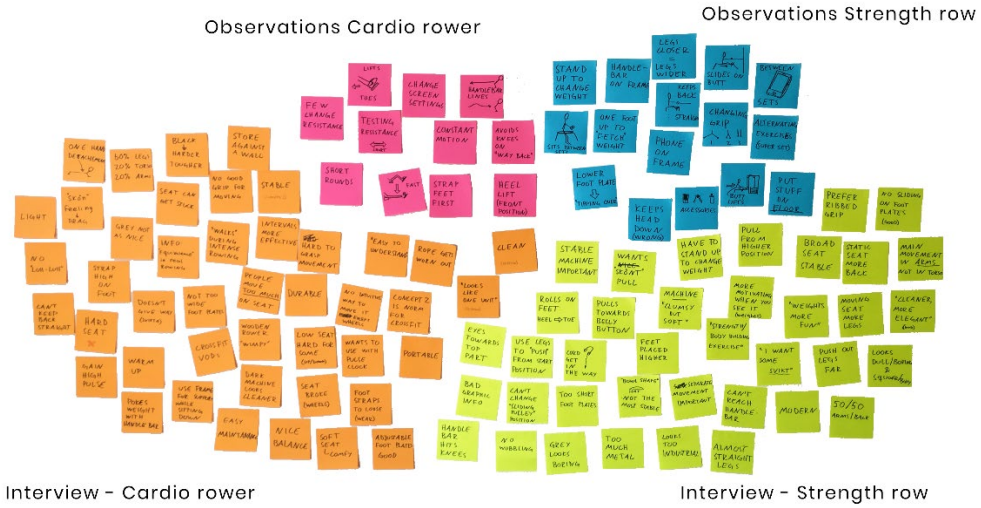

Figure 5.2. Information gathered from field research, colour coded based on origin.

Post-it notes were rearranged for three iterations with the first round focusing on gaining insights regarding different features of existing rowers. The second round focused on actions performed during the use and potential risks associated with the exercise and the possible addition of a flywheel resistance. Finally, the third round was mapped linearly with post-its sorted chronologically and focused on gaining insights of points to consider for an add-on product aimed at seated strength rows.

5.3.1 Round 1: Features

Firstly, the notes were divided mainly according to what features they represent, see Appendix K. Some of the key insights from the first round included:

- Needs to be easy to change exercise for multiple people using the same device.
- A sliding seat promotes the use of leg muscles during exercise.
- A static seat makes it easier to isolate and focus on training the back muscles.
- Important to consider placement for static foot plates.

5.3.2 Round 2: Actions and risks

Secondly, the notes were rearranged to gain insights according to what actions they belonged to and the risks associated with it, see Appendix L. The key insights from the second round were:

- Different height settings allow for multiple exercises being performed and increased adaptability for users of different height.
- It is important to have an intuitive attachment for switching between exercises.
- Hard to sit down and get up from lower seats for users with weak knees.
- There is a possibility to utilize a sliding seat for eccentric overload during flywheel rowing.
- Stability is more associated with strength rows and balance with cardio rowers.
- It is hard to perform the motion correctly on both cardio- and strength rowers.

Risks identified for potential rowing exercises on a flywheel-based rowing device:

- Overstretching the knees at the turning point of the motion if the flywheel pulls back to fast.
- Falling back due to the belt being too long or using too low inertia to pull the user back.
- Get thrown forward due to eccentric overload being hard to handle.
- Possibly unbalanced to overload with a sliding seat.
- Hitting the knees with the attached accessory used with high force due to eccentric overload.

5.3.3 Round 3: Possible impact of flywheel resistance

Lastly, a linear approach with information placed chronologically. Sorting the information throughout the process of using a rowing machine from start to finish, see Appendix M. The final session generated further insights on points to consider while constructing a flywheel-based device:

- Consider how to adjust the flywheel inertia.
- Adjusting the length of the belt before the action commence.
- Changing the handle or accessory between exercises.
- Attaching the add-on to the kBox.
- Raising the head up is important for the movement.
- Keep users from rolling on their feet during heavy strength training.
- How to set the flywheel in motion to start the exercise.

The insights from all three rounds became the foundation for the work on which the construction of the add-on was based on.

5.4 Product line comparison

The proof-of-concept prototype was used to evaluate the differences of performing seated strength rows on an add-on compared to *Exxentric's* existing devices. The purpose was to investigate seated rowing exercises, therefore standing rows on the kBox or kPulley was not evaluated. Instead it was performed from a seated position on the floor or on a bench, which usually is equipment available in a gym environment.

5.4.1 Seated strength row with the kBox

During the seated rows with solemnly the kBox4 Pro several problems were encountered, including that the kBox needed to be weighted down and stabilized with the feet in order to keep it from moving, see Figure 5.3.

Figure 5.3. Seated rows with the kBox4 Pro.

Further problems encountered included the friction that arose when the two straps rubbed against each other, making the motion slower, less efficient and wears on the straps. The cons outweighed the pros when performing a seated strength row on the kBox4 Pro, see Table 1.

Table 1. The pros and cons with performing seated strength rows with a kBox.

Pros	Cons
Possible to reach flywheel to set it in motion.	Not possible to adjust belt length from seated position on the floor.
Possible to perform on both floor and bench.	The kBox lifts at the far end during use.
Foot support on the kBox.	Unpleasant to sit on the floor.
	Feet must be placed on the kBox to prevent it from moving.
	Friction between the belt parts and the opening in the kBox.
	Not possible to adjust the height from one seated position.
	Difficult to use other parts of the body for eccentric overload.
	Difficult to perform a correct movement and target the desired muscles.

5.4.2 Seated strength row with the kPulley

The kPulley was a better option than the kBox for seated strength rows, especially when performed from an elevated seated position, see Figure 5.4.

Figure 5.4. Seated rows on a bench with the kPulley.

The main issue with performing strength rows on the kPulley was the stability. If the placement of the feet was too low in comparison to the torso, it caused instability during the eccentric part of the motion as the user was dragged forward without being able to compensate with the legs, see Table 2.

Table 2. The pros and cons of performing seated strength rows on the kPulley.

Pros	Cons
Possible to reach the flywheel from the seated position.	No natural foot support.
Variable pulling height available from the same seated position.	Unpleasant to sit on the floor.
Minimal friction loss.	Not possible to adjust belt length from a seated position.
Relatively stable movement, if seated on the floor.	Hard to use the legs to create an eccentric overload.
	Unstable when the feet are placed to low in relation to the torso.

5.4.3 Seated strength row with the proof-of-concept prototype

With the proof-of-concept it was possible to perform seated strength rows with eccentric overload in a stable motion. From the seated position it was, however, troublesome to set the flywheel in motion and to adjust the belt length, see Figure 5.5.

Figure 5.5. Seated rows on the proof-of-concept prototype.

The downsides with the proof-of-concept was mostly related to the necessary adjustments before the exercise commenced and that it could be hard to perform the proper movement with the sliding seat for inexperienced users, see Table 3.

Table 3. The pros and cons of performing seated strength rows on the proof-of-concept prototype.

Pros	Cons
Good foot support.	Takes up extra space.
No friction from kBox edges or between belts.	Hard to set flywheel in motion from a seated position.
Adjustable seat.	Hard to adjust belt length from the seated position.
kBox stable during normal movements.	Additional product required (the add-on).
Possible to create eccentric overload with the legs.	Troublesome to connect to kBox via interface.
Possible to perform additional exercises	Hard to focus on proper movements with a sliding seat.

Concerning the ability to perform seated strength rows, the proof-of-concept prototype provided the best alternative out of the evaluated ways of performing it and was the best option for training with eccentric overload.

5.5 Users of the add-on

During interviews, the personal trainers all expressed that many users experienced difficulties performing the movement properly on both cardio rowing machines and strength rows, especially when they are new to the machines. Rowing with a flywheel resistance instead of traditional weights could potentially boost the users training significantly considering the advantages of variable load and eccentric overload, which were made possible with a flywheel resistance. Nonetheless, the same benefits provided by a flywheel resistance could potentially be a safety risk if the user is not performing the movement right or is unable to handle the pull from the flywheel during the eccentric phase, both of which could lead to injuries.

Therefore, the proof-of-concept would be best suited for users with previous experience in training, preferably also row exercises. It can be used by others as well, although, for inexperienced users it would be good to perform the exercise with a coach or trainer, to ensure that movements are safe, efficient and that the desired muscles are properly activated.

According to the PID, see Appendix I, the main objective for *Exxentric*, with an add-on product for seated strength row was not to widen the target audience but to increase average order value. Therefore, during discussions with *Exxentric's* Management, *Exxentric's* existing users were chosen as the intended target group, mainly the performance sports segment, see sub-chapter 3.4.

The target group generally have extensive training experience and often train together with a coach or trainer which are good prerequisites for using a flywheel-based rower add-on. With the defined user, input of relevance from the interviews and observations for the chosen segment was clustered together once more into main themes to consider and evaluate against during the user tests of the construction phase, see Figure 5.6.

Figure 5.6. Main themes to consider for the chosen user segment.

The adjustability mainly concerns the settings and actions taken place before the exercise commence, ensuring the add-on is adjustable for users of different size and with different needs on the exercise being performed. Together with stability, the adjustability was the basis for performance which focused on the execution of the exercise, allowing for safe and correct movements.

It was a possibility that situations would arise where trade-offs could be a necessity, especially when striving to make the add-on adjustable and to make it manageable or durable. To design more features to be adjustable could cause the add-on to become less durable due to an increase in the number of moving components. It could also make it less intuitive with users facing more options before starting their exercise. Trade-offs were handled individually when they arose during construction and were evaluated against how they impacted the five main themes during user testing.

5.6 Research conclusions

The main objective was to investigate the usefulness of an add-on product allowing for seated strength rows to be performed with the kBox. However, with some acceptable options already available for rowing exercises with the current devices, both standing on the kBox and seated with the kPulley, it was considered if it was possible to perform additional exercises on the add-on product besides the strength row. The goal remained to satisfy the needs of performance sports athletes with the objective to provide an add-on to boost the training of their back muscles.

Ultimately, a revised requirement specification could be developed based on the information gathered during the research phase. It included the requested functions of being able to adjust the belt length and to set the flywheel in motion from a seated position. Furthermore, it stated that it was requested to have it as small as possible without compromising usage. Moreover, the requirement for the add-on to be shipped in a parcel equal to or smaller than what the kBox4 Pro was currently shipped in was removed. Through discussions with the Sales team at *Exxentric*, it was decided that it can be shipped in a longer parcel but when doing so, it is beneficial if it can be shipped in several smaller parcels rather than one large, to keep shipping costs down, see Appendix N.

6 Construction

The framework from the proof-of-concept prototype was used as a base to build upon for the testing and construction of the add-on to be designed. The following prototyping process was carried out in an iterative way with testing and refinement of changes being made evaluated continuously. User tests occurred frequently to generate unbiased user input to changes being made. The intended user was assumed to have prior experience with training and to be somewhat familiar with flywheel training this was also the desired users to test with during the construction process. In some cases, when time was a constraint, to decrease the threshold to flywheel training, people without insight into the project yet from within Exxentric was used for the tests.

The construction process could be divided into six different key areas to design for. These included the seat of the add-on, the foot support, height setting, beam, interface with the kBox and the back led of the add-on, see Figure 6.1.

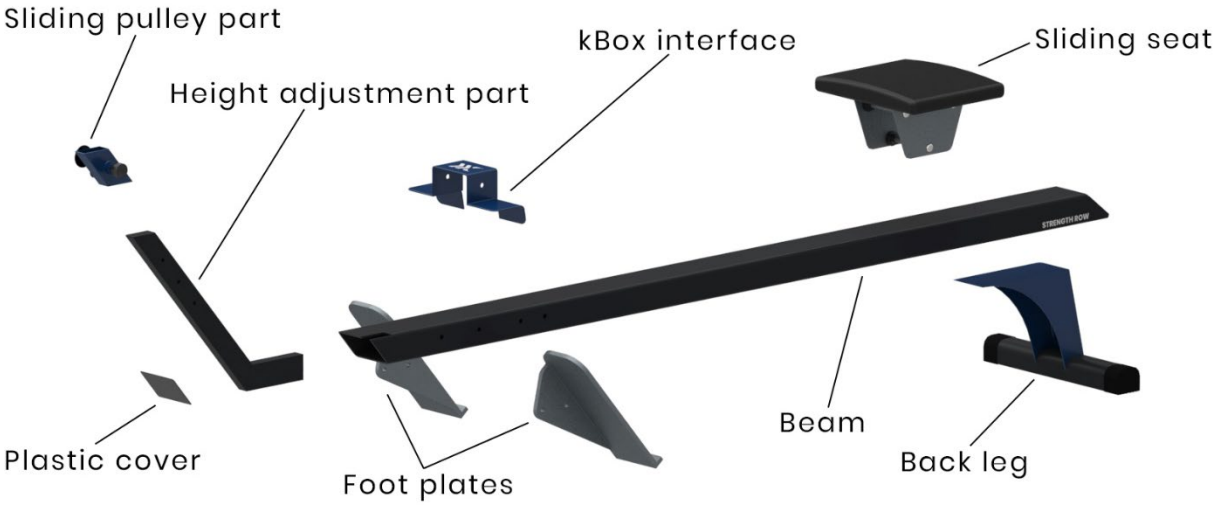

Figure 6.1. Exploded view of the constructed add-on product.

6.1 Seat

The starting point for the construction process was to decide whether a sliding seat should be used, like those on cardio rowers, see Figure 2.7, as such a feature would greatly impact the functionality of other features. The add-on was intended as a strength row which, as the research suggested, was benefitted by a static seat which was more stable and allowed for better focus on the muscles.

However, it was decided to use a hybrid solution with a sliding seat that could be locked in place. The possibility to perform strength rows with eccentric overload through the use of the legs with a sliding seat as well as the possibility to perform additional exercises was the most prominent deciding factors for the sliding seat, see Appendix O.

Figure 6.2. The seat of the add-on.

A black leather seat with firm cushioning was chosen and placed close on top of the beam, see Figure 6.2. Black is versatile and does not show when it gets dirty. The seat was made both broader and deeper than the sliding seat on a cardio rower to better suit a strength row. This to create a sense of stability and to avoid having the user focus on keeping their balance during heavy rowing.

Figure 6.3. Locking the seat is done by pulling and twisting the knob, causing the sprint to lock into one of the fixed positions on the beam.

Locking the seat was done by pulling and twisting the knob on the right-hand side of the seat. The shape of the seat ensured a geometric locking on the beam and the sprint locked it in the sliding direction, creating a static seat, see Figure 6.3.

6.1.1 Manufacturing the seat

The cushion could be ordered from a seat manufacturer. Sheet metal could be cut out and bent to make up the housing of the seat around the beam. Wheels, screws and nuts could be chosen from standard components. The seat is assembled before shipment and slides onto the beam during final assembly by the customer.

6.2 Foot support

The placement of the foot plates correlated to the height of the seat. To give a more robust impression and to keep the number of moving parts down, static footplates was chosen. Although adjustability and performance were a priority, the durability, stability and manageability benefits that static foot plates provided took priority in this case.

Deciding the placement and angle of the foot plates was done in correlation to the height of the seat and the placement of the front pulley, see Appendix P. They were placed 400 mm from the pulley position at an angle of 50° relative the beam.

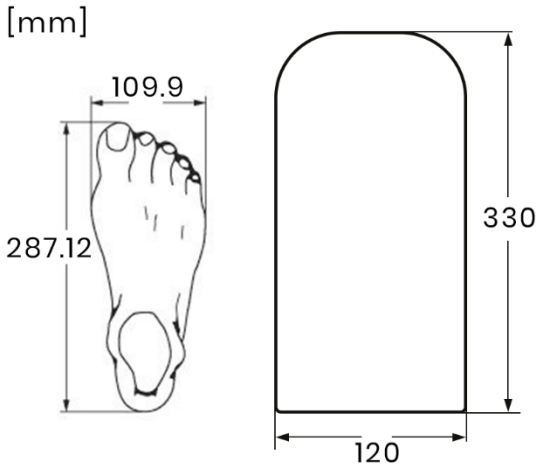

Figure 6.4. Foot sizes of the 95th percentile and chosen size on footplates.

To compensate for using static footplates that decrease the adjustability for users with different sized feet, large foot plates were used. Considering foot measurements for the 95th percentile of male users using anthropometric measurements (Hanson et al., 2009), a margin was added to accommodate for users in performance sports such as basketball, with extraordinary large feet. The final dimensions for the foot plates were set to 330 x 120 mm, see Figure 6.4.

During test, the footplates were experienced as slippery and it was troublesome to keep the feet steady during use. Changes were made adding a foot strap during test, which improved stability, see Figure 6.5.

Figure 6.5. Tests with strap on foot plates.

Although stability was increased, the main reason for foot straps on cardio rowers was to allow the user to pull themselves back towards the front as there is nothing pulling the users back once the movement is completed. Using flywheels, the user is pulled back at the end of the motion and the slipperiness could instead be corrected through the addition of a heel support, see Figure 6.6.

Figure 6.6. Prototype heel support for the foot plates.

In addition, a rubber matt of the same material and texture as that on the kBox was added on the designated area for the feet to further reduce slipperiness and to increase the intuitive understanding of foot placement, see Figure 6.7.

Figure 6.7. The foot plates screwed to the sides of the add-on.

6.2.1 Manufacturing foot plates

Sheet metal pieces with over dimensioned thickness, that create a robust look and feel, can be cut out and bent to create the footplates and the heel support. The rubber matt is glued onto the sheet metal pieces and it can be attached with standardized bolts and nuts.

6.3 Height setting

Designing the height setting the following main themes that emerged from the research phase were considered:

- Adjustability - Users of different heights should be able to adjust the position of which they pull from to optimize their training and to be able to perform different exercises on the add-on.
- Performance - It needed to be simple to understand, change the height and easy to put the belt into place.
- Stability – Could not feel cheap, unsafe, rickety or wobbly. Needed to be sturdy before, during and after use.

A variety of concepts were iteratively developed and assessed with users, keeping the main themes in mind, see Appendix Q.

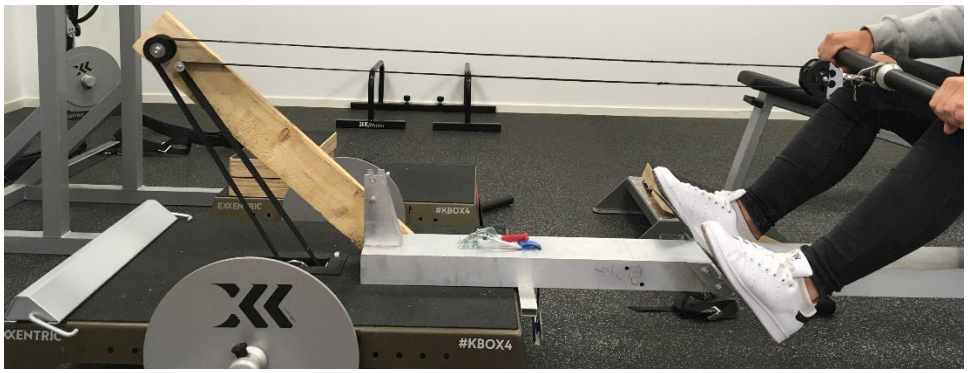

Figure 6.8. The belt of the kBox became too short if the height of the pulley was too high.

The main constraint to allowing users to pull from a certain height was the belt length of the kBox, see Figure 6.8. Further points to consider, in accordance with the requirement specification, was to design so that users would not hit the pulley part during exercise with different accessories, see Figure 6.9.

Figure 6.9. Using different accessories ensuring they don't hit the pulley part during use.

Being a strength row primarily, the movement should not allow for the hands to go past the feet usually or require a considerable high position to pull from. However, to have some safety margins for users with a long reach, the height adjustment could allow for some overhang at the top, see Figure 6.10.

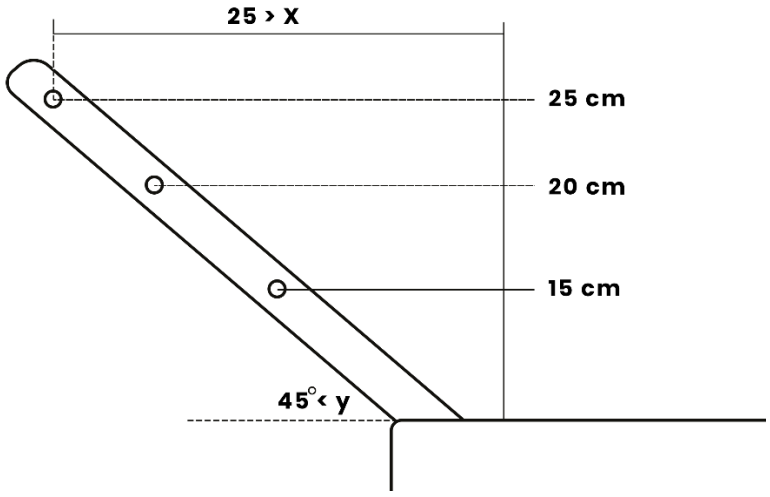

Figure 6.10. Height and overhang allowed for the height adjustment.

The final construction for the height adjustment was placed at the front, left side of the add-on, ensuring it does not cover the belt bite button of the kBox, with an overhang over the shaft at the centre of the kBox, see figure 6.11.

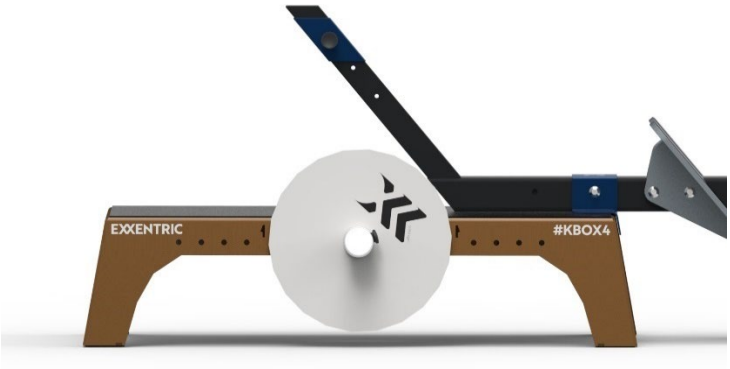

Figure 6.11. The add-on's tilted forward and reaches past the centre-axis of the flywheel.

The height was adjusted by pulling the knob and sliding the active part along the shaft. Three positions were made available at 150, 200 and 250 mm of height over the kBox surface to make it adjustable for different users and exercises. Fixed positions could also facilitate the adjustment process before the exercise begun as users could place the part at whatever position they used during their previous session, see Figure 6.12.

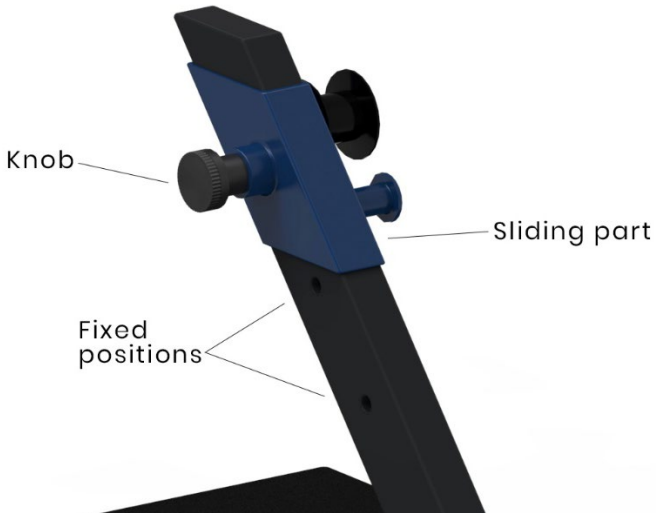

Figure 6.12. Deciding the position to pull from by pulling the knob and sliding the active pulley part.

The upper belt was to be placed on a pulley which rotates to decrease the friction during use whilst the lower, static, belt was placed on the solid metal part. The two belt parts were kept close together as the actual pull position is centred between the belts, see Figure 6.13.

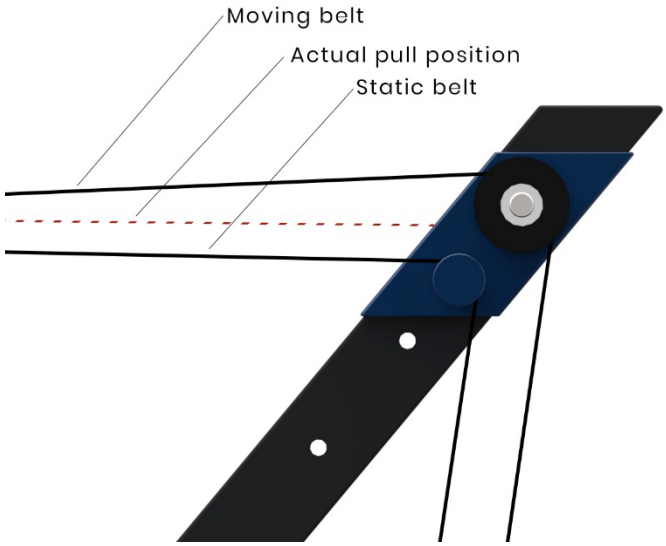

Figure 6.13. The actual pull position is between the two belts.

6.3.1 Manufacturing height setting

The beam can be welded or screwed together from standard profiles. The sliding part could be made from sheet metal or a hollow beam of a slightly larger profile with nylon bushings on the inside to decrease the wear. Components could be welded to it. The pulley can be chosen from an existing pulley being used on other *Exxentric* products.

By having the front of the beam open, it allowed the customer to slide the "tower" into place and lock it with standard screws before closing the open front end of the beam with a plastic lid during assembly, see Figure 6.14.

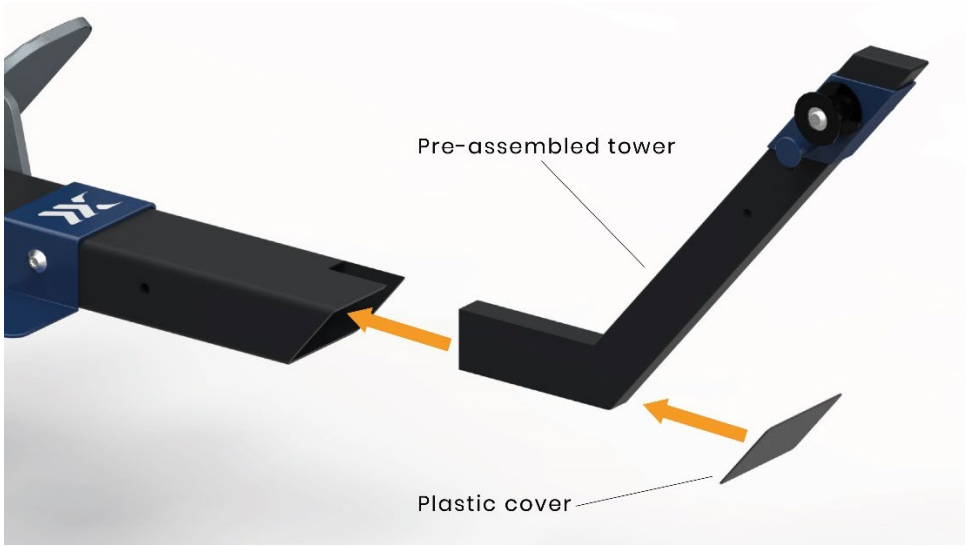

Figure 6.14. Assembling the height adjusting tower with the pulley part after delivery. The tower part is afterwards screwed in place in pre-drilled holes.

6.4 Beam

A sliding length of 1000 mm was considered enough as the most premium cardio rowers offered between 900-980 mm of sliding length (Bäst-i-test, 2018). By making it longer, taller pro athletes would also be able to use it.

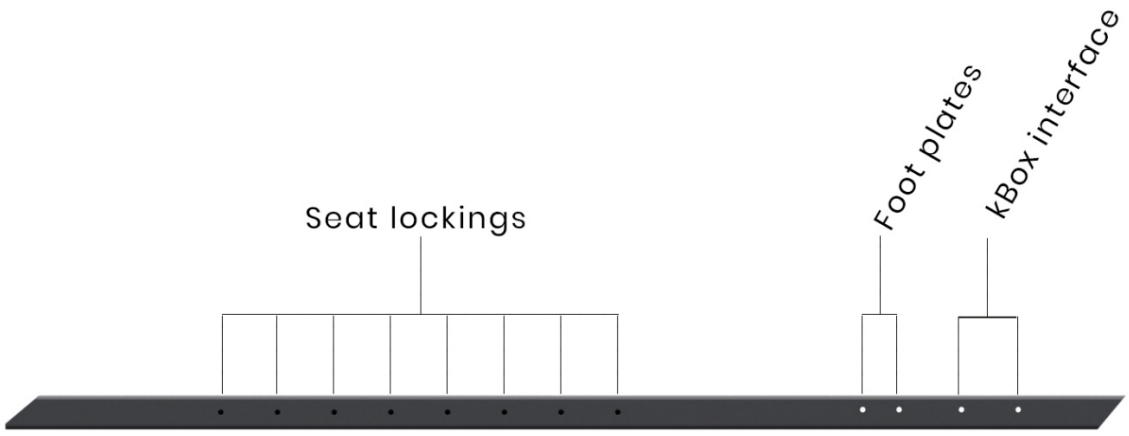

Figure 6.15. Side views of the beam.

Eight holes for locking the seat should be pre-drilled, 10 cm apart on the right side. As should holes for footplates, locking interface and height adjustment components be, see Figure 6.15.

With a length of 400 mm between the lower pulley position and the foot plates and extra length at the back to mount the leg, the total length of the beam became 1970 mm, see Figure 6.16.

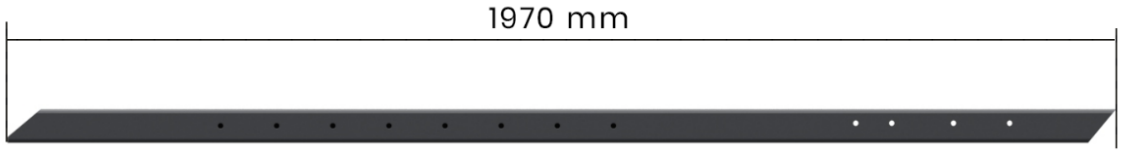

Figure 6.16. Total length and angled ends.

The front of the beam was cut to follow the angle of the front tower, at 50° whilst the back was cut at a steeper angle for design purposes, at 40°, then covered with a metal plate.

By shipping the beam by itself and allow the customer to assembly all components to it upon arrival. Shipping costs and times could be kept to a minimum which was desired by the Sales team at *Exxentric*.

6.5 kBox interface

During tests, it appeared difficult to know how far in on the kBox the add-on was to be placed. In addition, the add-on moved slightly sideways during heavy rowing if not locked or supported across the side of to the kBox.

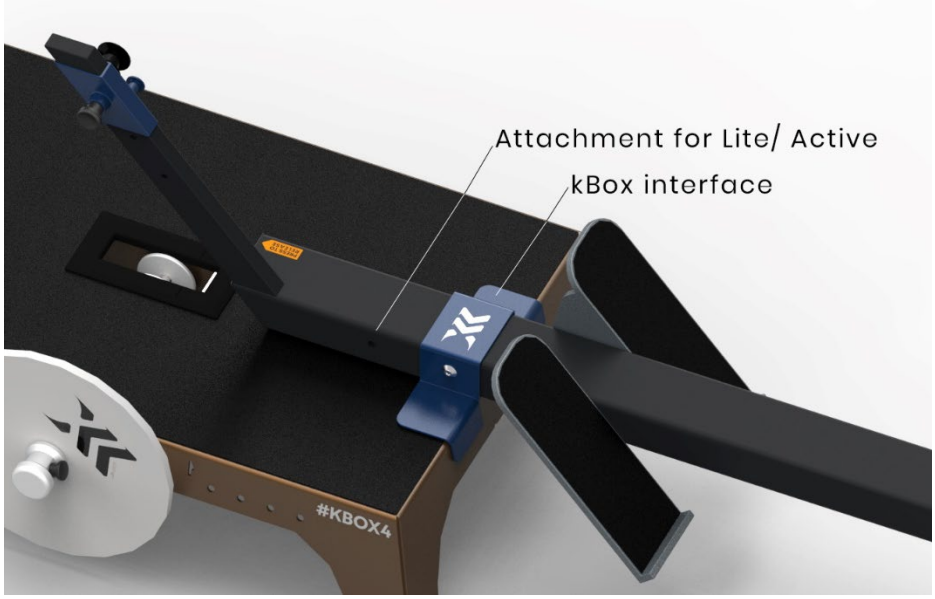

Figure 6.17. Interface on kBox provided support and stability in addition to acting as a guidance as to how far the add-on should overlap with the kBox.

These issues were solved by placing an interface piece with an offset shape if the kBox edge, see Figure 6.17. This acted as an indication as to how far the add-on should overlap with the kBox and provided stability during heavy rows.

It was assumed that users would either have a kBox4 Pro device or a Lite/ Active, if they had both it was seen as the most probable that the add-on mostly would be used for one of the devices. Therefore, depending on the add-on was to be used with a Pro or Lite/ Active, the interface would be assembled by screwing it to either the holes at 200 mm from the front of the beam for Lite/ Active or the holes at 300 mm from the front for the Pro device, see Figure 6.15. This would decrease the adjustability but also increase the stability and make it more manageable for users once assembled. It would be possible to manufacture it from sheet metal and it could thereafter be screwed to the beam during final assembly by the customer

6.7 Back leg

The support and sideways stability of the add-on became largely dependent on the back leg which was tested first with a width of 500 mm, see Figure 6.18.

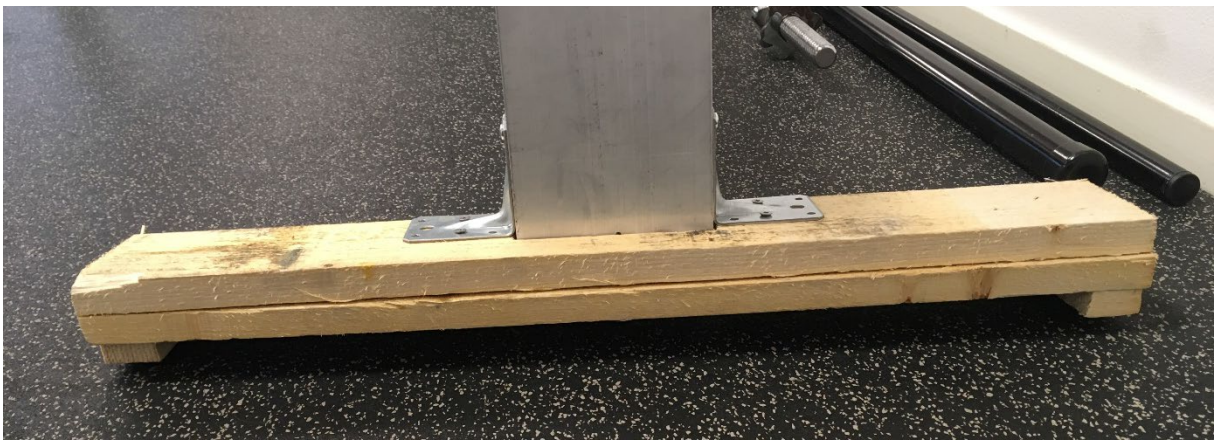

Figure 6.18. Prototyping and testing the stability of the add-on with a widened support at the back.

After tests, the width could be set to 400 mm which was stable enough yet narrower than the kBox4 Lite. Rubber pieces were applied to the ends of the horizontal beam to increase friction and stability while standing. Additionally, two wheels were added at the back of the beam which allowed the add-on to be tilted backwards onto the wheels, and rolled around which improved movability, see Figure 6.19.

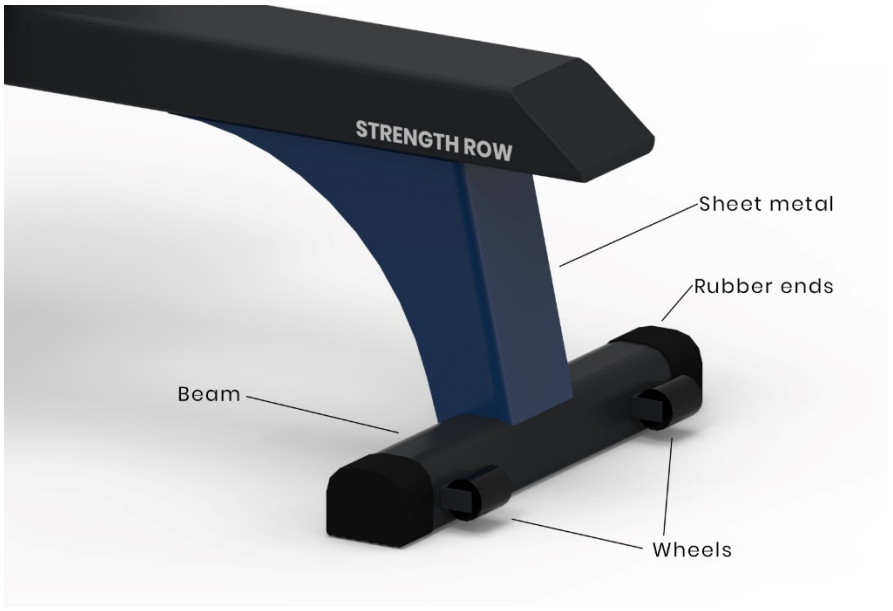

Figure 6.19. Back leg of the add-on.

By using a standard beam and standard components for wheels and screws to attach the leg costs could be kept down. The leg part could be manufactured using sheet metal pieces and screwed to the bottom of the beam.

7 How the guidelines were implemented

Applying the design guidelines was done in parallel with the construction work to make sure that design and function would be integrated together. During the construction process, when the main functions and features were set, a range of structural variations of different shapes were created in 2D. This was done to largely investigate what the add-on might look like with design guidelines applied in various ways, see Appendix R. The shape of the foot plates, seat, leg and beam was evaluated against the Design Platform to investigate what best represented Exxentric's brand. All implementations of the design guidelines on the add-on product will not be pointed out as it compromises confidentiality.

7.1 Shapes

Tight radiuses were used on the beam and on the corners of the bent sheet metal components, see Figure 7.1.

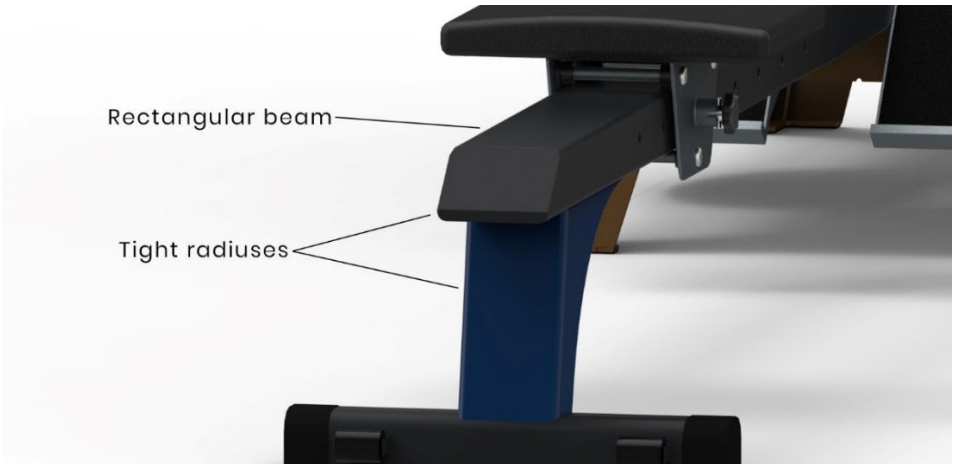

Figure 7.1. Tight radius on corners and a rectangular beam.

7.2 Details

Added features with a purpose that were over dimensioned compared to what was necessary included the length of the beam, see Figure 7.2, the size and thickness of the foot plates, see Figure 7.3, and different knobs used to release sprints of moving components, see Figure 7.4.

Figure 7.2. Beam is allowed to take up more space than needed by being extended past the back leg.

Figure 7.3. Foot plates being over dimensioned as to what's necessary for durability.

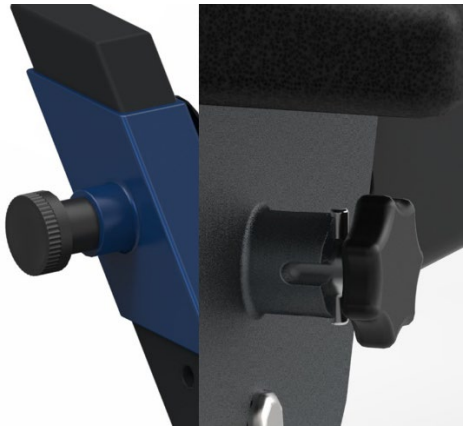

Figure 7.4. Knobs made over-dimensioned.

In addition, visible screws and washers used was chosen to be larger than required to create a solid and strong feel, see Figure 7.5.

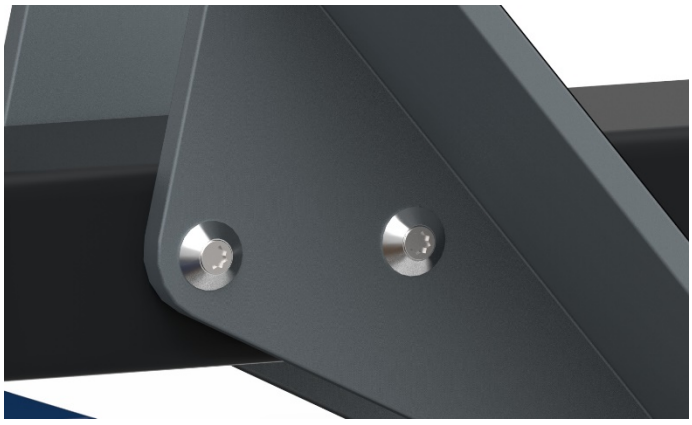

Figure 7.5. Screw and conical washer being over dimensioned.

Subtractive features such as pre-drilled holes for screws was kept small, not to make the material appear thinner or weakened.

7.3 Materials

Most components of the add-on were made of powder coated metal surfaces:

- Beam
- Back leg
- Height adjusting tower
- Seat
- Sliding pulley part
- Foot plates
- kBox interface

The metal parts of the back leg, kBox interface and sliding pulley part were highlighted by being powder coated in visible colours that can be varied according to the colours used on *Exxentric's* products, see Figure 7.6.

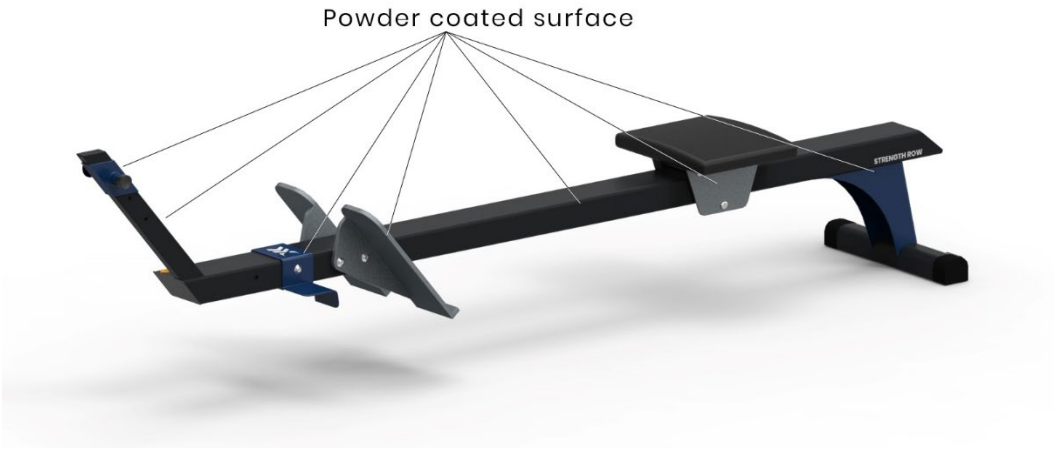

Figure 7.6. Powder coated components of the add-on.

7.4 Colour

As the target group for the add-on mainly involved athletes within the segment of performance sports, it is coloured the same way as a premium device with darker tones.

7.5 Logos

Being an add-on, the *Exxentric* text logo is not placed on the product. Instead the symbol is placed on the top, centred on the kBox interface where it is visible during use, see Figure 7.7.

Figure 7.7. Symbol logo placement placed on the powder coated surface of the kBox interface.

The products name is placed on a powder coated surface where it can't be covered during use, on side of the back leg pointing forward during use, see Figure 7.8.

Figure 7.8. Placement of text logo with the name of the product.

8 Results

The resulting add-on concept for seated strength rows on the kBox4 was evaluated against the five main themes used for the evaluation and user testing during the user-centered construction process, see sub-chapter 5.5. This chapter presents the results of these evaluations with regard to the concept's adjustability, stability, durability, performance and manageability.

8.1 Adjustability

One objective with the add-on was to allow for a wide range of users of different sizes. Performance sports athletes and coaches have high standards for the equipment they use which made it imperative that it would be possible to adjust settings.

The add-on allowed for adjustments vertically via the sliding pulley part and horizontally through the sliding seat for users of different height or performing different exercises. Foot plates were made wide to allow users to place their feet either close to the beam or far apart.

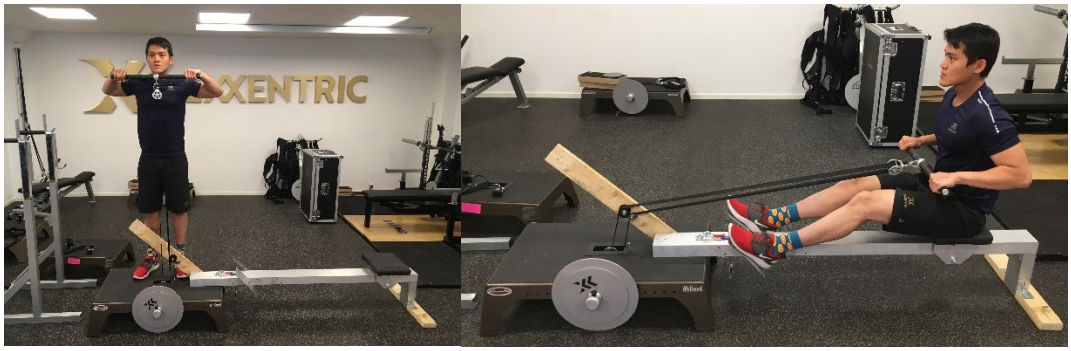

Figure 8.1. Pulling the kBar to the chin while standing on the kBox was a good estimate of how long the belt should be for seated strength rows.

Adjusting the belt length from a seated position was troublesome during tests. Before performing a strength row exercise, users can stand on the kBox and pull the kBar until it reaches the bottom of their chin, which turned out to be a decent estimate of how long the belt should be for seated strength rows, see Figure 8.1. After which only minor adjustments were required in some cases to achieve the optimal belt length.

8.2 Stability

The seat was made broader and longer than on a traditional cardio rowing machine. This gave the users a more stable experience without having to focus on keeping their balance. Broad wheels under the seat ensured that the seat did not wobble during use.

Foot plates were covered with a rubber matt to provide a better grip and a heel support was added which ensured that users did not need to worry about their feet sliding during use.

The interface towards the kBox prevented the add-on from moving or twisting during heavy rowing, see Figure 6.17, and the wider foot of the back leg provided the add-on with sufficient stability, see Figure 6.19.

8.3 Durability

During the interviews, it was stated that the parts of cardio rowers that became worn out most frequent was the wheels of the seat and the belt or cable attached to the handlebar. As the moving part of the belt of the kBox was placed on a rotating pulley, it should minimize the wear on the belt over time. The wheels of the add-on seat were made large with added bearings to decrease the chance of them being worn out.

The construction of the sliding components was based on existing solutions for which there was no experienced wear or breakage according to the interviewees. If components should break, the add-on was constructed in a way that made it simple for the customer to change the broken component on their own with the tool kit provided in with their kBox.

8.4 Performance

In addition to allowing seated rowing exercises to be performed, the add-on also allows for an additional four exercises that were hard to perform solemnly with the kBox, see Appendix S. The additional exercises that could be performed were:

- Leg press – for the leg muscles and glutes.
- Leg curl – focusing on isolating the hamstrings.
- High seated row – more focus on trapezius and the posterior deltoids, see Figure 2.5.
- Hand standing crunches – Working the abdomen and core muscles.

By using the legs and letting the seat slide during the concentric phase, the user can achieve an eccentric overload targeting their back during the eccentric phase, see Figure 8.2.

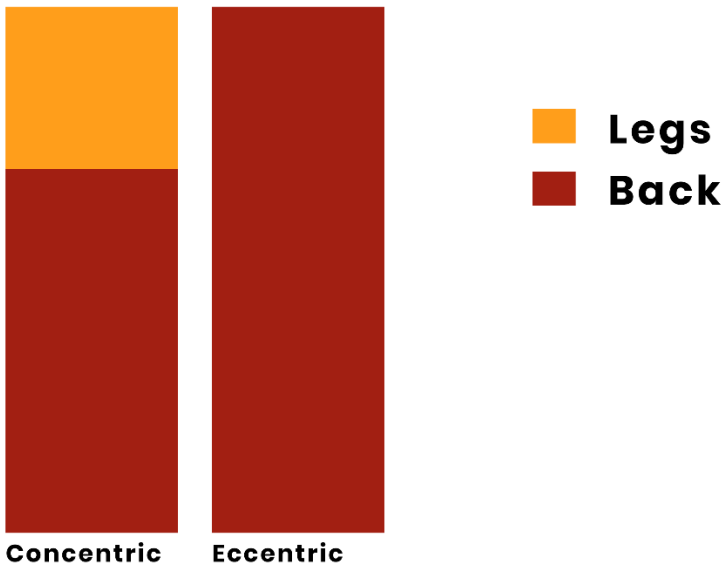

Figure 8.2. Achieving eccentric overload by pushing with the legs during the concentric phase of a rowing exercise.

Users with previous experience in strength rows and flywheel training methodologies had no trouble performing a controlled movement both sliding and with a static seat. It was possible to target the desired muscles and to reap the benefits of flywheel training during seated strength rows and other exercises on the add-on. The design and use of the add-on did not affect the opportunity to use the kMeter and get feedback on their training.

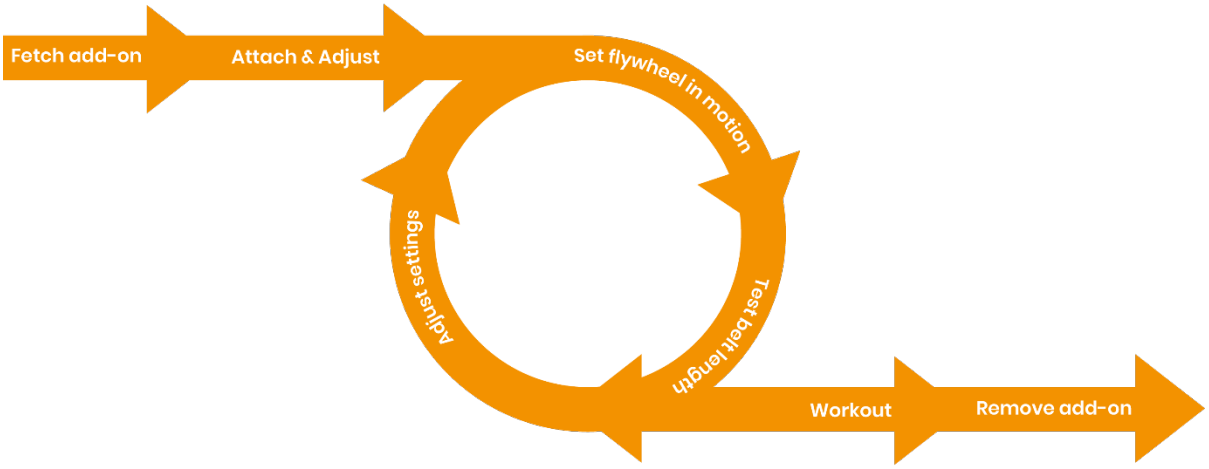

Figure 8.3. User journey without a coach, performing seated strength rows on the add-on usually required the belt length to be adjusted more than once before the starting the exercise.

A user performing seated strength rows on their own had a user journey consisting of eleven elements, see Figure 8.3. With the adjustment of the belt length being the most prominent as it needed to be adjusted up to three times before the desired length was acquired.

During tests with a coach assisting with the settings, adjusting the belt length was shortened to one element. Users performing the exercise without a coach, although being advised to first pull the accessory to their chin to set the belt length, required one additional adjustment at the most. The error margin was 40 mm at the most for the ten users being asked to pull the belt to their chin before sitting down during the tests.

8.5 Manageability

The assembled add-on measured 2218 mm long and 593 mm high, see Figure 8.4.

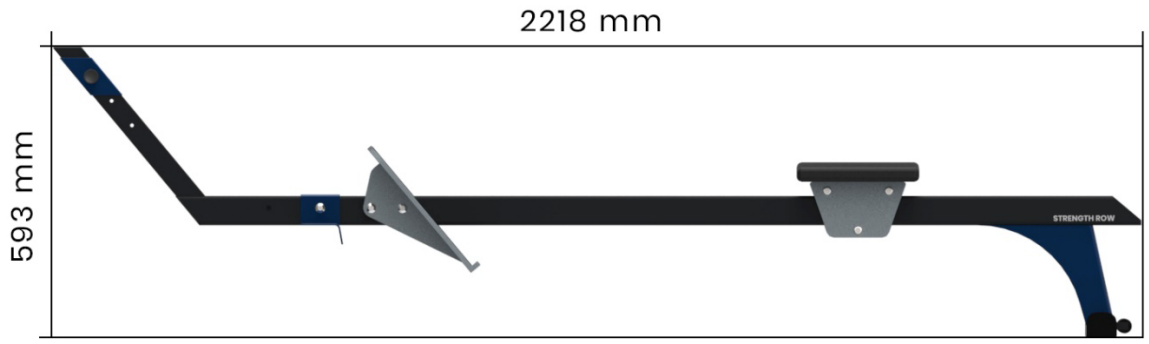

Figure 8.4. The final measurements for the add-on concept.

Being considerably longer than a kBox and to ensure a smooth experience moving the add-on around, it was designed to be lifted at the front, gripping the front beam and rolled on the wheels attached at the rear of the back leg, see Figure 8.5.

Figure 8.5. Move the add-on by lifting it at the front and rolling it around on the wheels.

It could be stored either against a wall or vertically, resting on the wheels and the protruding rear part of the beam to facilitate storage, see Figure 8.6.

Figure 8.6. The add-on standing on the beam and wheels.

Attaching the add-on to the kBox proved itself problematic for most users during tests. The add-on must be placed on the right side, viewed from the front, of the kBox. The construction of the kBox does not allow for the add-on to be placed elsewhere, as it "jumps" during heavy row due to the placement of the belt bite, see Figure 8.7.

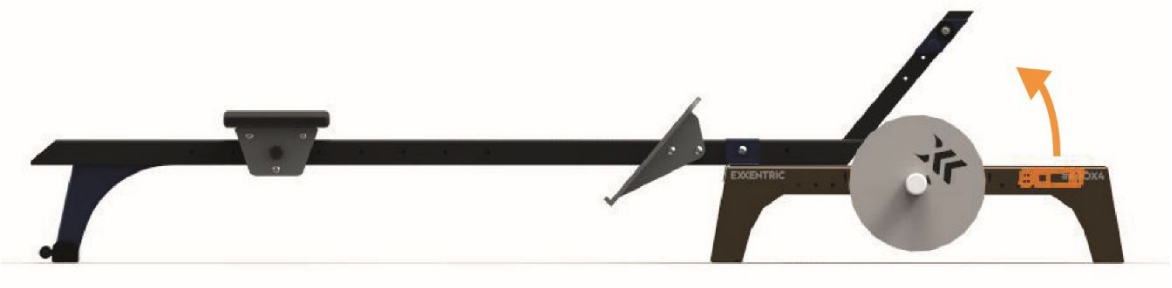

Figure 8.7. The add-on jumps due to the placement of the belt bite and auto retract when placed on the left side from a frontal view.

Currently, the suggested solution to increase the understanding as to which side the add-on should be placed on involved the use of graphics and stickers. An arrow-shaped sticker in a visible colour saying: "Press to release", which is imprinted on the rubber around the belt bite button as well, see Figure 8.8.

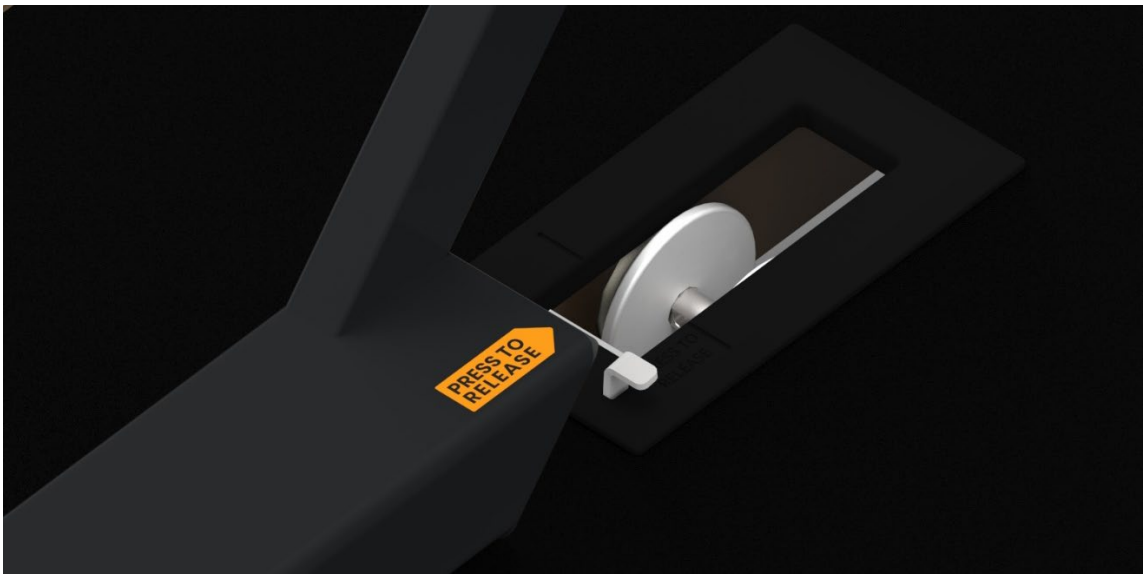

Figure 8.8. Stickers guiding the user to place the add-on on the proper side before use.

9 Discussion

In this chapter, the execution of the project is discussed with regard to methodology, factors that might have affected the final result, the objectives of the thesis and the research questions concerning the project.

9.1 Methods

As *Exxentric* is run as a business, currently selling flywheel-based equipment, it could be considered a bias source of information regarding the possible benefits of flywheel training. Therefore, the theoretical framework for the flywheel training was based on information from other sources. *Exxentric* was used as source of information regarding its existing products, methods and current operations.

With the relatively low number of responses from the reseller survey, all results presented in sub-chapter 3.3 should be critically viewed as the sample could be considered too small to be representative of the entire reseller base. However, in some cases, when a clear majority of the 11 respondents used the same word to describe the company or its products, these results was considered credible enough to act as the basis of discussions carried out during the phase of defining the brand.

Allowing for free interpretation during surveys might have caused associations to differ depending on the way the questions was interpreted. It was however interesting to allow respondents to associate freely as the spontaneous "gut" feeling of the company and its products was what was sought after.

The positioning workshop performed with the Research and Development team at *Exxentric* may have been affected by the fact that participants were employed by the company. As the surveys suggested, the perception of the company may differ depending on if it is viewed internally or externally. For example, *Exxentric* was considered one of the most premium brands in both the strength business and the flywheel business during the position workshop. This was also supported by the in-house survey enquiry where employees described the products with words like "quality" and "Premium", which was only mentioned by one person among the resellers.

Again, considering the low number of responses in the reseller survey as well as the free interpretation of questions, some people might still perceive *Exxentric* and its products as premium. The results from the positioning workshop and the in-house survey could otherwise be a desire from the company to be perceived as a premium brand, which was possible to discuss during the process of defining the brand and later be carried on into product design.

The analysis of competitor's form language was done to create an understanding of the market and to get a sense of how products on the flywheel market looked like. As it partly was a subjective analysis, it was important not to base any decisions merely on these subjective opinions as other people might perceive products differently.

By performing the observational sessions in two different gym during the research phase, reoccurring observations between the two gyms could be considered a better representation as there might be trends in a gym on how exercises should be performed. It could be a certain gym's trainers teaching exercises in a specific way causing all users in that gym to perform a similar execution of an exercise. This could potentially lead to the same mistakes being made or reoccurring knowledge gaps among users. To decrease the margin of error in this case, observations were carried out in gyms where trainers and staff were certified and had extensive experience of physical training.

The five main themes to follow while evaluating the construction of the add-on during the user-centered design process was established based on the user research but were never evaluated and discussed together with the intended users. However, as the themes were mainly used as guidance throughout the process during discussions and tests. Not as the sole base for any decisions being made.

The users during the user tests were not always a part of the intended target group of performance sports athletes but employees at *Exxentric* with experience of flywheel- and strength row training. In these cases, it could have impacted the opinions expressed during tests to be more positive and not as honest about things perceived as bad or in need of improvements. On the other hand, employees of *Exxentric* also want to make sure that products associated with the company are up to a certain standard which was incentive for not holding back harsh feedback or constructive criticism.

9.2 Usefulness of the add-on product

The thesis project was carried out under limitations that the add-on product should not require any changes being made to the current design of the kBox4. This caused several trade-offs to be made throughout the project, impacting the usefulness of the add-on. The placement of the auto-retract and belt bite of the kBox4 restricted the add-on from being placed on either side of the kBox. Instead it needed to be placed on the right side, seen from the front of the kBox, and the best developed option to communicate its placement was using graphics as it proved troublesome to make it intuitive by design.

Another required trade-off was to limit the height of which it was possible to pull from since the belt was not long enough when the pulling position was placed too high. It would have been possible to solve this problem by providing an extra extension strap to use for strength row exercises. However, the add-on product itself was already aimed as an additional product and therefore a second add-on being required to properly be able to use first the add-on was considered to be too troublesome and not in line with *Exxentric's* brand. Hence, the height was restricted to 250 mm above the kBox as a maximum.

Furthermore, in order not to cover the belt bite button to adjust the belt length, the front tower needed to be placed to the left in its current design, with the pull-to-adjust knob on the left-hand side of the tower. It could have been desired to place the tower on the right side as most people is right-handed and as it was considered more intuitive to place the pulley and belt visible from the front of the kBox.

The designed add-on was optimized for use on the kBox4 Pro, however it was requested that it could be used with the kBox4 Lite and Active as well. The Lite and Active are lower than the Pro model and though it appeared stable during tests, it is not certain it will appear premium enough if it would be placed on another device than it was optimised for. It was possible to add a feature to adjust the height of the back leg of the add-on, although this was ruled out as it was considered to make the add-on too complex and less stable with additional components required to be adjusted before use.

Although it was possible to adjust the belt length to a decent estimate by pulling the accessory used for strength rows to the chin before sitting down on the add-on, it was still not a perfect solution. To be able to adjust the belt length from a seated position on the add-on would be preferred whenever the user is not training with a coach, trainer or partner being able to assist. A mechanical solution to address this need might be possible, however, it proved too complex of a task to be performed for the duration of the thesis.

9.3 Product line

The business case with the add-on was to increase average order value and after sales business according to the PID. As such, the add-on is intended to be sold either together with minimum one kBox model or to customers who previously purchased a kBox. If it should be possible to use it with any kBox model it should, being an add-on product, be sold for less than the lowest priced main device, the kBox4 Active.

Since the add-on allows for additional exercises being performed other than seated strength rows, it could be considered to provide more value for money compared to if it only was possible to perform one exercise. However, allowing for several horizontal exercises, it could be competing for sales with the kPulley, the device optimised for horizontal exercises.

Increasing order value does not only have to be whenever someone orders a kBox, it could be when someone makes a larger purchase of several different devices. In which case, if customers choose to purchase a kBox with the add-on over buying a kBox and a kPulley, the average order value would decrease. It could also be the case that customers prefer to purchase a kPulley over the add-on, if the price difference between the two is too low and perform seated strength rows with the kPulley seated on a bench while getting the complete device optimised for horizontal movements.

9.4 Targeted segment

Performance sports athletes and coaches have high standards for the equipment they use in their training. They have experience, a frame of reference in previously used products and clear goals with their training. Flywheel resistance training provides benefits over traditional training with weights that allows users to enhance their training and to better achieve their goals. However, it is important that any product targeting the segment of performance sports should, in addition to provide the benefits of flywheel training, also allow for the intended exercise to be performed excellently whilst living up to the quality standards users have on their equipment.

Considering the trade-offs required for an add-on product to the kBox, if a perfect row experience is desired it might be necessary to investigate the possibility to develop a stand-alone product which can be optimized for seated strength row without the pre-existing delimitations that comes with developing an add-on product.

Having a defined user segment was important as a product which aims to fulfil the needs of a too broad segment would not be optimized for any user's needs as different groups generally have different prerequisites. However, although the performance sports segment might not be the best fit for an add-on device, it might be better suited for a different segment.

10 Conclusions

An add-on product for seated strength rows on *Exxentric's* kBox device provided a better strength row exercise than what was possible on current devices. It provided the best opportunity for eccentric overload training during seated strength rows and the possibility to perform an additional four new exercises. It was possible for users with previous experience of flywheel training methods to perform a safe and correct motion with the possibility to enhance the training of their back muscles and biceps.

A visual brand language for *Exxentric* should communicate *Strength* and *Effectiveness*. Products should be designed to feel *Innovative*, *Inviting* and *Premium*.

How it manifests in product design is confidential.

The visual Brand Language could be implemented in the product design of the add-on product through specific shapes, significative details, materials being used, logo placement and colour.

To properly answer if *Exxentric* can strengthen their business with an add-on for seated strength row, this issue needs to be addressed further.

10.1 Recommendations and future work

It is recommended that *Exxentric* develop a beta-prototype which can be used to properly evaluate the usefulness of an add-on for seated strength row. Once the usefulness of the add-on to the kBox have been established, its place in the product line should be considered with regard to the different user segments as well as existing- and future devices. Stakeholders to consider for the evaluation of the add-on includes:

- The person making the purchase.
- The person assembling it.
- The trainer instructing users.
- The person training with it.
- The person handling the maintanance.
- The person disposing of it.

It should also be investigated what the usefulness of an add-on product, allowing for the same exercises, might be for the kPulley. Moreover, it should also be investigated how a device of its, own allowing for seated strength row, would fulfil user needs. Thereafter, it can be answered if add-on products are in line with Exxentric's brand and vision and ultimately, it can be evaluated if Exxentric can strengthen their business with a flywheel-based, seated strength row product.

Future work that can be done to further improve the kBox add-on for seated strength row to develop the beta-prototype includes:

- Overseeing the manufacturing suggestions as they currently only are suggestion and might not represent the most effective way to manufacture the different components.
- Conduct durability calculations. It was assumed that components would be over-dimensioned but as it can be desirable to keep the weight down for shipping and moving

it around, it should be considered to optimize the dimensions and still meet the requirements of the requirement specification.

- Further develop the interface to make the design more intuitive as to where the add-on should be placed on the kBox.
- Develop a manual to provide information of how to assemble the product upon delivery and test it with intended users.
- Consider developing a V-bar grip for rowing exercises on the add-on, as it is the most commonly used accessory for low, seated strength rows.
- Evaluate if a bumper is necessary to protect the pulley part. The suggested concept allowed for 400 mm of space between the placement of the feet and the nearest position for the pulley, which during seated strength rows should be enough when performed correctly.
- Investigate an improved way of locking the seat which would not be dependent on pre-drilled holes but could easily be locked in place anywhere on the sliding beam.
- Add a loop or hook on the front of the seat where the belt can be attached to make it easier to perform the hand standing crunches.
- Consider if the powder coated surfaces will become worn down by the moving parts in contact with them. Especially the seat on the beam and the active, sliding pulley part on the height adjustment tower.

All identified improvements as to how and where the product design guidelines can be improved are confidential.

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11.1 Figure references

1 Introduction

1.1 [YiRong Na]
1.2 [Jonathan Henriksson, Model: YiRong Na]
1.3 [YiRong Na]
1.4 [Jonathan Henriksson, Model: YiRong Na]
1.5 [Exxentric, assembled by: Jonathan Henriksson]
1.6 [https://www.starkmagasin.se/magnusfrischenfeldt/2014/02/08/rehab-och-os/]
1.7 [Jonathan Henriksson]
1.8 [Jonathan Henriksson]

2 Frame of reference

2.1 [Exxentric AB]
2.2 [Exxentric AB]
2.3 [Exxentric AB]
2.4 [Exxentric AB]
2.5 [Jonathan Henriksson]
2.6 [https://www.privatetrainingonline.se/sittande-kabelrodd/]
2.7 [http://crossfitbeyond.com/blog/columbus-day-rowing-clinics/]
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3 Defining the brand

3.1 [http://www.desmotec.com/]
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3.4 [https://originfitness.com/impulse-sterling-incline-chest-press]
3.5 [https://www.indiamart.com/proddetail/lat-pull-down-machine-13310010855.html]
3.6 [Jonathan Henriksson]
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4 Design guidelines

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5 Research for the rower add-on

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6 Construction

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7 How the guidelines were implemented

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8 Results

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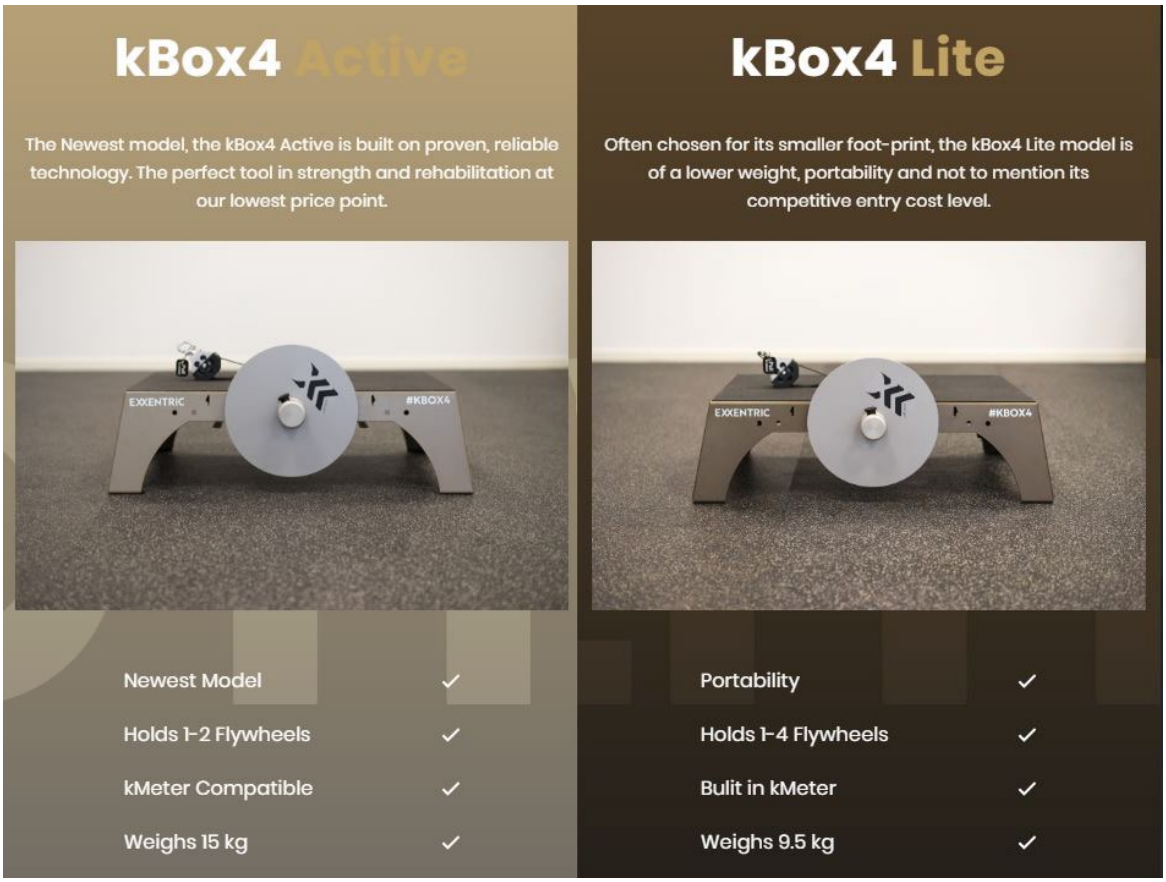
Appendices

The appendices referred to throughout the thesis report are presented during this chapter. They appear in chronological order according to when it first was referred to in the report.

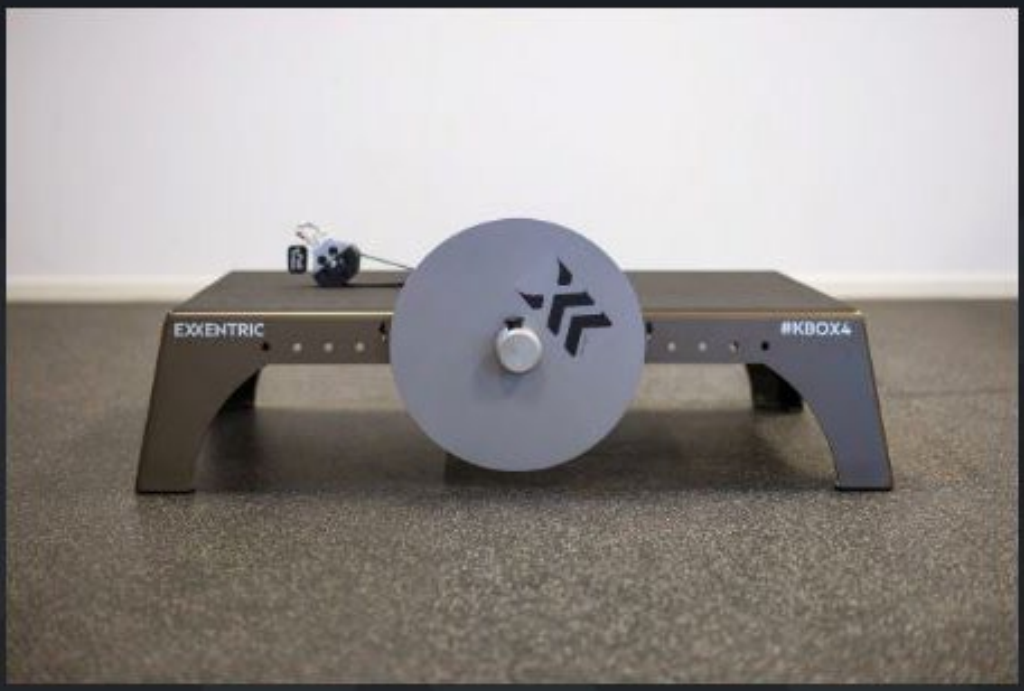
A. kBox 4 variants

The three variants of the kBox 4 sold by *Exxentric*. They range the Pro model which is the most premium device to the Active model which is the cheapest with the least number of features. Lite is the model in between the two with the same size as the Active but can carry more flywheels and is lighter as well.



kBox4 Pro

The kBox4 Pro is our premium model with the greatest versatility. It's ideal for sports teams and larger training and physiotherapy facilities.



- Largest Floor Space ✓
- Holds 1-4 Flywheels ✓
- Built in kMeter ✓
- Weighs 15.5 kg ✓

B. In-house Survey questions

In-house, the survey enquiry focused on how employees would describe the company- and its products using three words, defining what the company was selling and to answer which products two products they associated the most with the company. It was kept brief in to generate as many answers as possible and anonymous to encourage honest responses. It was a free interpretation of the questions, which was expected to make it easier to catch respondents' gut-feeling of the brand and products. The questions were:

Q1: What three words would you use to describe Exxentric?

Word 1: ……

Word 2: ……

Word 3: ……

Q2: Complete the following sentence:

Exxentric is selling…….

Q3: What three words would you use to describe Exxentric's PRODUCTS?

Word 1: ……

Word 2: ……

Word 3: ……

Q4: Which two products do you associate most with Exxentric?

First product: ……

Second product: ……...

C. Reseller survey questions

The survey enquiry sent out to the resellers contained three questions in order to genereate as many replies as possible. The questions were similar to the survey questions for the company *Exxentric*, see Appendix E. Questions included using three words to describe the company *Exxentric* and its products respectively. They were also asked to name the two products they mostly associated with the company. The layout of the questions was:

Q1: What three words would you use to describe Exxentric as a company?

Word 1: ……

Word 2: ……

Word 3: ……

Q3: Which two products from our product line do you associate most with Exxentric?

First product: ……

Second product: ……...

Q2: What three words would you use to describe Exxentric's PRODUCTS?

Word 1: ……

Word 2: ……

Word 3: ……

D. Interview questions

The interviews were semi-structured and performed across four gyms in the Stockholm region with eight interviewees. They were conducted in Swedish and focused on preparation, techniques, needs and opinions about existing rowers in the gym environment. Both Cardio rowers and Strength rows were of interest although the primary focus was on the strength row.

There were two sets of questions, a longer aimed at personal trainers and gym owners and a shorter for people training in the gyms. In the shorter list of interview questions it is also listed some key points during observations in a gym environment. The questions were:

Starters

- Hur länge har du jobbat som (personlig) tränare?
- Hur kom det sig att du ville bli det?
- Vilken typ av idrott eller träning har du hållit på med tidigare?
- Är roddövningar något du använder dig av mycket till dina klienter (och dig själv)? Vilka klienter – några specifika som du lägger in roddövningar för?

Broad

- Gå igenom tekniken med mig från början (som att det är första gången jag ska köra).
- Vad brukar folk ha problem med vid roddövningar i denna maskin?
  - Utförande
  - Maskin: Sätta sig, handtag, vikt, nå fram, start/slut
- Vad tycker du om den här maskinen? (Funktionalitet)
  - Byta vikt
  - Sits
  - Handtag
  - Fötter
  - Höjd
  - Balans
- Hur tycker du att den skulle kunna förbättras?
- Vad tycker du om utseendet av maskinen?
- Är den lätt att sätta ihop/ flytta?
- Vad är viktigt att en roddmaskin uppfyller för att vara bra?

Specific

- Vilken höjd instruerar du att armarna ska hållas? Mot vilken punkt på kroppen skall handtaget dras mot?
- Föredrar du ett fast säte eller ett rörligt?
- Vilken position tycker du att fötterna ska vara i? (Är detta ett bra läge?)
- Hur pass utsträckta/ böjda ben ska man hålla?
- Har du varit med om att en maskin har gått sönder? Hurdå?
- Hur tycker du att sittande (styrke)rodd står sig som övning gentemot andra roddövningar (hantelrodd, skivstång, stående, maskin)
- Är det någon skillnad beroende på om man är lång eller kort i användandet av maskinen?

Interview questions users (Shorter)

Starters

- Tränar du här ofta?
- Vad tycker du om gymmet?
- Vad tränar du idag?

Broad

- Brukar du köra roddövningar? (Varför/ varför inte)
- Vad tycker du om maskinen?
- Vad är svårt med övningen?
- Vad skulle kunna förbättras i maskinen?
- Vad tycker du om dess utseende?
- Hur upplever du den här roddmaskinen jämfört med andra roddmaskiner?

Observations

- Sitta upp/ ned
- Säte
- Byte av handtag
- Ändring av vikt
- Använder inspänning
- Fotplacering
- Lägger/ ställer bort flaska, nycklar etc.
- Vad görs vid påbörjan?
- Direkt efter?
- Mellan set?
- Placering av maskinerna

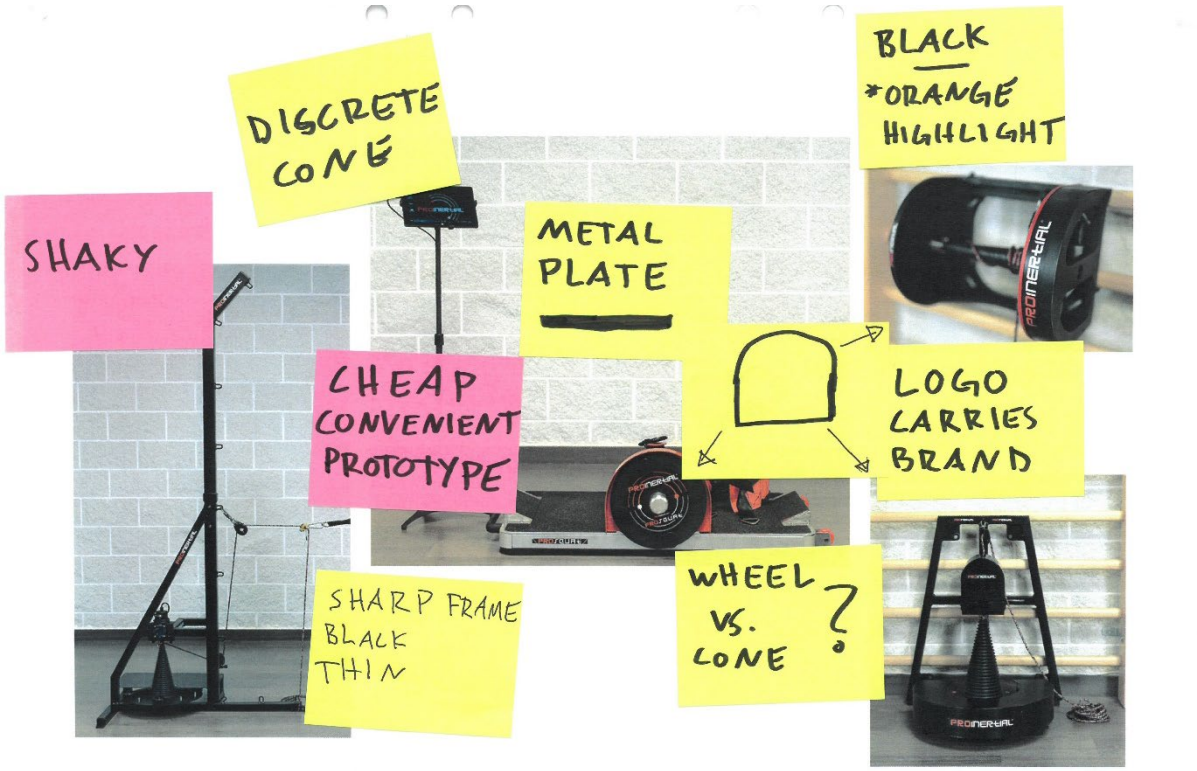
E. Flywheel market analysis

Analysis of seven companies active on the flywheel market based on visual brand language. Yellow post-it comments are objective observations of products material, colour, branding focus, coherence within the product line and aesthetics. Pink post-its represent the subjective impression of the products and brand.

Coneline:

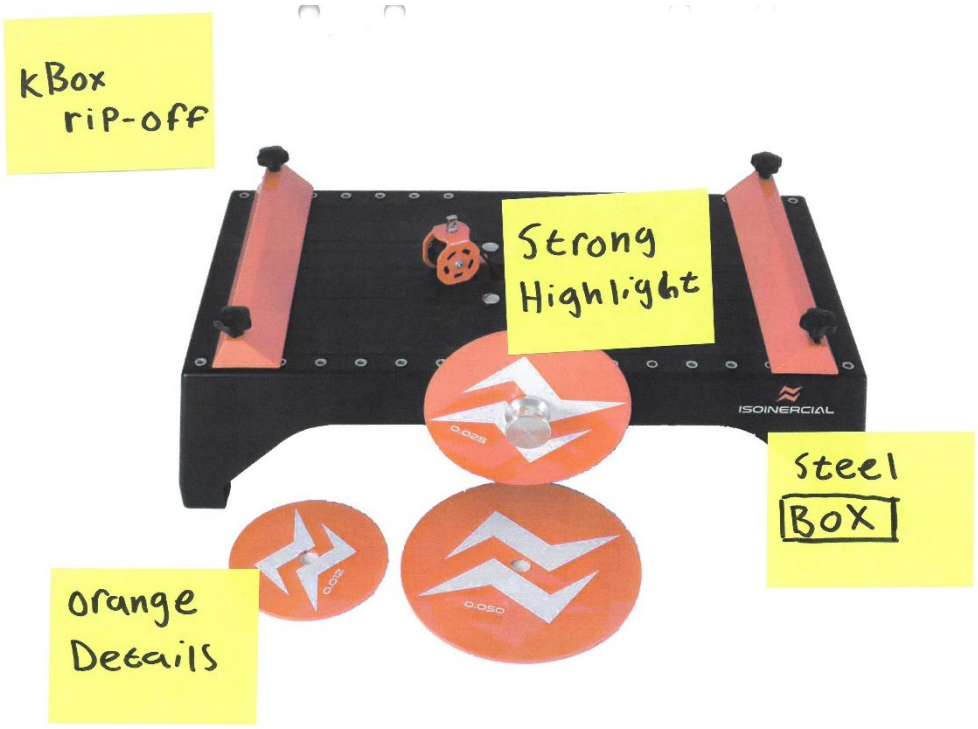
Spacewheel:

Proinertial:



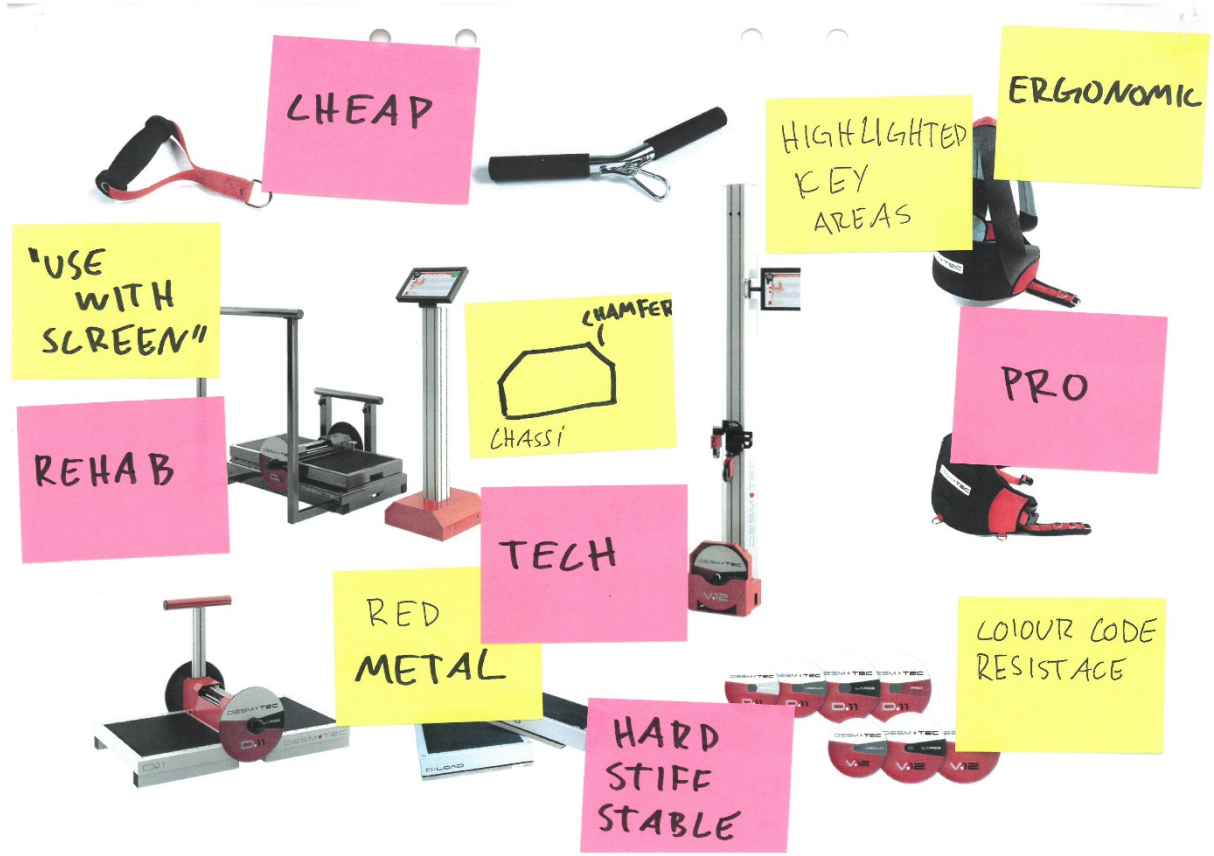
nHance:

Isoinercial:



Flycon Rower:

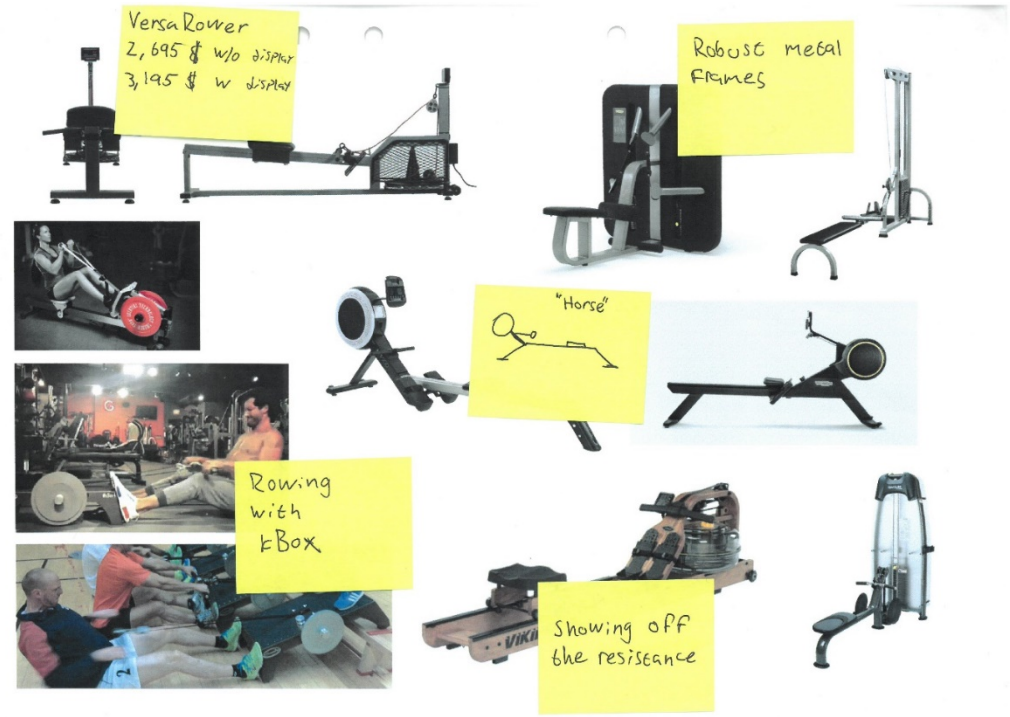
Desmotech:


CHEAP
ERGONOMIC
HIGHLIGHTED KEY AREAS
"USE WITH SCREEN"
CHAMFER
CHASSI
PRO
REHAB
TECH
RED METAL
COLOUR CODE RESISTACE
HARD STIFF STABLE

F. Analysis visual brand language gym machines

An analysis of the Rower and gym machine market. Rowers included strength rows, cardio rowers and different approaches to flywheel-based seated strength rows.

Trends were spotted among the gym machines with most machines on the market either being possible to categorize as “powerful”, “rehab looking” or fairly insipid in their design with plain beams and weight stacks.



Power

"normal"

Rehab/ soft

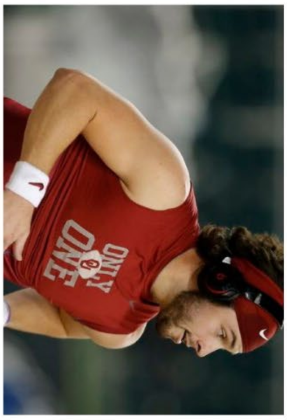
HQ
Elegant/Nordic

"normal"

Rehab

G. Personas

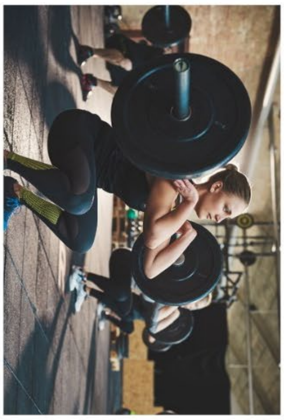
As part of the Design Platform and the product branding part of it, three personas were defined in order to better describe who the users of *Exxentric's* products were. The goal was to introduce not only how users train with products but how they got introduced to them as well as what their goal is with their training.



The college athlete
23, American football, Oklahoma, USA.

- Driven by something more than lifting weights. The goal is not to get stronger in the gym, it is to get stronger on the field.
- Wants to be drafted by a professional team, uses flywheel training to get a competitive edge.
- Often performs his physical training together with a strength & conditioning coach and knows exactly which muscles to train and how to best do so for maximum results.

Got introduced to flywheel training during the pre-season as a part of the workout regime to get stronger and prevent injuries for the upcoming season. Thinking about getting a kBox for himself to further spike his off-season training.



The personal trainer
29, Fitness, Amsterdam, Netherlands.

- Training every day and plans her meals preparing for her first crossfit competition next month.
- Likes to train functional and improvises exercises with the kBox to train multiple things at the same time.
- Wants to be able to perform supersets and is after the benefits of eccentric overload in her training.

Uses the kBox and kPulley at her gym to get stronger and as a complement in her training but measures results in her improvements in other exercises.

The weekend warrior
54, Full time office worker, Stockholm, Sweden.

- Injured his knee playing badminton, got introduced to flywheel training during his rehab by a physiotherapist.
- Busy life but tries to stay healthy by taking the bike to work every day, just want everything to work.
- Important to be able to focus on specific exercises and maintaining full control during the movement to prevent further injury.

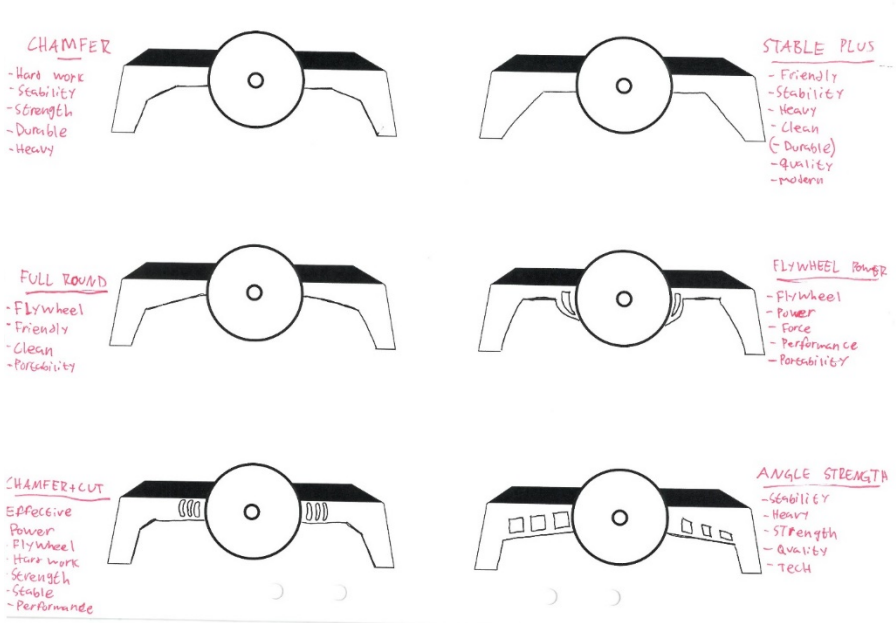
Had a hard time to grasp the concept of flywheel training at first. Realised the benefits of flywheel training when he worked with a physiotherapist, after which he bought one to keep at home as his primary strength training device.

H. kBox cut-out variations

When it was decided that the outer shape was to be kept on the kBox and the cut-out was identified as a good shape to work with as the existing cut-out shape was not purposely designed to communicate anything in particular. A series of sketches were produced, from which the six most promising shapes were analysed further against the benefits that *Exxentric's* products should communicate according to the Design Platform.

The initial sketches of the kBox cut-out shapes:

The six most promising shapes were analysed further:



The final cut-out shape chosen to include in the design guidelines is confidential.

I. Project Initiation Documentation

The Project initiation documentation was the starting point of the project and had acted as the basis for the first requirement specification. It defined the desired outcomes, background, business case, users and a rough project plan.

Project initiation documentation

Project title: kRower

Project definition

kRower will be an add-on device allowing for heavy (strength) rowing on the kBox 3 and 4.

Background

Exxentric has seen a usefulness for an add-on device turning the kBox 3 and 4 into a specific seated rower.

Desired outcomes

The desired outcome of this project is:

A fully functional kRower add-on with the requirements stated for this project.

Project scope and exclusions

The project will design a cost efficient, compact rower add-on to the kBox 3 and 4.

Packaging:

Sold as package ready for training, total weight packed <30 kg in cardboard box with 4-color printed case. Research for optimized dimensions needs to be carried out before final measurements.

Sales channels:

Via distributor and Exxentric (manual and webshop). Mainly direct to customer.

In scope

Design of the add-on and it's attachment to the kBox 3 and 4 (direct or via interface) with use of as many standard components as possible.

Form language and semiotics needs to be considered in order to ensure the product communicates Exxentric's values and is appealing to the target audience.

Pre-assembly and final assembly procedure to allow for efficient and fool-proof assembly and low transportation cost. (Design for Assembly).

Cosmetics design (color, stickers etc) is important and in the scope for the finished product.

Out of scope (Thesis)
Manufacturing and production planning.

Investigate optimal angles and height settings for users to minimize friction loss and also quantify this loss. (Maybe, friction loss and height settings will depend on the suggested concept and design and will therefore be in scope if necessary)

Constraints and assumptions
The project will not rethink the kBox4 design. The current suppliers shall be included in the process. Reuse existing flywheel and interface.

The user(s) and any other known interested parties
Customer is end user and not end user.

Customer segment: Sportclubs, gym, private persons, research facilities, medical institutions, uniformed services.

Research into whom it will be most relevant for and for which purpose in their training (might affect function and thereby design).

Interfaces
The kRower should work with kBox3 and 4 direct or via interface. Interface for integration into future kBox generations (minimise future restrictions).

Business case
The value for Exxentric with this product add-on on is to increase average order value and after-sales business and not mainly to widen the target audience.

Health and safety
Design of protective measures is part of this project but warning labels are part of the product but not this project.

Security and risk assessment
SWOT - To be performed as an evaluation of the suggested concept.

Legal requirements
Will the transition toward consumer product segment create need for legal requirement analysis? Consumer product regulations in the desired markets will be investigated by lawyers in a separate project.

Procurement strategy
Enable dual sourcing and sourcing from regional suppliers (Europe).

J. Initial Requirement Specification

The initial requirement specification was derived from the PID, see Appendix K. In it, 22 points were listed as either “must” or “should” requirements. Furthermore, requirements were categorized according to if they were “technical”, “dimensions” or “functional” requirements.

Project	kRower			
Date	20171030			
Version	0.1			
Nr	Requirement	Type	Category	
EX1		Must	Technical	
EX2		Should	Dimensions	
EX3			Functional	
1	Be able to ship in a box smaller than, or same size, as kbox Pro box, dimensions: 988x668x234 mm	Must	Dimensions	
2	Be able to assemble with minimal amount of very general tools	Must	Technical	
3	Feet should not damage floor and not slip	Must	Functional	
4	Weight less than 30 kg packed	Must	Dimensions	
5	Settings for users of different height (high row tall person, low row short person)	Should	Functional	
6	Be able to hold on to the kBox and not move with forces up to 3000 N	Must	Technical	
7	Sliding seat that easily can be fixed (single grip adjustment)	Should	Functional	
8	Be easy for one person to attach and detach to the kBox without any tools	Should	Technical	
9	Angles should be optimised in terms of friction loss	Should	Functional/Technical	
10	Have adjustable foot plates (angle, size)	Should	Functional	
11	Parts Cost < 150 USD in serial production of around 100 units	Should		
12	Bumper	Must	Technical	
13	Make sure that k-meter app can be used with kRower with accurate results	Must	Technical	
14	Dummy proof attachment	Should	Technical	
15	Be able to hold the weight of a person of 150 kg	Must	Dimensions	
16	Holder for Mobile/iPad	Should	Functional	
17	Weigh around 10 kg	Should	Dimensions	
18	No tools used for assembly	Should	Functional	
19	Minimal maintenance required	Should	Functional	
20	Fit kBox:3	Should	Functional	
21	Fit kBox4	Must	Functional	
22	Should be able to use without using arms (use as legpress)	Should	Functional	

K. Round 1: insights from the field research

Post-it notes were rearranged for three iterations with the first round focusing on gaining insights regarding different features of existing rowers. Some of the key insights from the first round included:

- Needs to be easy to change exercise for multiple people using the same device.
- A sliding seat promotes the use of leg muscles during exercise.
- A static seat makes it easier to isolate and focus on training the back muscles.
- Important to consider placement for static foot plates.

L. Round 2: insights from field research

Post-it notes were rearranged for three iterations based on the findings from the interviews and observations. The second round focused on actions performed during the use and potential risks associated with the exercise and the possible addition of a flywheel resistance. The key insights from the second round were:

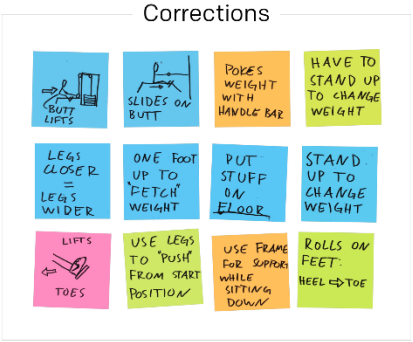
- Different height settings allow for multiple exercises being performed and increased adaptability for users of different height.
- It is important to have an intuitive attachment for switching between exercises.
- Hard to sit down and get up from lower seats for users with weak knees.
- There is a possibility to utilize a sliding seat for eccentric overload during flywheel rowing.
- Stability is more associated with strength rows and balance with cardio rowers.
- It is hard perform the motion correctly on both cardio- and strength rowers.

Risks identified for potential rowing exercises on a flywheel-based rowing device:

- Overstretching the knees at the turning point of the motion if the flywheel pulls back to fast.
- Falling back due to the belt being too long or using too low inertia to pull the user back.
- Get thrown forward due to eccentric overload being hard to handle.
- Possibly unbalanced to overload with a sliding seat.
- Hitting the knees with the attached accessory used with high force due to eccentric overload.

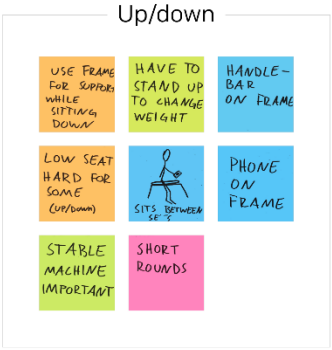
Risk 1: leg movement

Corrections

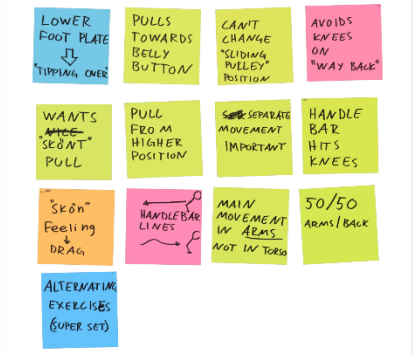


Risk 2: hit knees

Up/down



Height setting



Change strap length

Intuitive

M. Round 3: insight from field research

For the third and final round of clustering post-it notes together to gain insights from the interviews and observations was done linearly with post-its sorted chronologically and focused on gaining insights of points to consider for an add-on product aimed at seated strength rows. The final session generated further insights on points to consider while constructing a flywheel-based device:

- Consider how to adjust the flywheel inertia.
- Adjusting the length of the belt before the action commence.
- Changing the handle or accessory between exercises.
- Attaching the add-on to the kBox.
- Raising the head up is important for the movement.
- Keep users from rolling on their feet during heavy strength training.
- How to set the flywheel in motion to start the exercise.

N. Requirement specification 2.0

The updated requirement specification which was developed at the end of the research for the rower add-on. The requirement specification was based on the previous one, see Appendix J, with some additions based on insights from the user-centered design process. The entire requirement specification read as follows:

Functional criteria

Required

- Have something that stops the accessory from crashing into the pulley of the add-on.
- Make sure that k-meter app can be used with add-on with accurate results.
- Fit kBox 4 Pro.
- Be possible for one person to attach and detach to the kBox without any tools.
- Does not damage the kBox via the interface.
- Provides foot support.
- Allows for the correct motion of a seated strength row to be performed.

Requested

- Be possible for user to assemble with the same toolkit which is included in the kBox4 shipment.
- Feet should not damage floor and not slip.
- Settings for users of different height.
- Provide the possibility to perform eccentric overload training.
- Angles should be optimised in terms of friction loss.
- Have adjustable foot plates (size, angle)
- Fool proof attachment.
- Holder for Mobile/ iPad.
- Minimal maintenance required. - Usually belt and wheels that brake according to interviews.
- Fit kBox3.
- Fit kBox4 Lite and Active.
- Should be possible to perform additional exercises with the add-on.
- Be possible for users to adjust the belt length from a seated position.
- Be possible to set the flywheel in motion from a seated position.
- Be easy to store in a space-efficient way when it is not in use.

Limiting criteria

Required

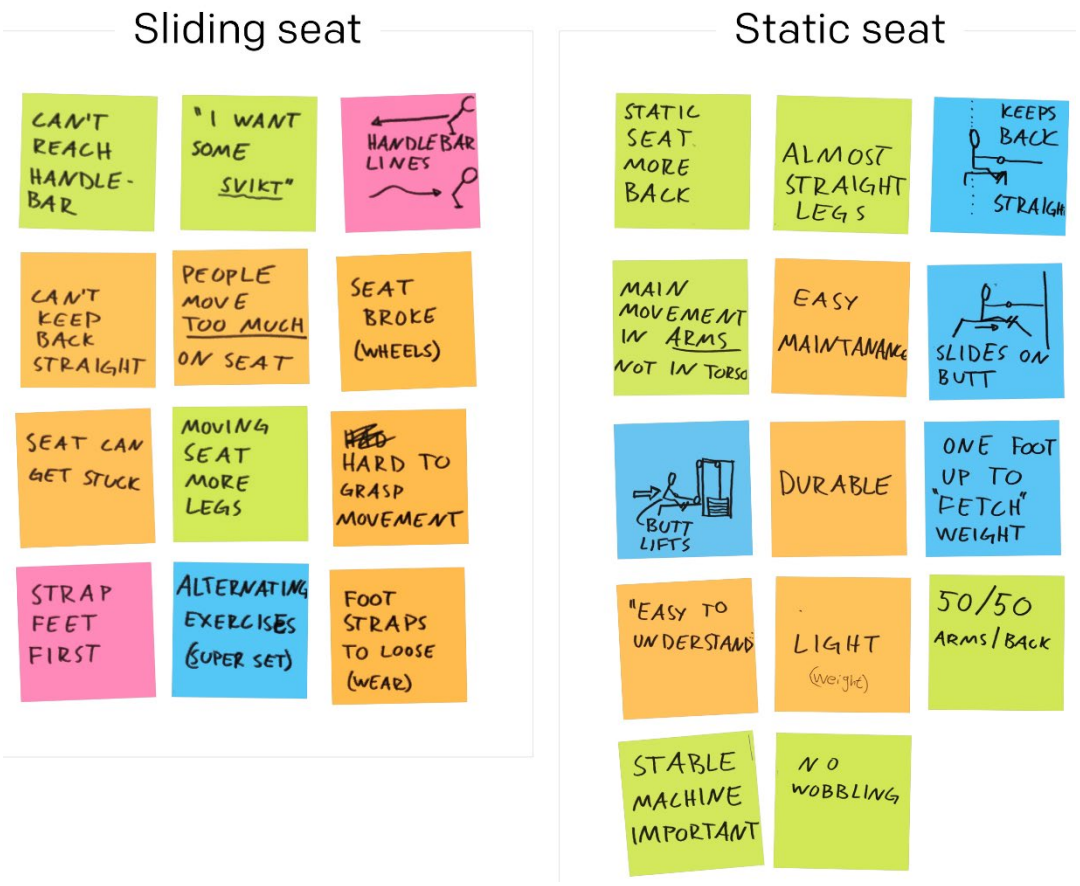
- Weigh less than 30 kg packed.
- Be able to hold on to the kBox and not move with forces up to 3000 N.
- Be able to hold the weight of a person of 150 kg.
- Sitting beam length minimum 950 mm.

Requested

- Parts Cost < 150 USD in serial production of around 100 units.
- Weigh under 10 kg.
- Beam length 1000 mm.
- Foot plates should be minimum 330 x 120 mm.
- Be able to ship in a box as small as possible.
- Should not be wider than any kBox it is attached to.

O. Sliding seat evaluation

The starting point for the construction process was to decide whether a sliding seat should be used, like those on cardio rowers, see Figure 2.7, as such a feature would greatly impact the functionality of other features. The add-on was intended as a strength row which, as the research suggested, was benefitted by a static seat which was more stable and allowed for better focus on the muscles.



In addition to clustering the information from the user research, pros and cons with each solution was listed. For a seated strength row, the sliding seat would provide cons whilst the static seat appeared more beneficial, see Table 4. However, it was decided to use a hybrid solution with a sliding seat that could be locked in place. The possibility to perform strength rows with eccentric overload through the use of the legs with a sliding seat as well as the possibility to perform additional exercises was the most prominent deciding factors for the sliding seat.

Table 4. The pros and cons of the sliding- and static seat.

Sliding Seat		Static Seat	
Eccentric Overload	More components	Focus on back	Less exercises
More exercises	More Maintenance	Safer	Harder to reach grip
Easier to reach	Hard with controlled motion	More durable	Harder so set flywheel in motion
Activate more muscles	Potentially less focus on back	Easier assembly	Less adaptability
	More expensive	Cheaper	Larger seat
	Increased risk of injury	More stable	

P. Construction of foot plates

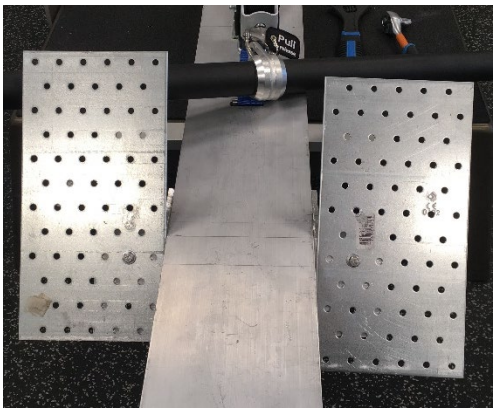
The placement of the foot plates correlated to the height of the seat. To give a more robust impression and to keep the number of moving parts down, static footplates was chosen. Although adjustability and performance were a priority, the durability, stability and manageability benefits that static foot plates provided took priority in this case.

Deciding the placement and angle of the foot plates was done in correlation to the height of the seat and the placement of the front pulley. They were placed 400 mm from the pulley position at an angle of 50° relative the beam.

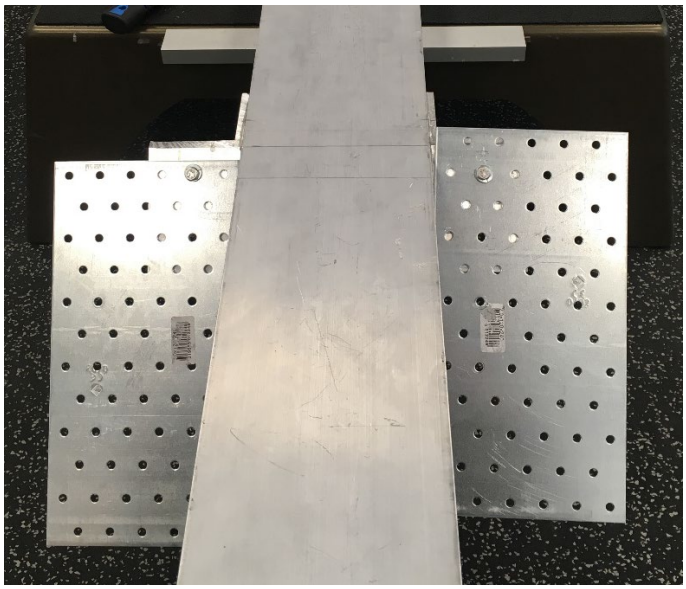
The design process was iterative and occurred with frequent user-testing. The proof-of-concept prototype had foot plates with an angle that was considered to steep for most users:

To address this problem, the footplates were changed from wooden to steel plates allowing for more freedom to experiment with the vertical and angular placement.

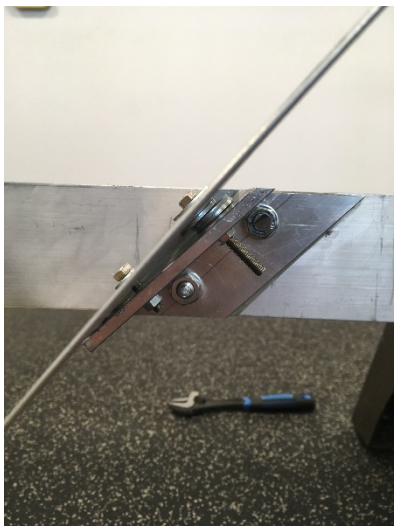
High placement:



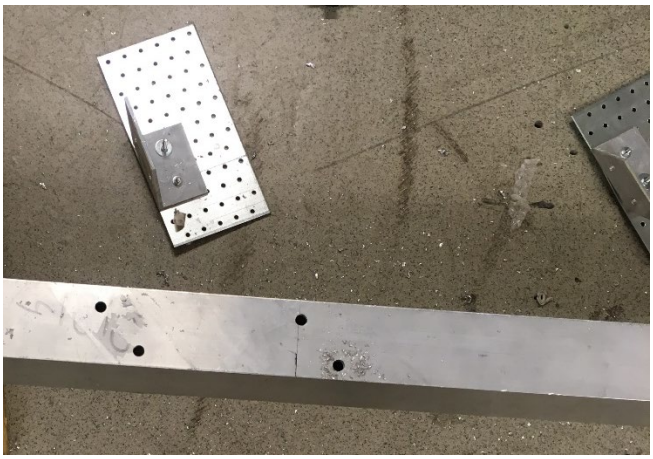
Low placement:

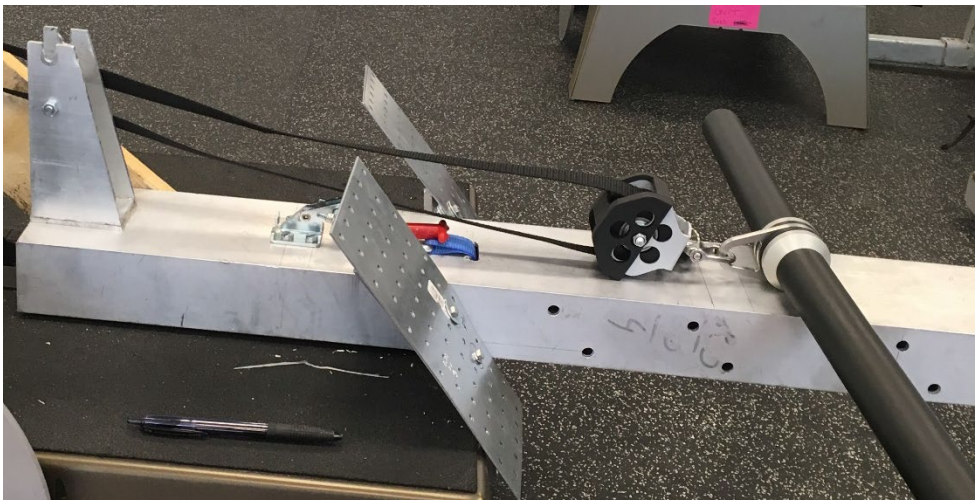


Adjusting the angle with metallic washers:



Testing the horizontal placement on different distances from the pulley at the front:



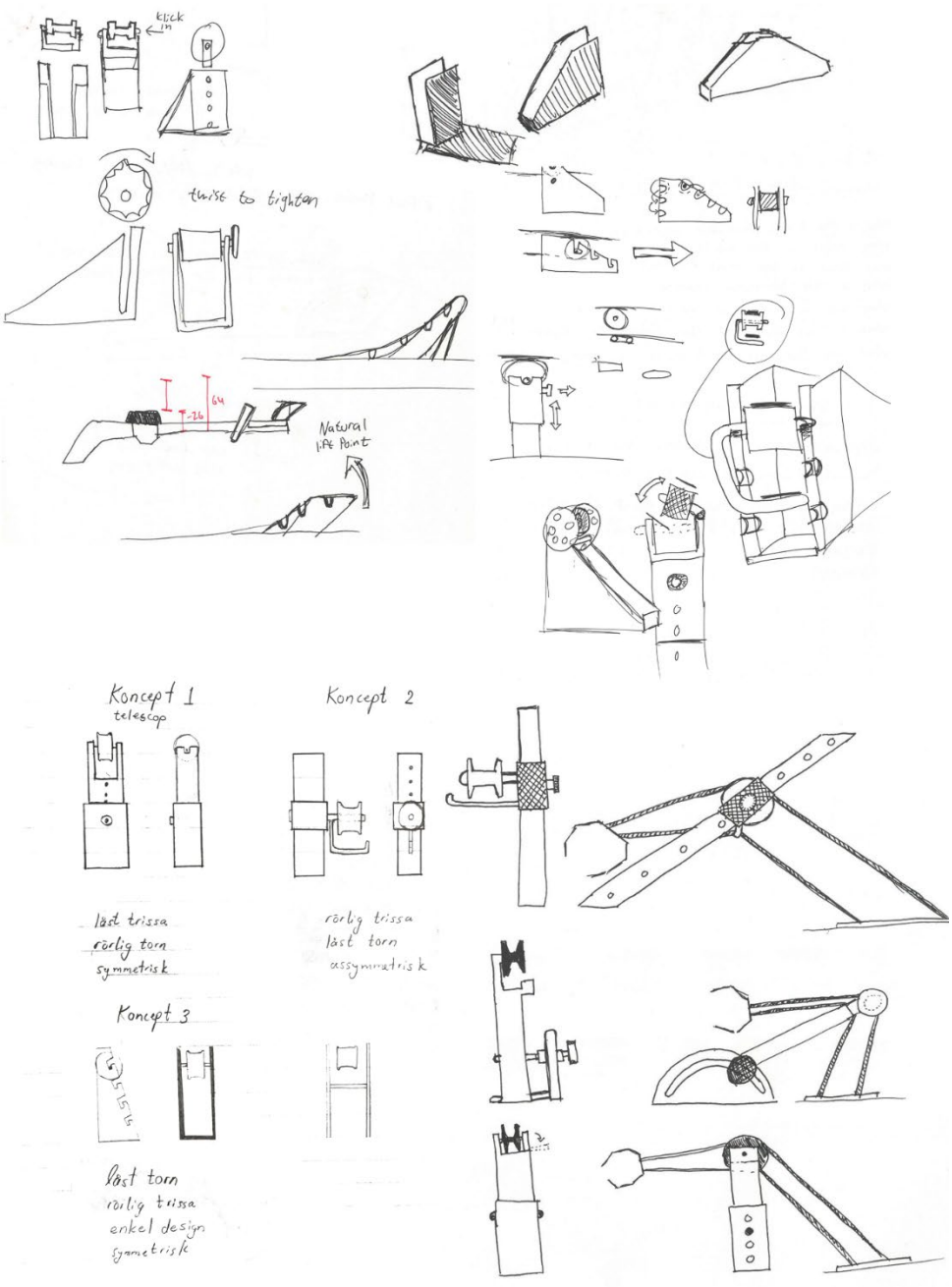


After 400 mm from the front pulley was decided to be a good distance, the stability was tested with the addition of first straps, followed by a heel support:

Q. Height adjustment construction

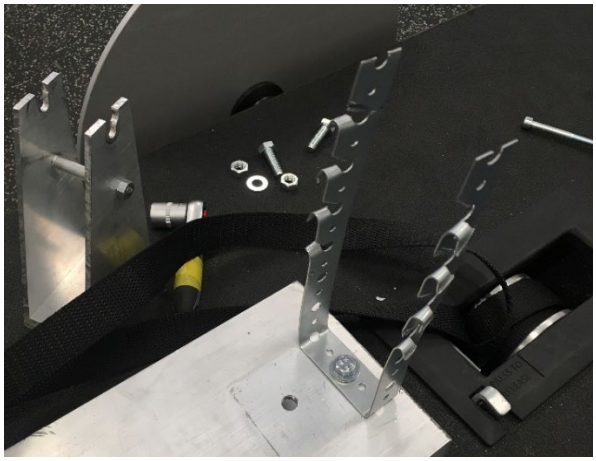
The process of designing the height adjustment was based on the feature to be placed at the front of the add-on. Concept ideation starting with sketching and carried on into mock-up and prototype testing of the most promising concepts.

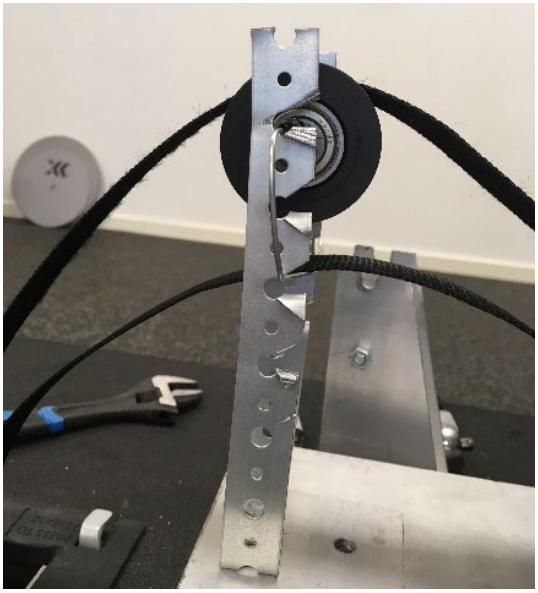
Exploring concepts through sketching:

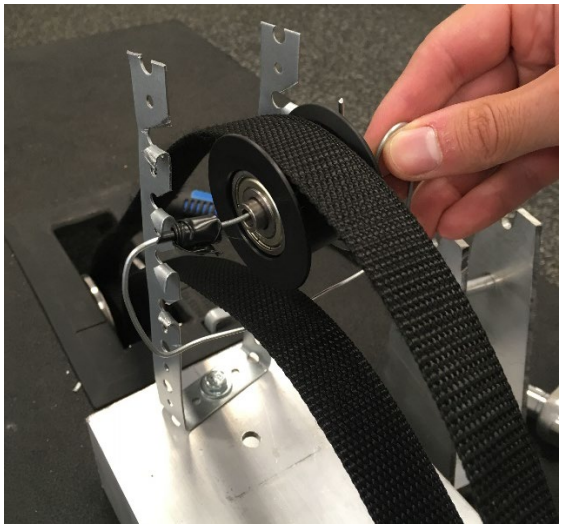


The existing “tower” at the front of the proof-of-concept prototype was removed and replaced with a tower that made it easier to adjust the height of the pulley after the belt had been put in place. Figure of the proof-of-concept pulley part:

The first prototyping test with a solution that would allow for more freedom of adjusting the height. The solution did not feel premium and was considered to be too complex for the user to adjust the height setting with:





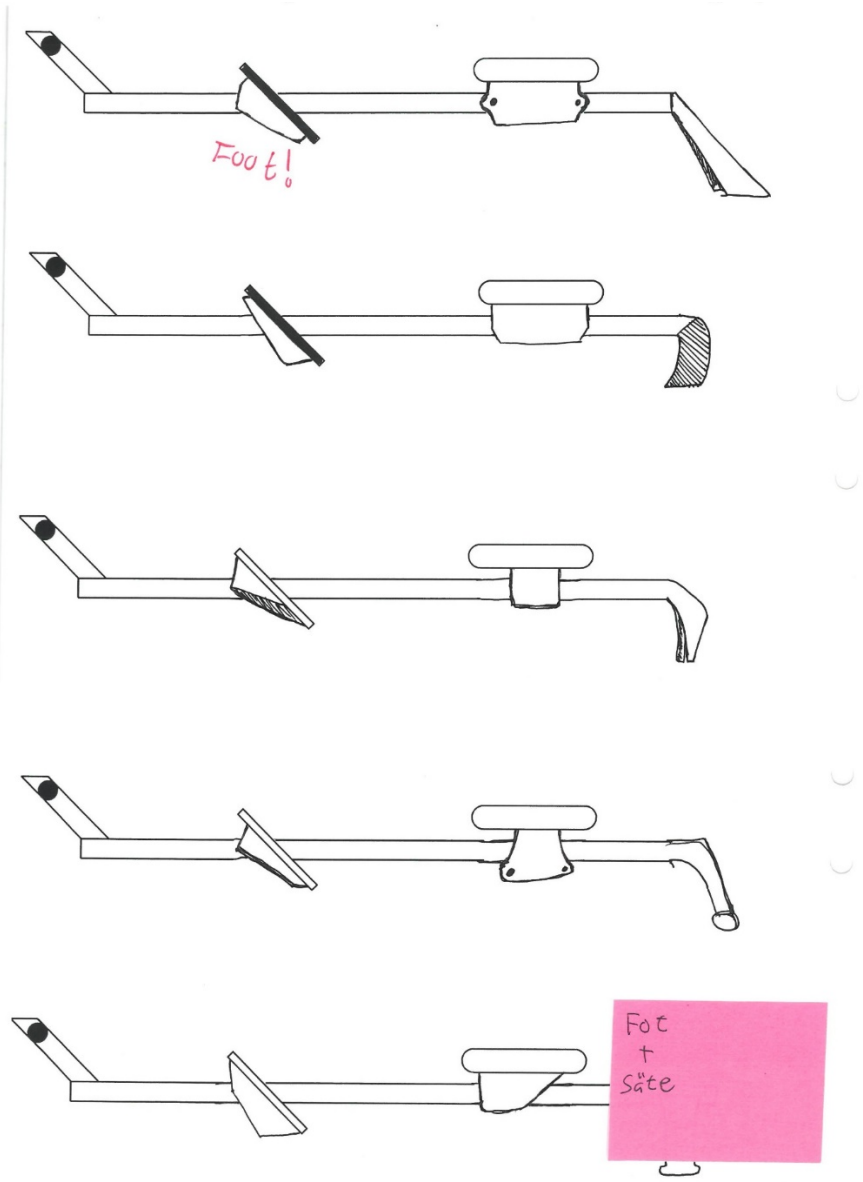


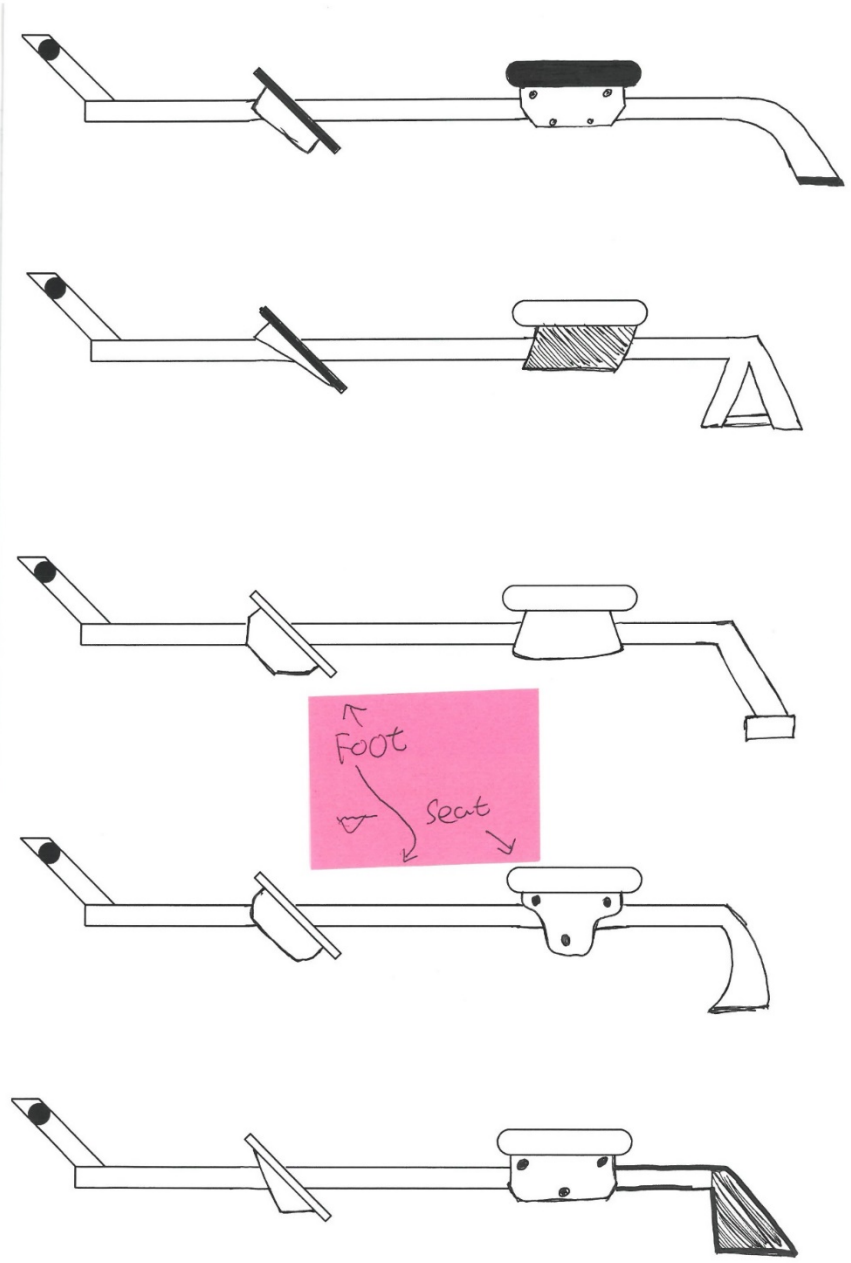
Thereafter, prototyping begun on a concept which was based on the pulley being attached only to one side of the “tower” rather than both. A solution that could be made more elegant and was similar to the construction of the sliding pulley from the kPulley device. The sliding part of the kPulley was attached to the full-scale prototype to test the sliding feel and quality:

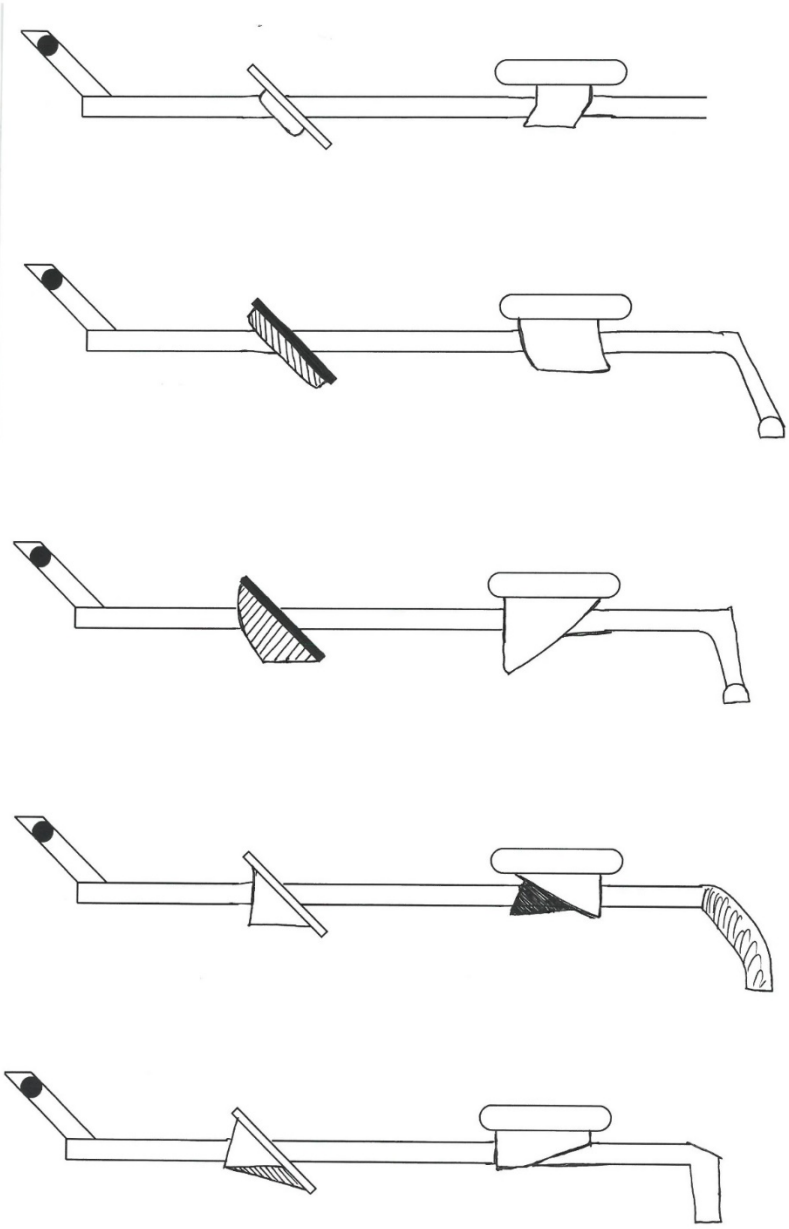
To properly test the functionality of the concept, a wooden board was used with holes pre-drilled that different height settings could be tested:

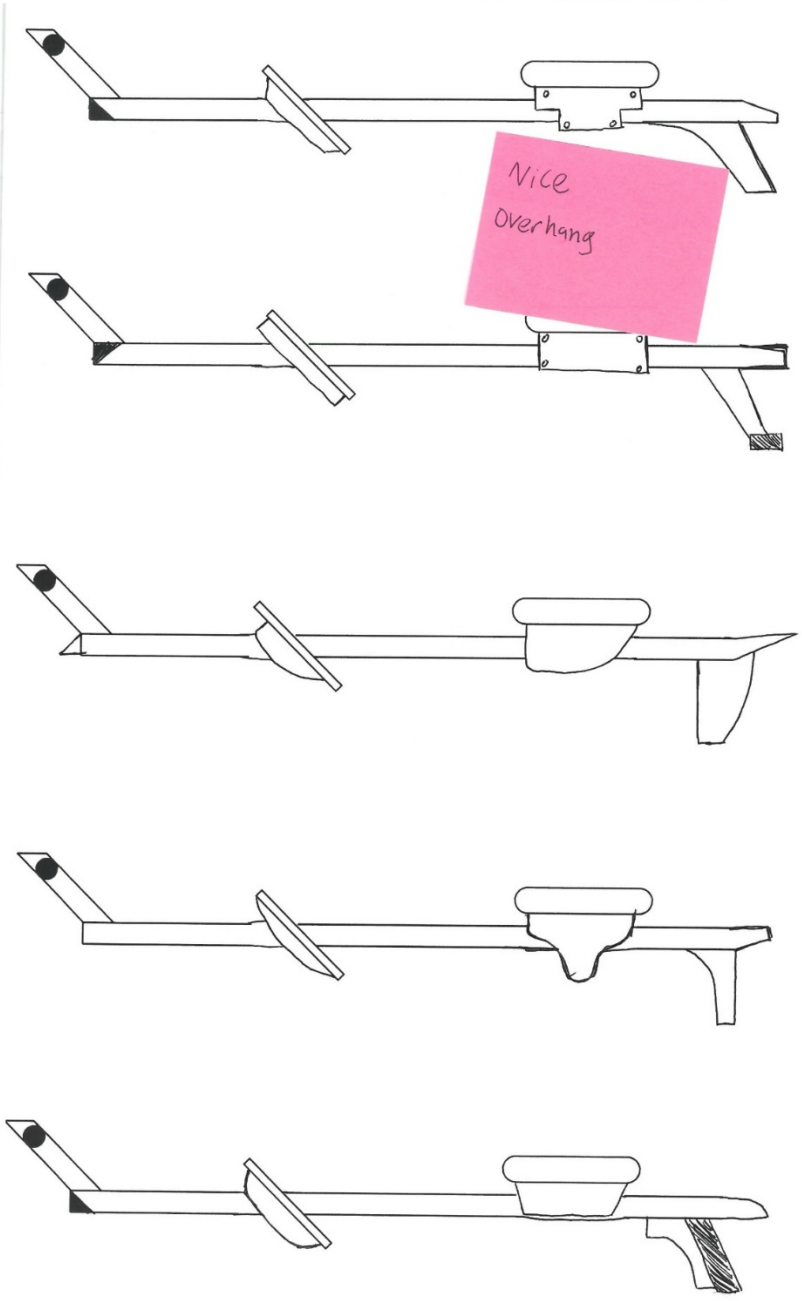
R. Structure variations of the add-on

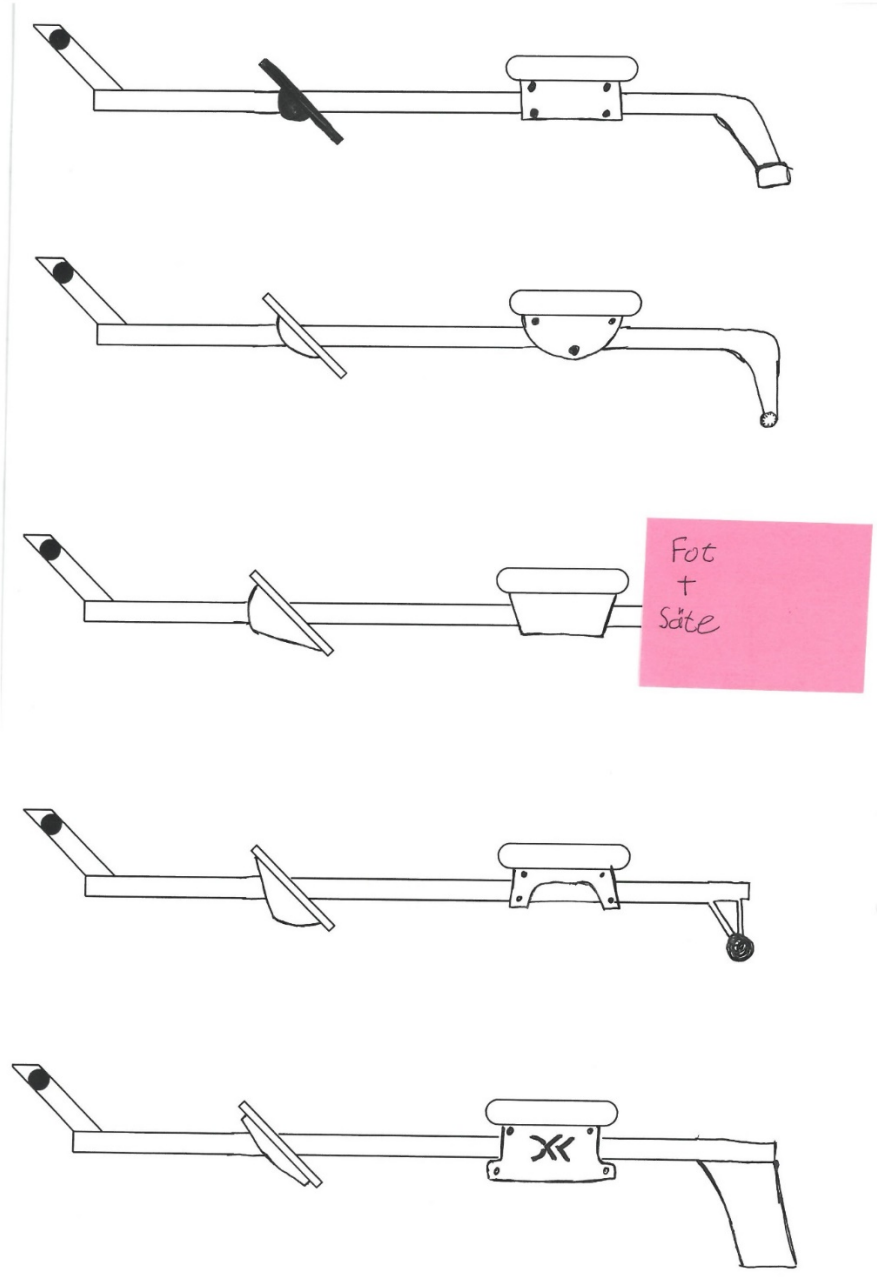
To test what the overall design might look like with the design guidelines applied and to explore different directions the add-on design could go towards a series of 2D sketches were made. The sketches varied the look of the foot plates, seat and back leg as these were the features with the highest impact on the design that would not affect the functionality in any severe way. The evaluation against the Design Platform is confidential. However, the sketching process and some promising designs look as following:




Foot
Seat




Nice
Overhang

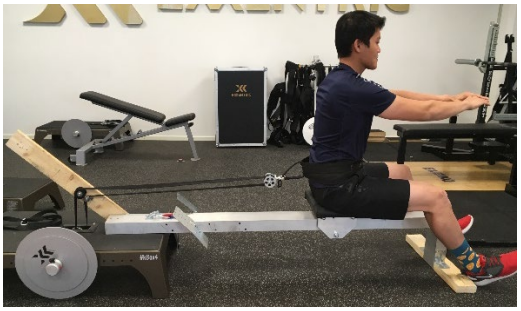
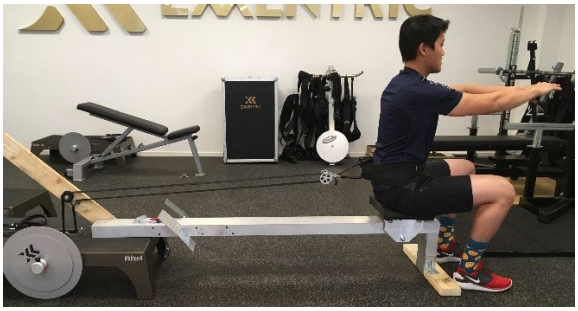

Fot
+
Säte

S. Additional exercises with the add-on

In addition to allowing seated rowing exercises to be performed, the add-on also allows for an additional four exercises that are hard to perform solemnly with the kBox. The additional exercises that can be performed were:

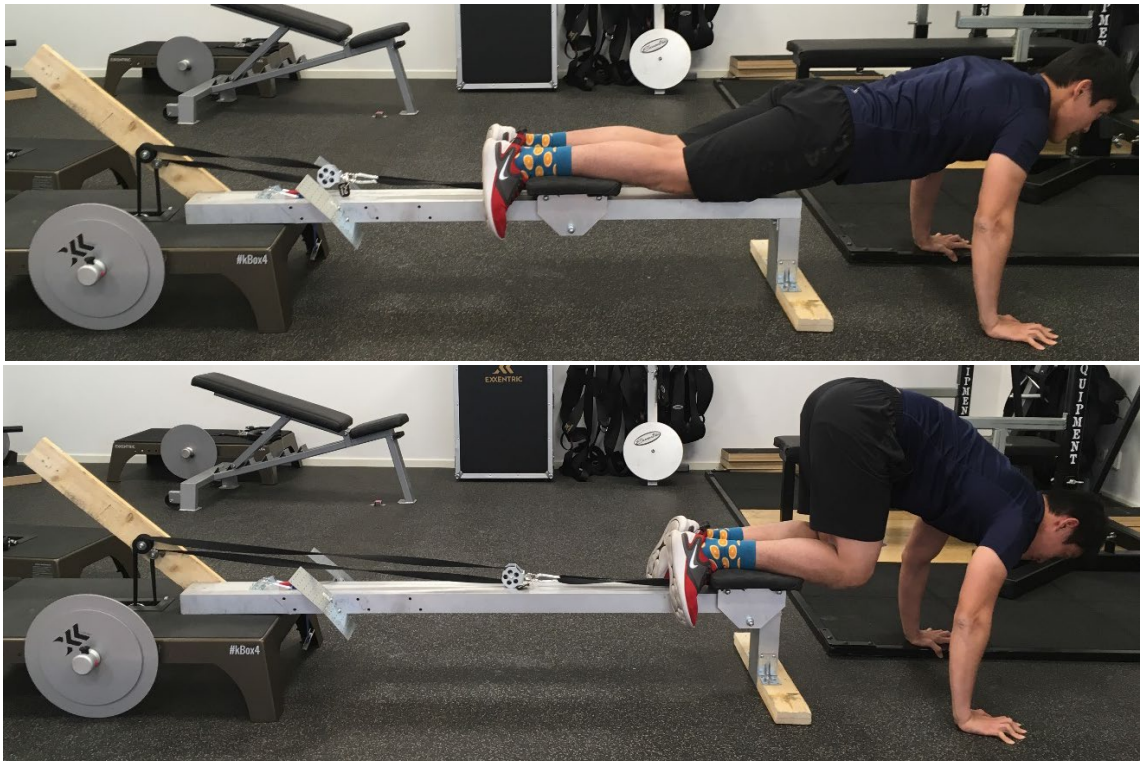
- Leg press – for the leg muscles and glutes:


- Leg curl – focusing on isolating the hamstrings:

- High seated row – more focus on trapezius and the posterior deltoids of the back and shoulders:


- Hand standing crunches – Working the abdomen and core muscles:



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