



ARK 56 - Final Report

Writers: Isak Lidén, Rasmus Linell, Oscar Johansson and Mohammad Aljabiri
Course: MT2573, Transformative Product- and Service System Innovation.
Date: 2022-01-19

Abstract

The digitalization of society is continuing and seemingly very analog activities are starting to show changes in this way. There is a counterintuitive juxtaposition in that people want to get out in nature more and more these days, but at the same time expect a certain digitalization. This creates an opportunity for services such as the nature and hiking app ARK56 which provides information about the Blekinge archipelago biosphere. Needfinding activities conducted have however shown that there are opportunities and areas that the app doesn't take full advantage of and the opportunities available. The three most important identified opportunities are that an increasing number of people are enjoying outdoor activities, people expect a certain level of digitalization, and encouraging non-athletic people to start exercising on a regular basis. To improve ARK56 in this regard, this project has set out to improve the three following aspects:

- Improve the value proposition
- Gain exposure and recognizability
- Expand the target group

By a divergent followed by a convergent product development structure, the resulting final concept landed in a digitalized outdoor gym. This gym consists of the physical location itself, which includes gym machines that count your repetitions as well as an interface part to get information and customize your training sessions. The other part is the ARK56 app, which in this concept includes an exercise support platform and data logger. The idea with this concept would improve the value proposition by increasing the users engagement with the location and thus the app. It's also to expand the target group by making personal training goals and statistics easily relatable and motivational for users that are not usually exercising. By increasing the value of the product in this way and improving the marketability and design, the exposure of the app would increase as people actually relate the product to something that they come across on a more regular and direct basis. Future work would include further development of both the physical and application aspects. Recommended activities are such as creating a fully functional application for the phone and physical hub interface and to create sensor modules that are easily installable in a wide variety of different training machines.

Table of Figures	I
Table of Tables	I
1- Introduction	1
2 - Theory	2
2.1 - Design thinking	2
2.1.1 - Empathize	2
2.1.2 - Define	3
2.1.3 - Ideate	3
2.1.4 - Prototyping	3
2.1.5 - Test	4
2.2 - Tools	4
2.2.1 - Six thinking hats	4
2.2.2 - Brainstorming and brainwriting	5
2.2.3 - Benchmarking	6
2.2.4 - Tech- and Trendwatching	6
2.2.5 - Storyboard	7
2.2.6 - Survey	7
2.2.7 - Customer Journey Map	7
2.2.8 Design Sprint	8
2.2.9 - Dark horse	8
2.2.10 - Persona	8
2.2.11 - Simio	9
2.2.12 - Sustainability Criteria identification with Knowledge Maturity	9
2.3 - Hardware	9
3 - Method	10
3.1 - Needfinding	10
3.2 - Ideation	10
3.2.1 - Persona	11
3.2.2 - Customer Journey Map	11
3.3 - Prototyping	11
3.3.1 - Design Sprint	11
3.3.2 - Dark Horse	12
3.3.3 - Final prototype	12
3.4 - Testing	12
3.4.1 - Design Sprint	12
3.4.2 - Dark Horse	13
3.4.3 - Final Prototype	13

3.5 - Simulation	13
3.6 - Sustainability aspect	14
4 - Results	16
4.1 - Needfinding	16
4.2 - Ideation	18
4.2.1 - Six Thinking hats	18
4.2.2 - Persona	18
4.3 - Prototyping & Testing	20
4.3.1 - Design Sprint	20
4.3.2 - Dark horse	21
4.4 - Final concept - digital outdoor gym	23
4.4.1 - Physical location	23
4.4.2 - App	24
4.5 - Simulation	25
4.6 - Sustainability aspect	26
4.7 - Business model	27
5 - Discussion	29
5.1 - Needfinding	29
5.2 - Ideation	29
5.3 - Design Sprint	29
5.4 - Dark horse	30
5.5 - Final concept	30
5.5.2 - Simulation	31
5.5.3 - Sustainability aspect	31
5.5.4 Business model	32
5.5.5 - Future work	32
5.6 - Learnings	32
6 - Conclusion	34
7 - References	35
Appendix	38
1 - Compilation of findings from needfinding	38
2 - Stakeholder analysis	39
3 - Value strategy canvas	40
4 - Tech- and trendwatching	41
5 - Analogies and benchmarking	42
6 - Six thinking hats	43
7 - Customer Journey Map	45

8 - Calculation of cost	46
9 - Sustainable template	47
10 - Sketches	52
11 - Code	53

Table of Figures

Figure 1 - Illustration of the five design thinking phases.	6
Figure 2 - Janus cone about mobility and vehicle technologies.	7
Figure 3 - Post that indicates that the trail is part of the ARK56 initiative	18
Figure 4 - Power-interest grid for the stakeholder analysis.	19
Figure 5 - the storyboard of a scenario for the check-in station.	20
Figure 6 - Persona for the project.	21
Figure 7 - The small scale prototypes.	22
Figure 8 - The two designs of the prototypes that are going to be tested.	22
Figure 9 - Information menu on phone.	23
Figure 10 - The projected screen at the training machine.	24
Figure 11 - Digital outdoor gym prototype with interactive hub (A) and digital training machine (B).	25
Figure 12 - User interface during training	26
Figure 13 - Homepage (left), progress (middle) and scoreboard (right).	
Figure 14 - The structure of entity flow in Simio.	29
Figure 15 - Business model canvas	29
Figure 16 - Flowchart illustrating flows between different stakeholders.	30

Table of Tables

Table 1 - Data implemented in Simio	16
Table 2 - Indicated level of weight and maturity.	17
Table 3 - the amount of scans performed from the testing.	23
Table 4 - The feedback from the test persons.	24
Table 5 - Result from the simulation	28
Table 6 - the result from sustainable template	28
Table 7 - Cost of the concept if sold as a product or a service	30

1- Introduction

The trend of wanting to get away from the urban environment and experience nature is something fairly new. In most cases people don't disconnect entirely from technology when out in nature. As such, there are many different mobile apps to enhance the user experience in this regard. These apps are interactive maps, activity planners, etc. Which concentrate the information which traditionally have been available in tourist information offices and printed form. As today's society is continuing to expand its digitalization, these tools are going to be more integrated into the physical experiences. Another example of digitalization of typically analog activities is the trend of training watches that takes in real world data to represent your activities and uses this to improve the experience of training. The purpose of this project is to develop the existing concept of ARK56 to improve its value proposition, gain exposure and recognizability, and expand the target group. The project will initially look at how people are experiencing outdoor activities and how technology can help improve the users enjoyment of these, traditionally analog, activities.

ARK56 is an app designed to help people experience Blekinge Archipelago to its fullest. It includes a network of trails which can be experienced by foot, bike, boat or by kayak coming together at 13 different nodes where you can swap between the different methods of transportation. The app also helps you find everything from gourmet restaurants, beaches, camping sites and places to have a barbecue. The name of the app comes from the abbreviation of the word "arkipelago" and the latitude of Blekinge which is at 56 degrees. The development of the app has been done in collaboration with VisitBlekinge and Karlskrona municipality. [1]

2 - Theory

2.1 - Design thinking

This project will be conducted with *design thinking* as the method of product development. *Design thinking* is a template for an iterative process that involves different phases with particular goals and focuses. These phases are *empathize*, *define*, *ideate*, *prototype* and *test* (fig. 1). *Empathize* and *define* are often It's also a non-linear process meaning there is no set order in which the phases are to be conducted. Often (and ideally) the phases are revisited during the project. Different stages also put particular focus on *divergence* and *convergence*. The former involves exploring as many possibilities as possible and the latter working towards distilling the knowledge or decisions in a more specific way. A big factor of success is to reach the testing phase and collect information to further develop or change direction of the project. Different varieties of the model exist with slight differences and in some cases a final *implementation* phase is added. [2]



Figure 1 - Illustration of the five design thinking phases.

2.1.1 - Empathize

The empathize phase involves understanding the problem which is to be solved. This is usually done with research in the form of analyzing data, making observations, conducting interviews, doing experiments, etc. It could be summarized as doing research in an objective manner to get the knowledge that is not obvious at first glance. During the first cycle of the project, this phase is often heavily characterized by divergence while later iterations may seek more specific information. This stage is an important stage in the design thinking process because it allows designers to learn about the motivations and experiences of the people who will be using their product. It's practically hard to solve a user problem without going through the empathy stage. At this stage, designers sit with people to, among other things, absorb their opinions, their world and other observations that may be captured in the moment. This happens without the designer having any kind of angle in his thought, that is, designers right there and then are neutral in their way of thinking and have not yet drawn any conclusions of their own. What designers do is, above all, consult subject matter experts about their thoughts on a particular subject. At this stage, you as a designer engage personally to familiarize yourself with the subject area itself in order to form a better perception of the area from the user's perspective, whether it is a specific product or

service. In addition, designers can have in-depth conversations about the subject at this stage to reinforce their perceptions and share each other's thoughts. At the same time, it is important that designers at this stage put themselves in the physical environment that the subject touches and involve themselves in it in order to strengthen their perception and thoughts about, for example, existing ideas that they have. [3]

2.1.2 - Define

The define phase builds on the findings in the previous phase and aims to synthesize it to define one or more aspects to focus on. These aspects are often described as problem statements which should take into account the different personas or user categories involved. At this stage, the observations made about the users in the first stage above are synthesized. Defining problem statements in a clear way at this stage will further facilitate the start of the third stage and help the third stage go in the right direction. However, it is important to note that the different stages do not always have to go in sequential order, they can go in parallel with each other and be repeated iteratively. Each step thus has its important function for the whole process, which is the important function at this stage to get a good definition of the problem statement. [4]

2.1.3 - Ideate

The ideation phase is initially one of divergence to collect as many ideas as possible before ranking and combining them. A wide range of tools such as different types of brainstorming variations can be used here with great benefits [2]. This process is also frequently revisited throughout the project to come up with better or more optimized solutions. These solutions don't necessarily have to be brand new, but ideas or concepts are often taken from existing ones. This happens both in a direct sense where a concept is applied in a different scenario or built upon and in an indirect sense where one takes inspiration from it. [5] In early parts of this phase it's important for the team to remain open to all ideas generated as the goal is to explore the solution spaces as much as possible. Only after this has been done do the assessment of the concepts come into play. An idea that seems poor at first glance may start a different branch in which to explore. A further reason for having an open mindset is because concepts that seem to have low value may also be combined in different ways to increase its value.

2.1.4 - Prototyping

Prototyping is a key element in product development. This is an interactive process where developers create material or digital concepts of a solution so that tests can be issued. By testing a solution on users at an early stage, both time and money can be saved for the project. Here you can get opinions from users about what they think of the solution and in this way change the design of the product or service so that it matches what is in demand.

The further into a project you get, the more difficult and expensive it becomes to make major changes. Therefore, it can be good to make several prototypes during the development process so the ideas can be tested. [6]

Prototyping can be divided into two sectors, low-fidelity and high-fidelity. The amount of fidelity to is how much details of the real solution are implemented in the prototype. The amount of fidelity in a prototype is often depending on where the development process is at the moment. Lower-fidelity prototypes are often created earlier in the development process. For example, they can be made of paper, and they are fast and cheap to manufacture. The con with such a prototype is that they have lack of realism so the user can miss understand the function that wants to be tested. The high-fidelity prototypes are often used later in the development process. This can for example be a digital prototype in the form of a website. This one has more details and can engage more details. The cons are that it takes more time to make and can also be more expensive. [6]

Prototypes are not just for users. It can also be good for other stakeholders to see how the concept works. Usually, a prototype is not made for the entire solution. A prototype should be focused on parts of the concept that are interesting to test. This so time and resources can be saved from unnecessary work. Prototyping involves actualizing the ideas from the previous phase. This phase, more than any other phase, should be revisited as much as possible to get as much knowledge as possible. It's often very beneficial to start by doing very rudimentary prototypes, which could be done by combining everyday items to illustrate a concept or as paper prototyping. By doing many iterations you get a progressively better idea of how the final product will be. It's important to take into account what you want out of the prototype at the moment. [6]

2.1.5 - Test

The testing phase is directly tied to the prototyping phase and uses the prototype to gather information about the currently proposed solution. This information is in turn used to iterate the prototype. It's important to have a clear picture of what information is sought after when testing a prototype. To more easily define the test the method of storyboarding can be used. By visualizing the whole process in this way it's possible to single out just a few aspects to focus on during the test. This is particularly valuable in the early tests as the team may not have all aspects of the project in place. [7]

2.2 - Tools

2.2.1 - Six thinking hats

Six thinking hats is a very effective strategy that may be utilized in a variety of situations, especially when discussing different ideas in a group [8]. Because people think in different ways and from different viewpoints, this sometimes leads to lengthy conversations when it comes to recognizing unique ideas, among other things. Because it includes thinking in a specific way while wearing a specific hat, that strategy becomes effective. Each of the six hats has one color, and each hat represents a different worldview. If you're wearing a white hat, it suggests you're looking for and analyzing data. It's also crucial to look back at previous trends and capitalize on a lack of understanding on the subject. As a result, the white hat represents objectivity and analysis, and you must think objectively here.

The red hat, on the other side, represents the exploration of feelings toward the concept. The emotional factor is at the foreground here; how do we feel about the concept? Is it something we like or something we don't like? The red hat allows you to pay attention to your gut instincts and examine the situation based on the emotions that have formed in response to the concept. The positive mindset is set in motion when you put on the yellow hat. At this stage, all of the positive aspects of the idea should be considered, and an examination of what is excellent and functional about the idea should be carried out. The black hat pushes us to think in negative ways, allowing us to reason out potential negative outcomes if we choose to develop an idea. The green hat, on the other hand, indicates creativity. It allows you to look outside the box and see if there are any better alternatives or alternative ways to the original idea. For these to succeed, you must come up with inventive solutions to the problems or ideas you have. The blue cap, last but not least, indicates process control. When you're wearing this hat, you can choose which of the other headwear is best for making decisions. [8]

2.2.2 - Brainstorming and brainwriting

Brainstorming is a well-known approach for addressing difficulties and coming up with several new answers and ideas for a problem [9]. There are many different forms of brainstorming stop and go techniques, with one of the most common being brainwriting.

When five to twenty individuals meet together to work on a job or problem, this method is most commonly utilized. The fundamental principle of the approach is that the process should be able to run uninterrupted. The method can be applied to a wide range of circumstances in which new ideas and solutions are required to solve a problem. The method is the most widely used and is well suited to product development.

The following are the most basic guidelines and principles to follow when using the process: It is impossible to criticize an idea before it has been implemented. There are no wrong ideas here, and spontaneity is welcomed. If a plan doesn't work out, the group should come up with a new one. Because quantity leads to quality, quantity takes precedence over quality. Participants assist one another in developing, adapting, and refining their ideas. All ideas are recorded, regardless of consistency. [10]

2.2.3 - Benchmarking

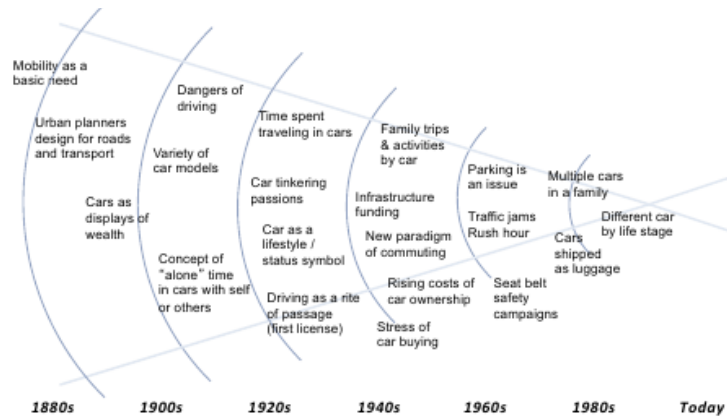
Benchmarking is a method for a company or design team to evaluate the performance of their product or service to that of other leading companies [11]. The goal of such a strategy is to identify numerous parts of the competitor's business that might be improved. Analyzing other organizations that are prominent in a particular area and how they operate can be quite beneficial to one's own process. It may also be valuable to look at companies and solutions that are not directly linked to the concept one seeks to improve. The value strategy canvas is a tool that identifies what value different solutions have in respect to different categories. For example, if one type of bicycle has a carbon fiber frame and another does not, it indicates one type of value which must be weighted. As such, this tool is both objective and subjective which provides depth to it if done right.

Continuous or dramatic improvements are usually the two sorts of improvements that can be performed. Continuous improvements imply that small tweaks are made to existing solutions in order to attain success. While huge improvements can be made by modifying the entire solution, such as through reengineering. [12]

2.2.4 - Tech- and Trendwatching

To be able to understand what has led to today's solutions, an important method is to look at what trends have existed and whether they have influenced various decisions and thus also resulted in today's trends and solutions. This method is called tech- and trendwatching. By studying which trends are current and which have been relevant in recent times, it becomes easier to predict future trends and thus also come up with a solution that will be interesting and valuable in the future. [13]

By using Janus cones tech and trendwatching can be done which can be seen in figure 2 below, dividing the past into different pieces. Where each piece corresponds to a certain period of time which is an important point for any trend. Furthermore, the cone is filled in and all important years and important trends are wroted down to today's trends. It is also possible to go further and predict the tech and trends of the future with this tool, then apply a mirror-inverted cone to the right of the existing one. [13]



Source: Tamara Carleton, Stanford University, ME410, 2008

Figure 2 - Janus cone about mobility and vehicle technologies.

2.2.5 - Storyboard

Storyboard is a way of creating an event sequence for a product or service. By creating a small story, developers can more easily see how and where their solution will be used. A storyboard should represent a sequence of events when the user is in contact with the product or service you are working with. It can also be helpful to make a storyboard during prototype development. In prototype development and testing, the focus is to test parts of a product that you are unsure about. With the help of a storyboard, functions or parts can be identified that you want to know more about. This can both save time and money for the development process. [14]

2.2.6 - Survey

Survey is a tool that can be used to find out what a larger number of people think about different things. By creating a survey, it is possible in an easy way to ask questions to people that they can answer when available. This is a time-efficient way compared to interviewing each person individually. By having a digital survey, the answers are updated after each person has completed it, this means that the result is always up to date regarding the answers that have been received and there are always updated statistics about the answers and the amount of participants. The disadvantages of conducting a survey are that the answers to the questions will not be available for follow-up questions. The interest to take the time to follow a survey is also lower than if you do interviews in front of a person. Long

surveys usually have a much lower response rate than shorter ones. This means that you want a survey to be as short and specific as possible, which leads to that the survey is not as detailed as you would have liked. [15]

2.2.7 - Customer Journey Map

The Customer Journey Map is a useful method for identifying what motivates your users - their wants, hesitations, and worries. Although most businesses are relatively effective at collecting information on their customers, statistics alone cannot explain the customer's complaints and experiences. A story can do this, and the customer journey map is one of the finest storytelling tools in business. A customer journey map employs storytelling and images to depict a customer's engagement with a program or product across time. The story is presented from the customer's point of view, which gives insight into the customer's whole experience. It assists your team in better understanding and addressing the needs and pain points of your customers when they interact with your service or product. [16]

2.2.8 - Design Sprint

A Design Sprint is a process where the goal is to get answers to critical questions over a short time. The process usually lasts for 5 days and consists of design, prototype and testing with stakeholders. By working together in a design sprint, you can shortcut later steps that usually take a long time, and still get a useful result. The main goal is to get fast answers on questions and ideas to see if they are worth going forward with. The first step in a design sprint is to identify what questions are of interest to get answers on. When this is clear a rapid prototype can be built that covers these questions and can be quickly built. With the rapid prototype it's time to test it with stakeholders, and through this take learnings by observing and interviewing. With these learnings decisions can be made whether to proceed with an idea or not. [17]

2.2.9 - Dark horse

This strategy should aid in the exploration of new and undiscovered paths outside self-defined boundaries and habitual routines. This has the potential to result in innovative business models and dramatic advances. Dark Horse concepts are about purposefully applying adventurous, unusual, and outlandish concepts. Experience has shown that the most logical ideas are also the ones that are the closest to current answers. Polarizing techniques, on the other hand, typically have the greatest impact. The name Dark Horse originated from sports betting, wherein the "dark horse" does have the least chance of winning but makes the most profit. If the present situation should be profoundly questioned and drastic reforms are required, this strategy is recommended. Dark Horse prototypes, due to their open nature, are particularly suited to the divergence phase of concept creation and prototyping. [18]

2.2.10 - Persona

A persona is a tool which is utilized throughout the development process during the inspiration phase. Personas, according to Tharon W. Howard, *“persona is essentially a representation or life-like model of a targeted demographic in the broad range of users who may purchase the product being developed.”* [19, pp. 21] Personas, in other words, are a technique to understand the interests of a specific group of individuals by creating a template in which info about the subgroup is represented by one person. The information required to create personas is gathered through investigating possible consumers and the environment wherein the product is intended to be utilized. Need-finding research, which includes observations and interviews, is a common method of doing research. [19]

2.2.11 - Simio

The simulation method that was used for this project was a program called Simio. Simio is a program which makes it possible to simulate flow systems that can be simulated over a selected time span. The modeling approach is called Discrete Event Simulation. It is about simulating queues and waiting times, by which you can model a scenario for a customer. With the help of data sheets and logic blocks, a good simulation of reality can be created so that valuable data can be retrieved. The data that can be retrieved is very broad, but in this project it is about getting costs and revenues for ARK56 outdoor gym. Time for repair and installation was also of interest to take out of the simulation. [20]

2.2.12 - Sustainability Criteria identification with Knowledge Maturity

One of the most important aspects of project implementation is contextualizing the project from a sustainability standpoint. As a result, it is critical to reflect on and untangle diverse ideas and assumptions as a team in order to boost selection transparency and be able to prioritize the customer's needs and requirements. Thus, the objective will be to discover a method to develop more robust procedures and decision support for, among other things, the design of sustainable products. To achieve this in the best possible way, techniques that contribute to greater traceability and transparency of, among other things, the selection of sustainability criteria must be offered. To move a step closer in this aspect of the project, raise some questions about the material utilized, how the sustainable solution should be produced, how the solution should be used, and what happens when it can no longer be used. They also attempt to see the solution's life cycle in order to find certain strengths and weaknesses with the solution itself and so contribute to its greater durability. [21]

Ability for decision-making and strategic planning toward sustainability necessitates the development of relevant skills and competences by organizations and individuals of all sectors and disciplines [22].

Group model building is a well-established participatory system modeling approach wherein participants co-create a common knowledge about how a system behaves and how that behavior may be modified via the use of dynamic system simulations and causal modeling. Such modeling may help with understanding and strategizing in complex systems, as well as guiding effective, or strategic, decision-making [22]. Participants in the group model building activity may create a causal loop diagram to highlight the interdependence of stakeholders in the social and ecological systems and then use it as the foundation for debate in order to arrive at a sustainable possibility [22].

Causal Loop Diagrams are an important approach for System Analysis since they enable for system modeling. They enable the mapping of the complexity of an issue of interest [23]. A causal loop diagram helps us to comprehend cause and effect rather than assuming a direct proportionality between system aspects [23]. It allows us to understand how a behavior has manifested itself in a system so that we may build methods to work with or against the behavior. We would also like to determine how and to what degree the problem is linked to other systems. Creating a causal loop diagram allows one to see and therefore better comprehend the feedback processes that occur in a system. As a result, they provide for a look at both the structure and the operations in a system [23].

2.3 - Hardware & software

The Raspberry Pi is a series of small single-board computers commonly used in hobby projects and prototyping because of the low cost. The different versions of the Pi get progressively higher performance and more features such as more memory and built-in Wifi. The version used in this project is the 3 Model B+ released in 2018.

One of the main features beyond the small footprint is the general purpose input/output pins (GPIO) which can be used with a large variety of sensors, buttons, screens and other electronic components. A free Linux version is available for the Pi which includes a variety of programs such as different editors for coding. This Project utilizes the integrated development environment (IDE) program for Python called Thonny, which is designed for beginners. When using the GPIO pins with python, it's important to choose the proper mode on which the sensors are read. These modes are the pull up or pull down which changes if the "true" value is when the sensor is at the reference voltage or at ground. The sensor in this project is a digital sensor taken from an old computer mouse and has three connections. These are connected to the 3.3V, GND and GPIO pins appropriately. [24]

2.4 Training motivation

Motivation in training is a key element to keep people exercising on a regular basis. There are various tools to use to make people feel motivated to exercise. According to Kailus,

motivation can increase if goals with the training are set. This means that the person has something to achieve with his training and they can follow the progress over time. Another thing that is also considered important is to have a schedule for the training. This will make it a habit in everyday life and it will be easier to keep on going. Support is also an important aspect of the training experience. Many people prefer to train more often if they have someone that pushes them and tells them how to do it. This provides guidance for those who do not have the knowledge and habit to train, which in turn motivates the person. [25]

3 - Method

3.1 - Needfinding

To come up with an innovative solution, several different methods have been used. But first and foremost, the existing application was carefully studied how it works and what it contains. To do this all members of the team downloaded the app and examined its various functions by going through one by one, notes were taken down on what they thought worked well and those they thought worked less well. Furthermore, to get a deeper insight of who the application is aimed at, a stakeholder mapping was done. With help of the stakeholder mapping different stakeholders could be identified and map their needs and why the needs exist. This creates an image of what needs the team should be focused on.

A tech- and trend watching was also conducted in the group. This was done to get an understanding of potential emerging trends and what will be a solution that will attract users in the future, this was done by searching the internet for major trends that have existed in the past and the years in which they occurred. Different innovations in the past were investigated to see which decisions have led to what ARK 56 is today.

To diverge and get a different perspective on the problem a survey was created that was sent out to people living in Karlskrona. The questions were asked in such a way that the team got answers on how many have used the ARK56 application and what would create value for them in everyday life. The survey was sent out to the network of contacts the various members of the team had, they were also sent out to ARK56 themselves and the supervisor's network was also used to get an even wider target group that could take part in the survey. Based on the answers from the survey, investigation of needs was conducted. This was done to converge to a smaller number but with higher precision of the needs.

To look at the existing market and compare the different solutions among themselves, a value strategy canvas was used. Similar application to ARK56 was listed and then the group analyzed what they have in common and what differed. In parallel, a stakeholder analysis was also performed to understand the interest of the various stakeholders and the impact they have and could have on the solution.

3.2 - Ideation

After the application had been studied deeper and needfinding had been conducted, the team started a brainstorming session about what problems users may experience and what possible features could be applied to the application to create greater value for the user. In order to diverge and not stare blindly at the already intended solutions, a method called analog benchmarking was used. All the problems with ARK56 were listed and then the team investigated other companies to see how they have solved similar problems. By putting ARK

56 in relation to another product or solution on the market, the team can take advantage of this and design new ideas for ARK 56 problems. To make a fair assessment of the various proposed solutions, six thinking hat was used where each group member had to fill in their own opinions and thoughts about each solution. Each solution was scored between 1 to 3 there 1 is not good and 3 is good. By voting the solutions a result could be achieved that says which solution the team should work further with.

3.2.1 - Persona

The personas were created utilizing information gathered during the project's needfinding phase. This tool was used by the group as follows. Firstly, the target group on whom the focus will be on was chosen. Based on the information that was gathered before, different people were picked. The demographics, actions, and attitudes of each selected individual were the focus of the gathered information. After, an assessment of each person's unique needs was made, as well as their goals and ambitions. Furthermore, the collected data was used for a design of up to 3 answers to the question "How can we help?" for each person.

3.2.2 - Customer Journey Map

One persona has been chosen among the several personalities that were created. The situations were imagined in which the person goes through many stages to go to the outdoor gym. The group were able to describe the many actions, ideas, emotions, pain points, and opportunities for each stage.

3.3 - Prototyping

3.3.1 - Design Sprint

Once a concept had been chosen, a storyboard was made with one scenario that could happen for our solution. With help of the storyboard the team decided to do a prototype of an attractive pole. Sketches of an attractive pole were made by discussing and sharing ideas between group members. To make the sketches more real and easier to take in, small prototypes were made with the help of cardboard and glue. The group discussed which designs were the best so that larger prototypes could be built. Using cardboard, wood and glue, two prototypes with different designs were built. These would later be tested to get answers to questions we had regarding the concept.

3.3.2 - Dark Horse

To make a more scifi turn of the concept an internet study was made to find high-tech trends in the market. The team decided to go for a digital outdoor gym that with the help of sensors and laser pointers will guide the user through the training experience and motivate

him to keep training. The dark horse prototype consists of a projector that is placed next to a training station. The test subjects were told to follow the instructions given on the interface with minimal guidance from the test leaders. The goal at this stage was to observe the test subject's interaction with the prototype and find potential shortcomings in the user experience. After the test was done, a short interview was done to get direct statements and opinions on the experience.

3.3.3 - Final prototype

Following the implementation of the dark horse, some aspects of this concept were selected to move on with the development of the final prototype. The prototype was separated into two parts: a software part and a physical part. In the first section, an app was created that is linked to sensors installed on the physical prototype part, the machine. The actual pieces of the prototype, the post, and the training machine were built with hand tools and machinery (see figure 12). Furthermore, the prototypes were painted and programmed in order to create a functional system.

3.4 - Testing

3.4.1 - Design Sprint

The testing of the prototypes went out in such a way that a treasure hunt with 3 stations were created. To keep track of how many people scanned the QR codes and how many people completed the entire treasure hunt, QR was used. Each station had one QR code except the first one. By having two different QR codes for each design at the first station tracking of which design getting the most scans could be performed. The treasure hunt took place at level 2 at BTH. When a person scans the code with their phone, they will receive a picture with a clue of where the next station is. If the person proceeds to the other station, they will see another QR code. When they scan that one, they will get another clue for the last station. When the user arrives at the last station, there was a paper on which the subject could rate what they thought of this experience. As a reward for their participation, a bowl of sweets was placed here as a thank you.

3.4.2 - Dark Horse

The testing of the Dark Horse went out in such a way that three volunteers had to go through a training session on a training machine. The volunteers got no help from the creators and had to manage themselves. The first thing was to go to the attractive pole that was placed in the middle of the gym. There the user scans a QR-code to get information on where to go, to start the exercise and a machine is highlighted with a laser to guide the user to the right place. When the user is standing at a machine a screen is lighted up where he

can see an instruction film of exercise or start the exercise. If the user chooses the instruction film he/she will see a tutorial and then start the exercise. When the exercise is started sensors will count the reps the user is making and also tell the user when he needs to rest etc. After the testing session each volunteer got some questions about their experience.

3.4.3 - Final Prototype

The final prototype was tested on two people, where the two test persons were allowed to test both parts of the prototype. The test started with the people scanning the QR code that was on the digital hub, then they were led on to the application. The people played around in the app to get acquainted with it. The people then start their session on the *central interactive hub*, where they choose the number of repetitions. After the selected number of repetitions had been reached on the training machine, they went back to the application to check that the data had entered the app. After the tests were completed, they were followed up with an evaluation from the two different test persons, where they gave feedback on what experience they had during the session and if there was anything they wanted to improve.

3.5 - Simulation

To simulate the use and expansion of outdoor gyms, two types of users were used. One free user who does not pay a subscription, and one paying user who pays a subscription. Also two types of workers were used. One repair man and one installation man. These workers will be called to the outdoor gyms when a new gym is going to be constructed or when a gym has broken. The first thing that was done was to build up the flowsystem of how the user arrives at the gym and exit the gym. This was done with the help of two source blocks, one for each type of user. They were connected to a server which will illustrate the gym. After the server block the entities will go to sink which will illustrate the user leaving the outdoor gym. A second sink was also added to the model. This retrieves entities while the outdoor gym is being repaired.

The simulation contained two outdoor gyms and the time period was for one year. In the beginning of the simulation there were no existing outdoor gyms in Karlskrona. So the installation man needed to install the first gym in the beginning, and this was located in Karlskrona. After that, a new gym will be constructed after 120 days at Ronneby. With help of the process and states menu in Simio the failing time and installation time could be structured in the right way. The following data that were implemented can be seen in table 1 below.

Table 1 - Data implemented in Simio

Simulation time	365 Days
Time for a new gym	120 Days
Construction cost	3600 kr + 500/hour
Time to construct a gym	48 Hours
Service/maintenance period	2 times a year
Repair time	4 Hours
Repair cost	600 / hour (eventual material cost included)

3.6 - Sustainability aspect

To get the sustainable aspect of our concept the “*Sustainability KM GMB WS*” template was used, see Appendix 9. The first step was to characterize what the solution needs to fit into a sustainable society. With guided questions could materials, suppliers, end of life, etc. be determined so that the solution fits the sustainable perspective. In the next step, the current preconditions of designing and delivering these characteristics were analyzed. By looking at raw materials, manufacturing, distribution and maintenance and then linking these to ecological, social and economic dimensions, strengths and weaknesses could be identified. In the third step different criteria were identified that can guide the solution towards a sustainable solution. From these three steps six leading sustainable criteria (LSC) was created for the solution. Together with the needs from the needfinding, the LCS were graded in form of weight (how important the criteria are) and maturity (how sure you are of the grading). The indicated level of weight and maturity can be found in table 2. The voting sessions were done several times both individually and within the team.

Table 2 - Indicated level of weight and maturity.

Weight	Maturity	
Critical	1	Inferior
Essential	2	—
Nice to have	3	Acceptable
Irrelevant	4	—
—	5	Excellent

4 - Results

4.1 - Needfinding

The survey, research and personal experience with the ARK56 application gave the team a base level understanding of a handful of needs and improvement opportunities. These were divided into four categories to break down why the app may not be very popular (appendix 1).

The survey brought to light different problems with the app's functionality such as the GPS not working properly and difficulties in using the app for people with poor eyesight. The marketing of the app is also an area of improvement as it's almost exclusively dependent on word of mouth since the signs in the trails are very anonymous (fig. 3) and 52% of the respondents had only heard about it from previous school activities. It is however probable that these numbers are biased towards this being the case since there has been previous collaboration with the ARK56 project. It's also not very obvious that the signs are connected to the mobile application of ARK56.



Figure 3 - Post that indicates that the trail is part of the ARK56 initiative

The survey also showed that people feel that features outside of the app in the physical locations are lacking. These are things like a lack of activities for all age groups, lack of more time efficient activities, lack of educational information for people that want to learn about nature, and lack of information and activities specifically for disabled people.

The needfinding activities also provided general information about people’s habits and thoughts about outdoor activities and the digitalization of society in general. The three most important findings were central in coming up with the final concept. These findings were:

- An increasing number of people who are enjoying outdoor activities.
- Meet people’s expectations of the level of digitalization of outdoor activities.
- Encourage non-athletic people to take the step into exercising on a regular basis.

The stakeholder analysis shows that the developers of *ARK56* and *VisitBlekinge* are two most important stakeholders. They differentiate themselves from *Blekinge citizens* and *tourists* in that they have a very high interest in the product. (appendix 2) This places the former two into the category of *manage closely* while the latter two gets placed into the *keep satisfied (and improve satisfaction)* (fig. 4). Even though the end user does not have such a large impact on the outcome, they should still be taken into account, because a solution that is not appreciated by the end user is a solution that in the long run will not be used either (fig. 4).

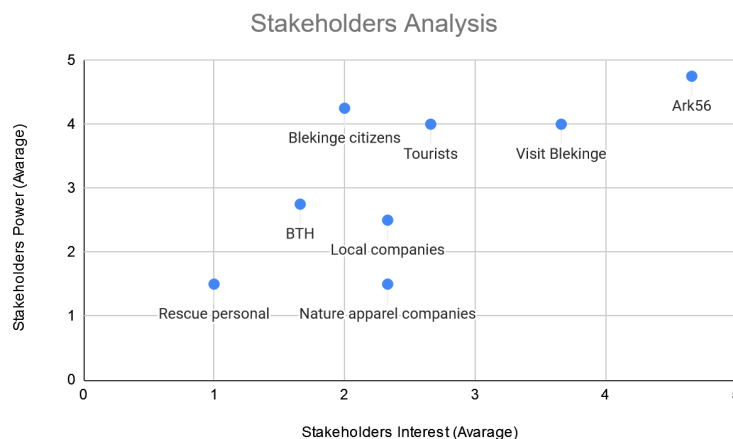


Figure 4 - Power-interest grid for the stakeholder analysis.

Based on the tech- and trendwatching tool and from the analog benchmarking tool, the group got a broader view of the problem where existing solutions that other companies have made to solve equivalent problems. By studying the past trends, inspiration could also be taken and a future prediction of which trends will come in the future (appendix 4 & 5).

4.2 - Ideation

4.2.1 - Six Thinking hats

The results of six thinking hats revealed the following three winning ideas in terms of points (appendix 6):

- Users may scan a QR code to learn more about an activity or a location.
- A school-based orientation and tip walk
- High score leaderboard for user statistics

The storyboard can be seen in figure 5 below. The story represents a person walking in nature and then arriving at an outdoor gym. There he sees a check-in station with several QR codes. Depending on which QR code he scans he will be guided to the ARK56 website. In this case the different categories he can scan are digital trainer, information about the site, bluetooth connection and nearby activities.

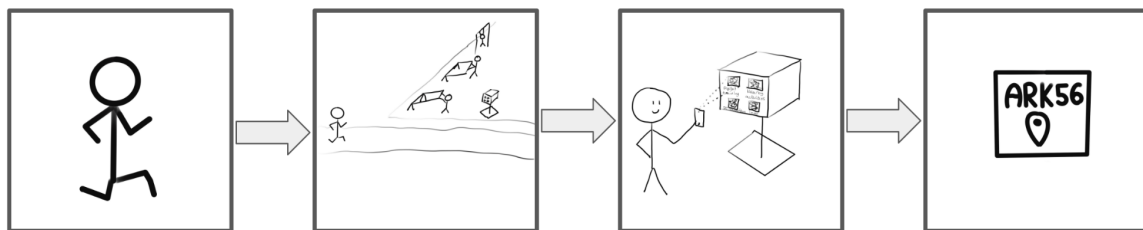


Figure 5 - the storyboard of a scenario for the check-in station.

4.2.2 - Persona

The persona produced for this project was Daryl. Daryl is a man of 25 years, he drives a truck during the day and at work he does not move much, most of the time is spent inside the truck. In his spare time, he likes to hang out with friends and fix his car. The training comes secondary for Daryl but his motto is that one training session is better than none. More information about him can be seen in figure 6 below. For details on how he experiences this type of activity at an outdoor gym, see Appendix 7.



Daryl

Love to hang out with friends and do some exercise sometimes just to keep up the good health., 25

"A little training is better than none at all"

DEMOGRAPHICS

A healthy man in his 25 years

Working as truck driver

Lives in Karlshamn

BEHAVIORS

Training 2-3 times a week

Doing both running exercises and muscle exercises.

ATTITUDES

Poor cardio

Semi lazy

Naturally fairly strong

NEEDS/CHALLENGES

A platform where training exercises are illustrated

Training is time consuming

Sometimes it hard to find motivation to train

GOALS/MOTIVATIONS

Getting motivated when I see the progress during time.

Being the best truck driver in Blekinge

HOW CAN WE HELP?

A platform that shows exercises for a specific machine that is updated every week with new exercises.

Calorie counter that motivates the user to continue their workout.

Goals to achieve during training

Figure 6 - Persona for the project.

4.3 - Prototyping & Testing

4.3.1 - Design Sprint

During the prototype building phase, several concepts were created. The first prototypes were made in small scale just so the team could feel and think what type of design is the best. After some voting in the group the decision was to combine design B with C as one design, and combine D with C as the second design, see figure 7.



Figure 7 - The small scale prototypes.

The final result of making the prototype can be seen in figure 8 below. A strong color was used so the prototype will stand out from the surrounding. The Ark56 orange color and logo are also applied so the name will be exposed for the user. A QR code is attached to the two designs which will direct the user to a website where a picture and clues for the next station will be shown.

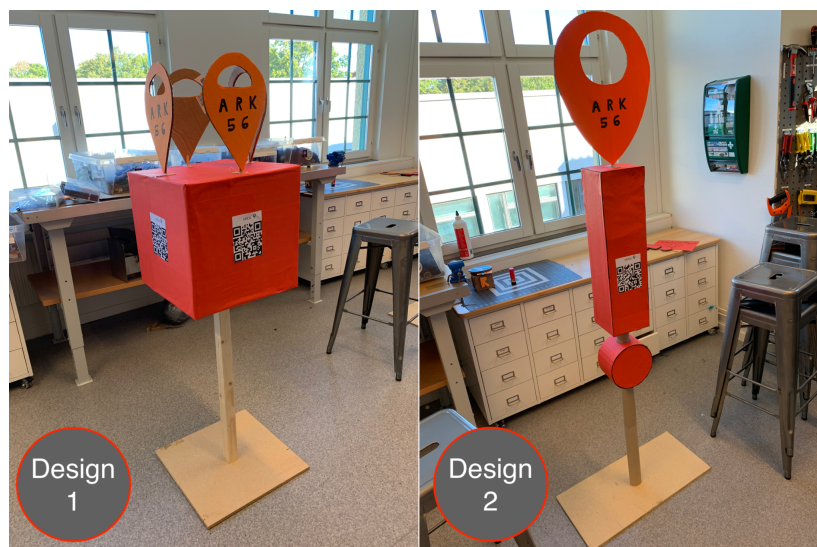


Figure 8 - The two designs of the prototypes that are going to be tested.

In total, 25 people participated in the test. There were 14 people who scanned design 1 and 11 who scanned design 2. From the evaluation paper that was placed at the last station there were 10 people who gave feedback about their experience. The result of the number of scans and feedback from the last station can be seen in table 3 below.

Table 3 - the amount of scans performed from the testing.

	Design 1	Design 2
Number of scans	14	11
What do you think of activities like this?		
Funny	2	
Exciting	0	
Want more	6	
Not interesting to me	2	

4.3.2 - Dark horse

The first part of the outcome from prototyping is a menu that will occur when the user scans the QR code on the ARK56 pole, see figure 9.

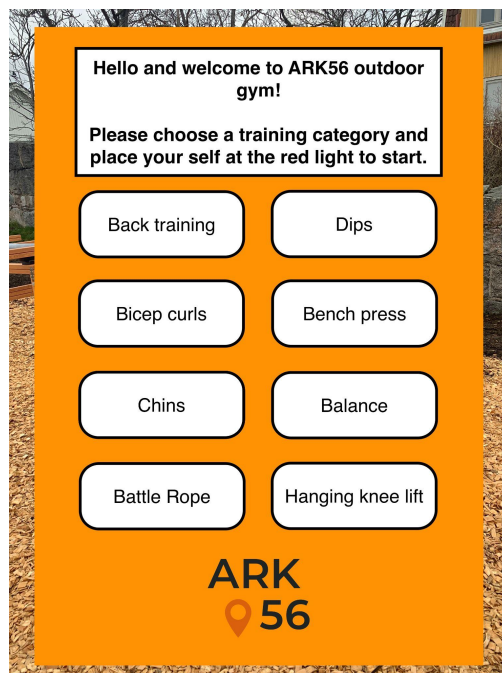


Figure 9 - Information menu on phone.

The information from the menu may guide the user to place themselves at a training machine. The second outcome from “Dark Horse” is the physical screen, which consists of a white screen which a projector projects an interface. Through the interface he or she can choose from seeing instructor films of exercises or choose training programs. When a training program has been chosen the place where the user must stand will be highlighted with a laser to guide him to the right place. While the user is doing the exercise the sensors will count the reps on a display and have a timer that counts how long the user needs to rest between the sets, see figure 10.



Figure 10 - The projected screen at the training machine.

The result from the dark horse builds on the feedback gathered from the test persons. A compilation of the feedback can be found in table 4.

Table 4 - The feedback from the test persons.

<p>If this system was in place (more polished, fully automatic), would you use it and how often?</p>	<p>Yes I would consider using this. Probably a few times a week.</p>
<p>Which aspect of the prototype do you think added the most to your training experience?</p>	<p>Nice with videos that show how to do the exercise. Good that the system keeps track of reps and tempo.</p>
<p>Which one did you think added the least?</p>	<p>The light that was highlighting the training machine can be skipped. It didn't add any experience</p>

Do you have any other feature that you think would be nice to implement in this concept

Feedback on the exercise.
Track the training process over time.

4.4 - Final concept - digital outdoor gym

The final concept is the result of all previous activities and a direct continuation of the Dark Horse design sprint. The reasoning behind this is that the initial broader concept was deemed to be too non-specific to develop into a real concept. By focusing on this specific aspect of the project the team was able to create a solution to some of the problems really well rather than solving all of the problems half-heartedly. For clarity, the concept was split into two parts. These being the *app* and the *physical location* (fig. 11), which are two separate systems that interact with each other and share information between each other.



Figure 11 - Digital outdoor gym prototype with interactive hub (A) and digital training machine (B).

4.4.1 - Physical location

The features of the physical location include the *central interactive hub* (figure 11 A) and the *digital training machines* (figure 11 B). The former contains the touch interface, which is an iPad mini, where the user interacts with the location and gets information about the ongoing training session. The latter is where the training is conducted and consists of a normal training machine, which in the prototype is for training your back.

The Raspberry Pi, on which the Python code runs, is installed on the training machine together with the digital sensor that counts the repetitions. The iPad mini is connected wirelessly to the Raspberry Pi by connecting the two units to the same WiFi (in this case mobile hotspot) and then using the iOS app VNC Viewer. The interface (figure 12) and the functions of the system are coded on Python 3 and utilizes the UI library GUIZero.



Figure 12 - User interface during training

4.4.2 - App

The newly developed application has a completely new front page (figure 13) and it also has three new functions, the new functions are as follows. The first is Progress which is a tab where you can check your statistics, you can see your daily training but also the total for the month. You can see how many repetitions you have done, how many calories you have burned both in the form of a sum but also in the form of the number of cinnamon buns (figure 13). The second news in the app is the high score page, this page shows all users who have used the app on one of the connected gyms, based on the total amount of repetitions the user has done, a ranking is created where you can see how you relate your amount of training to others users in the past month (figure 13). The third and final news that the app has received is a tab with instructional videos for the specific exercises. By selecting a specific exercise under this tab, you can see and learn through both touching image and text how the exercise should be performed.

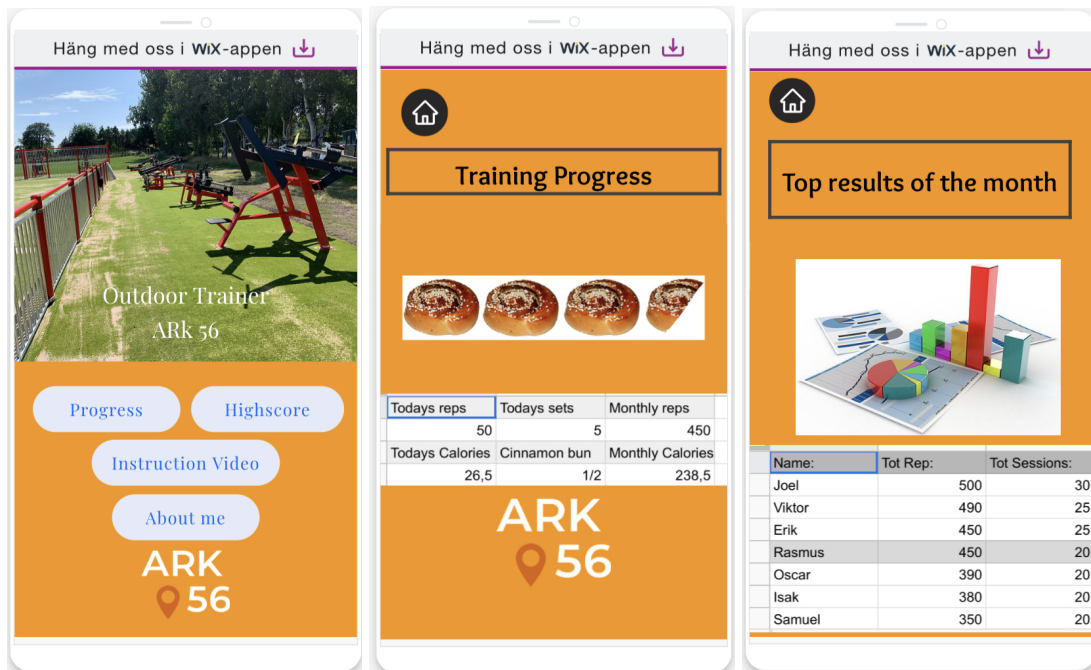


Figure 13 - Homepage (left), progress (middle) and scoreboard (right).

4.5 - Simulation

The result of the modeling setup can be seen in figure 14. The setup illustrates one of the simulated outdoor gyms, and is located in Karlskrona. The second gym is located at Ronneby and looks the same.

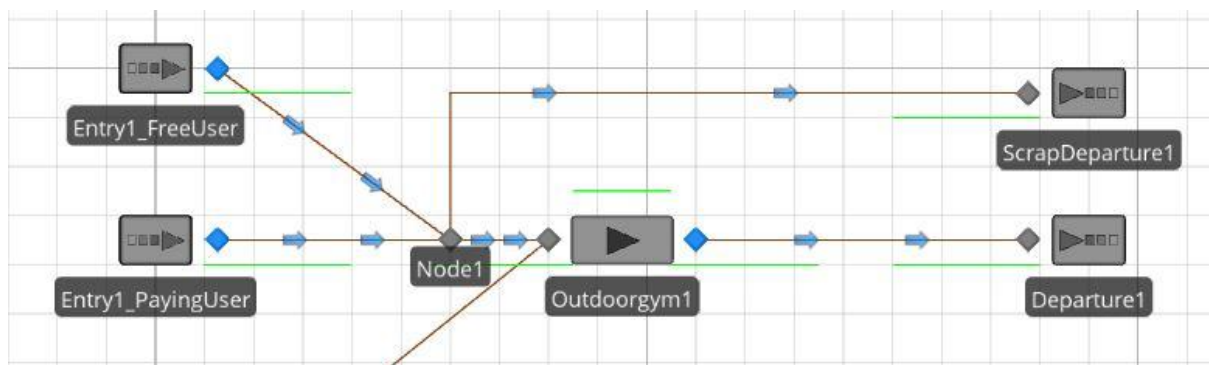


Figure 14 - The structure of entity flow in Simio.

The total cost for installation of two outdoor gyms and maintenance during a time span of 365 days was 34098 kr. This area covers the maintenance and installation service, third party suppliers and IT-system from the business model. The revenue of the simulation covers the users sector of the business model. The total number of paying users over the years was 5324. A problem here is that this is not taken into account how many times each user is training each week. Therefore an assumption was made here that each user is training 2 times a week. From this assumption the actual number of paying users was calculated to 50 paying users, see table 5. From this the monthly cost for a subscription each month will be

57 kr. The cost for this simulation is meant to go for the municipality and partner companies in the form of a service. This means that they pay a monthly fee that covers maintenance and installation. The Calculation can be found in Appendix 8.

Table 5 - Result from the simulation

Installation & Maintenance Cost (kr)	34 098
Amount of paying users	50

The numbers used to simulate arrival-time, costs, repair time, etc are based on estimates. No real values have been taken into account here due to this would require a long time of data collection of users' mobility to and from the outdoor gym etc.

4.6 - Sustainability aspect

The result of the sustainable template identified six different LSC that the solution should meet to be a sustainable product. The LSC was identified by what characteristics the solution should have and how the lifecycle should look like for the product, see appendix 9 and 10. The LSC that were identified can be seen in table 6.

Table 6 - the result from sustainable template

Leading Sustainable Criteria (LSC)	Comment
Recyclability at end of life	Easy to disassemble, few different kinds of materials
Robust ("hands off" usage)	Can sustain at least 120 days of function without needing maintenance.
Toxicity of wood treatment	No toxic treatments of water resistant chemicals.
Local suppliers/contractors when manufacturing and repairing	Only use suppliers/contractors in Blekinge.
Important information, ex right of public access and recycling stations.	Learn people how to behave in nature
Repairs doesn't lower the quality of the product	When repairs are made, the product should still have the same durability and visual looks.

From these LSC and the needs from the needfinding a deeper grading of weight and maturity was made. The result from the grading shows that the needs and LSC:s are affecting each other in some way, see Appendix 9.

4.7 - Business model

The business model (figure 16) is based on the assumption that ARK56 would play a central role in bringing this concept to market. A more detailed description in the form of a business model canvas can be seen in figure 15 below.

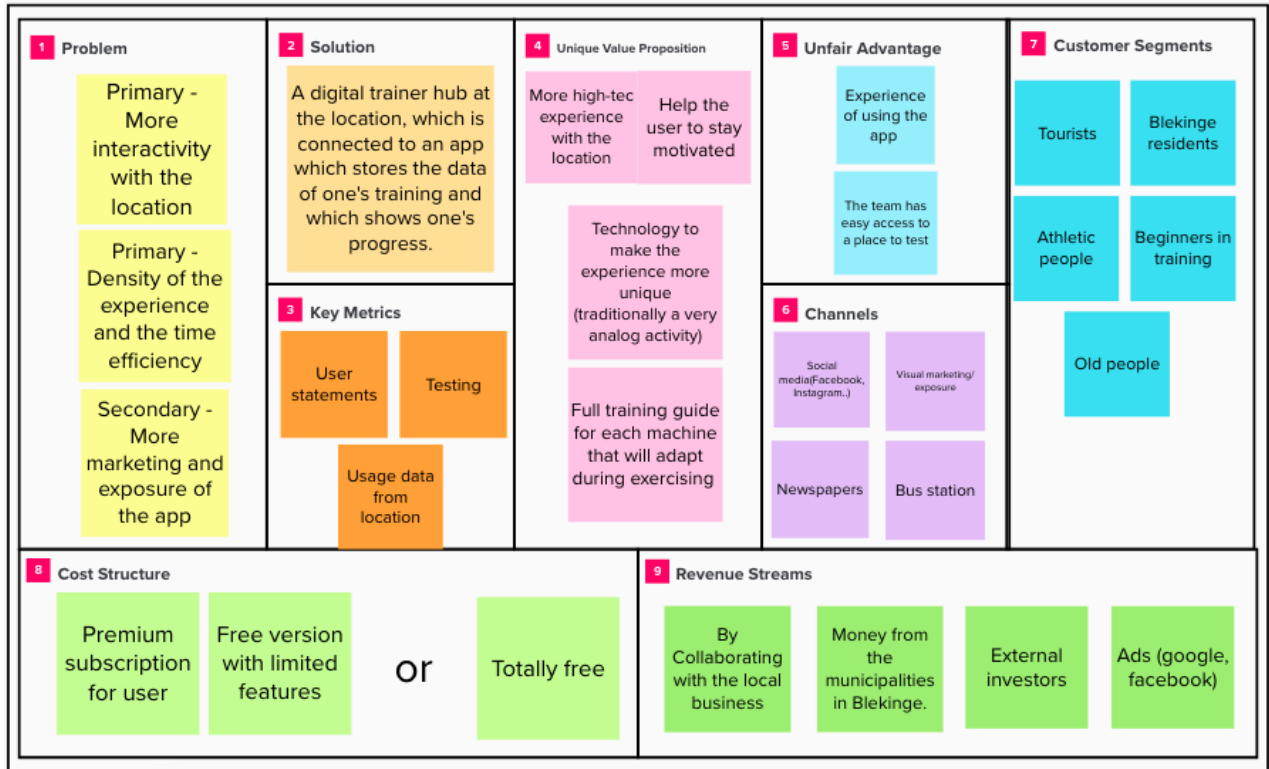


Figure 15 - Business model canvas

The reasoning behind this is that the concept is built with the goal of improving the value of the app and that a certain level of progress has already been made in terms of features. As it stands currently, the business model assumes that the monetary flow is the same, which means that there will be a cost to the users in the form of subscription models service. The concept could be sold as a product or a service (table 7) to the municipalities where the latter would include the maintenance.

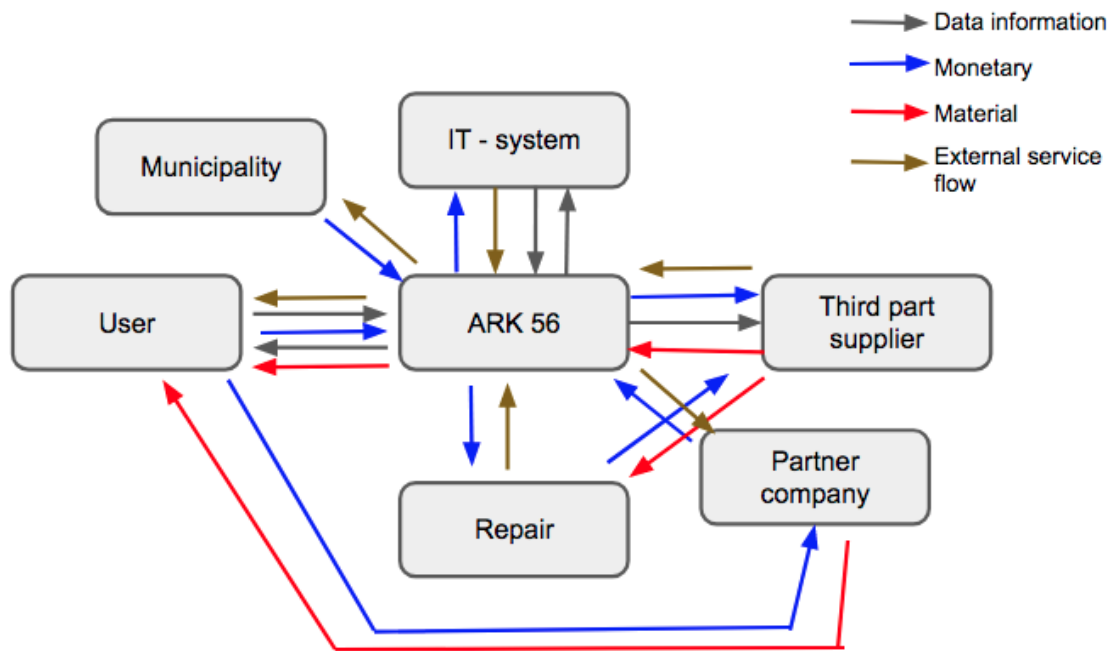


Figure 16 - Flowchart illustrating flows between different stakeholders.

There are two different ways to acquire this solution, the first and the cheapest solution is to buy the solution as a product. By doing this, you can order a basic package of sensors, the pole and screen with connection to the app. With this option, you can easily add extra add-on packages if the gym you want to apply the solution to has more than five different machines. In this solution, you have to take care of the installation yourself and so also with maintenance and repair. You can buy service packages and order new parts if any part breaks (table 7).

The second option is to buy the solution as a service, where you do not have to worry about anything. From placing your order on a package to your gym and the entire life of the gym, the solution will work without them having to think about anything. With this solution, installation and the necessary parts to get a completely updated outdoor gym are included. The annual cost includes repairs if needed, but the annual maintenance is also included, both in terms of the physical parts but also the software, so everything should be updated all year round (table 7).

Table 7 - Cost of the concept if sold as a product or a service

Product		Service	
Parts	3 600 kr	Installation + parts	15 200 kr
Avg. cost of maintenance	500 kr/repair	Avg. cost of maintenance	7 200kr/year

5 - Discussion

5.1 - Needfinding

From the needfinding several needs were identified. For this project the value of finding needs for the service was important. Due to the team getting free hands on improving valuable content into the ARK56 application the project got quite big and complex. There are all kinds of solutions for this purpose so deep investigation of needs and stakeholders had to be done. The needs found from the various tools were many and varied in categories. To facilitate the management of needs, the needs were sorted into 4 categories, which can be seen in the results. As there was no major knowledge of programming and software within the group, this was not relevant to make deeper improvements on that front. Instead, more focus was placed on examining hardware and services to see how this can be value-creating for ARK56.

The stakeholder analysis was also valuable for the project due to the team getting a better picture of which groups and people are interested in ARK56. By knowing which stakeholder has the most amount of influence over ARK56 the further work of interviews and surveys was facilitated. Better focus was put on the more important stakeholder to see what they think is good and bad with the existing solution.

5.2 - Ideation

After using the tool six thinking hats, the team came up with three winning ideas. The majority of our suggestions are based on user feedback and our own experience with the app. The team was able to see distinct ideas from diverse angles with the use of six thinking hats, which explained the benefits and drawbacks of the ideas themselves. Furthermore, it revealed that the highly scored concepts were the most well-thought-out and appropriate, contributing to their selection for further consideration. We also had several additional ideas that were well-received. The team utilized some of these ideas in a Design Sprint to acquire some findings that might assist the group build these ideas into a finalized design. In the future, we'll combine some of these ideas with any new ones that arise to come up with a concept that makes a difference and adds value to the app, and that you can put into practice and receive real results.

5.3 - Design Sprint

The result from the prototype test was interesting and valuable for us. In some way the concept of attracting people to scan a QR code and then do a form of orienteering activity will work in practice. And from the feedback that was achieved this strengthened our theory. However, improvements are relevant as some shortcomings in the test were found during the time. In this test the two designs of poles were placed at different spots. There was no

sign that told the user to scan the station they thought was the best. This could be improved if a test was going to be performed again. The two designs should be placed next to each other and then some sort of indication that tells the user to scan the design they think is the most attractive. By doing this, more people will maybe scan the prototypes and know why they are doing it. This will also provide more reliable data for the team which can be used in the development process. Future work of the development process will be to do further testing on different functions in the solution. Until now testing has only been performed inside BTH. To get a more realistic review of the users and more reliable data, testing in nature or in the city would be preferable. To accomplish that the team needs to investigate which functions need to be tested and what questions we need to answer on. A better and more robust prototype needs to be manufactured so the material can handle outside weather.

5.4 - Dark horse

By using the concept of prototype from the design sprint a better version of it was built. The new one was more robust and was completely made of wood instead of cardboard. This makes it a more high-fidelity prototype and more functions can be tested. The results of dark horse showed that there was an interest in using a digitized outdoor gym. The feedback given by the test persons gave both advantages and disadvantages of the concept. The idea with the dark horses was to go in an unexpected direction with the project and go outside the safety zone. This meant that the concept got a more sci-fi / future tone. What was noticed during the experiment was that many of the functions that were implemented were a bit superfluous and did not directly do any good. An example is that when the user had scanned his QR code, a machine would be marked with a laser. This is to guide the user and make it extra clear where he or she should go. However, this did not quite work as intended. Due to daylight, the laser lights did not appear as clearly as desired and the subjects did not even observe it. When the team saw potential in the concept and noticed that users appreciated the experience, it was decided that the end product should be based on the dark horse idea. With the help of additional needfinding and feedback from the test persons, the concept was optimized to become the final concept.

5.5 - Final concept

The final concept which includes the interactive hub, training machine and training app are the outcome from all the needfinding and workshop sessions that have been made. The key features of the concept are solving the main questions that were identified in the beginning of the project, which were "How might we increase the density of the user's experiences with the help of ARK56?". This concept meets up to this question in the form of the user will be able to interact more with the location which will increase the density of the training experience. By letting the digitized system tracking the reps and training process the user

can see how the progress evolves over time. This will motivate the user to keep training and use the ARK56 application more which also was a wish from ARK56.

The development of this project has ended with more value being created for the ARK56 application. This is because a physical product has been developed that is linked to their app, which makes the users act with the brand name more physically, but still have the digital experience. In this way, the project has undergone a transformative development as the solution has been developed to not just be an app. With this solution ARK56 will also be able to track user data from the outdoor gym. With this data they can get more detailed information about how the users are using their app and through this, develop the concept over time to make it fit the user behavior.

5.5.2 - Simulation

With this simulation model, a reasonably good picture can be obtained of how the flow of users and service people will work. The result is that costs and revenues can be compiled in a flexible way. One thing to keep in mind is that this model is not based on real data but is made up. Another factor to keep in mind is that the monthly cost that has been calculated only covers the annual cost of repairing and installing the outdoor gym. Extra costs will need to be added if the business is to be profitable.

In this model only two outdoor gyms were built during the year. To do a more detailed simulation, different scenarios can be made for the outdoor gym and see which scenario will be the most optimal. For example there can be more gyms that are built during the year or more users are paying for the subscription of the gym service. Any ways this model can be used to implement more features and are a good base frame to work further on.

5.5.3 - Sustainability aspect

The result of the sustainable template gave the project nice directions to develop the concept to a sustainable solution. The physical product will be made of wood, which will make it easier to recycle at the end of life stage. To make the product robust from weather and other forms of tear the wood should be treated with an environment friendly impregnation. The same goes for the paint which should also be environment friendly so no toxic substances leak out in nature. The only part of the solution that is difficult to make better for nature are the raspberry and screen. These electronics need heavy metals to be functional and are hard to get out of the product. To make even less impact on the environment the material for the solution will be from local suppliers. This to minimize the transportation of material around the world.

5.5.4 Business model

There are pros and cons to both of the two options of selling proposals. The first option where you buy the solution as a product has the advantage that the initial cost will be much cheaper, this is because the buyer is responsible for the installation of the product. The buyer must also keep track of when the gym needs service or when something needs to be replaced. The big advantage of this is if you as a buyer have the time and knowledge to organize installation and repair / service under your own business, then this will be the best option for the customer.

But if you as a buyer want a free ownership problem where no time or effort needs to be put into either installation or repair / service, the alternative is the right choice for the customer. This contributes to the customer having to pay a larger start-up cost but not having to worry that they will have problems with the installation as it is performed by knowledgeable staff. In this option there is also an annual fee that is recurring every year, this cost saves the customer time and energy on servicing their facility and also the software behind this.

5.5.5 - Future work

For future work to bring the product to market, the digital hub needs to be made more robust. Partly in terms of weather-resistant, for both rain, snow and wind so it can withstand the Nordic climate. Furthermore, the screen also needs to be replaced with one that can be worn outside all year round, it must be replaced with a screen that works even when it is raining as well as when it is scorching sun. The interface of the digital hub needs to be made more user-friendly so that it can be used by all age groups in a simple and smooth way. Furthermore, the app must be developed even more, the basic functions work, but even here the interface must be improved to create a professional look that can attract future users. A stable and secure communication between the digital hub and the app must be maintained, so there is a secure communication between the systems. A way to easily improve the app aspect of this project is to investigate potential collaborations with existing applications that include similar features to the ones desired in this product.

A deeper study of which sensors are best suited for the intended function, partly to be able to count repetitions at an outdoor gym but also that the sensors must be weather-resistant and not give different outcomes depending on the weather. To bring this concept to market a selection of different packages of sensors that fit different types of outdoor gym machines would be beneficial for both monetization models. The idea with these sensor packs would be the ease of installation as well as removing the need to customize every installation.

5.6 - Learnings

Many lessons have been learnt during the course; the majority of the lessons are minor and have little impact on the ultimate solution's conclusion, but they are crucial to include for future work. One of the lessons was that it is critical to have a clear strategy in place from the start of the course. It is essential to establish the norms and expectations of each group member, as well as the goals for which the group should aim. Another lesson is that you can never expect to have all of the information required, so that you must rely on certain methods and strategies to acquire the necessary and vital information that pushes the project forward.

It's indeed crucial that team members be critical at the same time as they focus on both details and the long view, rather than wasting time on ineffective approaches. It is wise that the group implements suitable tools and procedures that improve the product development and get you one step closer to the goal.

Another important learning is the significance of identifying users and their needs while developing a product or service, as well as why they have these needs, in order to better understand the problem. A positive take away from the course is that it may be beneficial for all members to be familiar with the presentation parts, which strengthens the ability of present and allows one to be better at it. Later in life, you may indeed be required to present something without having prepared for it.

A major takeaway from the team's restrictions is how critical it is to think through the testing of the prototype, or in this instance, prototypes. It is critical not only to get things out there and let people test them, but also to think through the desired test case. What may go wrong, what is crucial to focus on, but also how would you react if you were a test subject? It makes no difference how much research you have done or how much time you have spent on prototypes if you are careless and miss important features throughout the testing process. This is by far the biggest lesson we take with us from this project and will take this with us to future projects.

6 - Conclusion

- The problem statement from the needfinding is “How might we increase the density of the user's experience with the help of ARK56?”
- After deep analysis of ideas using brainstorming and six thinking hats, the three winning ideas were as follows:
 - Users may scan a QR code to learn more about an activity or a location.
 - A school-based orientation and tip walk.
 - High score leaderboard for user statistics.
- A first prototype was built with the goal of looking attractive and attracting users to scan the QR code.
- A test was performed with the prototype where the user gave feedback of what they thought of their experience.
- The importance of planning the test phase in detail in advance, so the test doesn't miss a lot of important information during the test due to poor structure of the test.
- The high interest in a digital outdoor gym could be confirmed with the help of the Dark Horse strategy.
- Users will be motivated to continue training in connection with the use of ARK56 by interacting with the app's functions with the outdoor gym.
- Even though a simulation is not based on real data, it provides an overview of how several possible scenarios may seem if they were implemented in reality.
- It is essential that the materials used in the development or construction of a product meet sustainability requirements so that they would not have a detrimental impact on the environment.
- Increased robustness that allows the prototype to resist all potential weather conditions will be considered when the concept is further developed.

7 - References

- [1] "Om ARK56 - Länkade kustleder i ett Unesco biosfärområde", *ARK56*, 2022. [Online]. Available: <https://ark56.se/om-ark56/>. [Accessed: 15- Dec- 2021].
- [2] "What is Design Thinking?", *The Interaction Design Foundation*, 2021. [Online]. Available: <https://www.interaction-design.org/literature/topics/design-thinking>. [Accessed: 26- Oct- 2021].
- [3] Springboard, "What Are the 5 Stages of Design Thinking?". [Online]. Available: [What Are the 5 Stages of Design Thinking? \(springboard.com\)](https://springboard.com/what-are-the-5-stages-of-design-thinking/). [Accessed: 26 Oct 2021]
- [4] R.F Dam, T.Y Siang, " Stage 2 in the Design Thinking Process: Define the Problem and Interpret the Results," *Interaction Design Foundation*, 2020. [Online] Available: [Stage 2 in the Design Thinking Process: Define the Problem and Interpret the Results | Interaction Design Foundation \(IxDF\) \(interaction-design.org\)](https://www.interaction-design.org/literature/topics/design-thinking/stage-2-in-the-design-thinking-process-define-the-problem-and-interpret-the-results). [Accessed: 26 Oct 2021].
- [5] "Ideation", *Corporate Finance Institute*, 2021. [Online]. Available: <https://corporatefinanceinstitute.com/resources/careers/soft-skills/ideation/>. [Accessed: 28- Oct- 2021].
- [6] Interaction design foundation, "What is prototyping". [Online]. Available: <https://www.interaction-design.org/literature/topics/prototyping>. [Accessed: 28 Oct 2021]
- [7] Tenney.com. 2022. *The Importance of Product Testing | Tenney Environmental*. [online] Available at: <https://www.tenney.com/blog/importance-product-testing> [Accessed 26 January 2022].
- [8] De Bono Group, "Six Thinking Hats", De Bono Group, September 2021. [Online] Available: https://www.debonogroup.com/services/core-programs/six-thinking-hats/?fbclid=IwAR1R0YZJbpqVy1GVoFQ__HTP5WZRHWe0OsFpqTb64PHwnFh_OjcTw4TOEIY [Accessed: 17 sept, 2021].
- [9] "What is brainstorming and how does it work?", *IONOS Startupguide*, 2022. [Online]. Available: <https://www.ionos.com/startupguide/productivity/brainstorming/#:~:text=Brainstorming%20is%20a%20very%20common%20group%20method%20for,which%20is%20based%20on%20spontaneity%20and%20unfiltered%20creativity>. [Accessed: 25- Jan- 2022].
- [10] Österlin, K. (2003). Design i fokus. Liber ekonomi, (p.45-46). Retrieved from: <http://sodratornet.se/artikel/brainstormning/>
- [11] Marr, B. (2020). "The Different Types Of Benchmarking – Examples And Easy Explanations", *bernardmarr*. [Online]. Available: <https://bernardmarr.com/the-different-types-of-benchmarking-examples-and-easy-explanations/>. [Accessed: 24- Jan- 2022].

- [12] "En del av Operativ effektivitet & Ledningssystem", *Canea*, 2021. [Online]. Available: <https://www.canea.se/management/benchmarking> . [Accessed: 26- Oct- 2021].
- [13] "Technology Trend Awareness", *Cleverism*, 2021. [Online]. Available: <https://www.cleverism.com/skills-and-tools/technology-trend-awareness/> . [Accessed: 29-Oct- 2021].
- [14] Bumcrot, J. (2019). "How to use storyboards for product development". [Online]. Available: <https://www.uxbooth.com/articles/how-to-use-storyboards-for-product-development/>. [Accessed: 29 Oct 2021]
- [15] "Technology Trend Awareness", *Cleverism*, 2021. [Online]. Available: <https://www.cleverism.com/skills-and-tools/technology-trend-awareness/> . [Accessed: 29-Oct- 2021].
- [16] Visual Paradigm, "What is Customer Journey Map?," *Visual Paradigm*, 2021. [Online] Available: [What is Customer Journey Map? \(visual-paradigm.com\)](https://www.visual-paradigm.com/what-is-customer-journey-map/) [Accessed: 29-Oct 2021].
- [17] "The Design Sprint — GV", *Gv.com*, 2022. [Online]. Available: <https://www.gv.com/sprint/>. [Accessed: 25- Jan- 2022].
- [18] Design Thinking Methods Catalogue, "Darkhorse prototype," 2022. [Online] Available: <https://www.designthinking-methods.com/en/4Prototypen/darkhorse.html> [Accessed: 29-oct-2021]
- [19] T. W. Howard, "Are Personas Really Usable?," *Communication Design Quarterly*, vol. 3, no. 6, pp. 20-26, March. 2015. [Online serial]. Available: [View article \(google.com\)](#). [Accessed 29-Oct-2021]
- [20] S. LLC, "Simio Software | About the Company | Simio", *Simio.com*, 2022. [Online]. Available: <https://www.simio.com/about-simio/>. [Accessed: 15- Jan- 2022].
- [21] M.C, Zijp, et al. " An Identification Key for Selecting Methods for Sustainability Assessments." *Sustainability*, vol. 7, no. 3, Mar. 2015, pp. 2490-2512, doi: 10.3390/su7032490.
- [22] Romero-Castro, N. et.al. 2022. "Understanding the Antecedents of Entrepreneurship and Renewable Energies to Promote the Development of Community Renewable Energy in Rural Areas" *mdpi*. [Online] Available at: [Sustainability | Free Full-Text | Using Group Model Building to Foster Learning for Strategic Sustainable Development | HTML \(mdpi.com\)](https://www.mdpi.com/2077-0480/14/1/104) [Accessed 27 January 2022]
- [23] Franz, C., 2021. *System Thinking & Causal Loop Diagrams*. sustainability methods [Online] Available at: [System Thinking & Causal Loop Diagrams - Sustainability Methods](https://www.mdpi.com/2077-0480/14/1/104) [Accessed 27 January 2022]

[24] "Raspberry Pi 4", raspberrypi.com, 2022. [Online] Available:
<https://www.raspberrypi.com/products/raspberry-pi-4-model-b/>. [Accessed: 27-Jan-2022]

[25] Kailus, J., 2022. *5 Ways to Stay Motivated to Exercise Regularly*. [online] Gaiam.
Available at:
<https://www.gaiam.com/blogs/discover/5-ways-to-stay-motivated-to-exercise-regularly>.
[Accessed 27 January 2022].

1 - Compilation of findings from needfinding

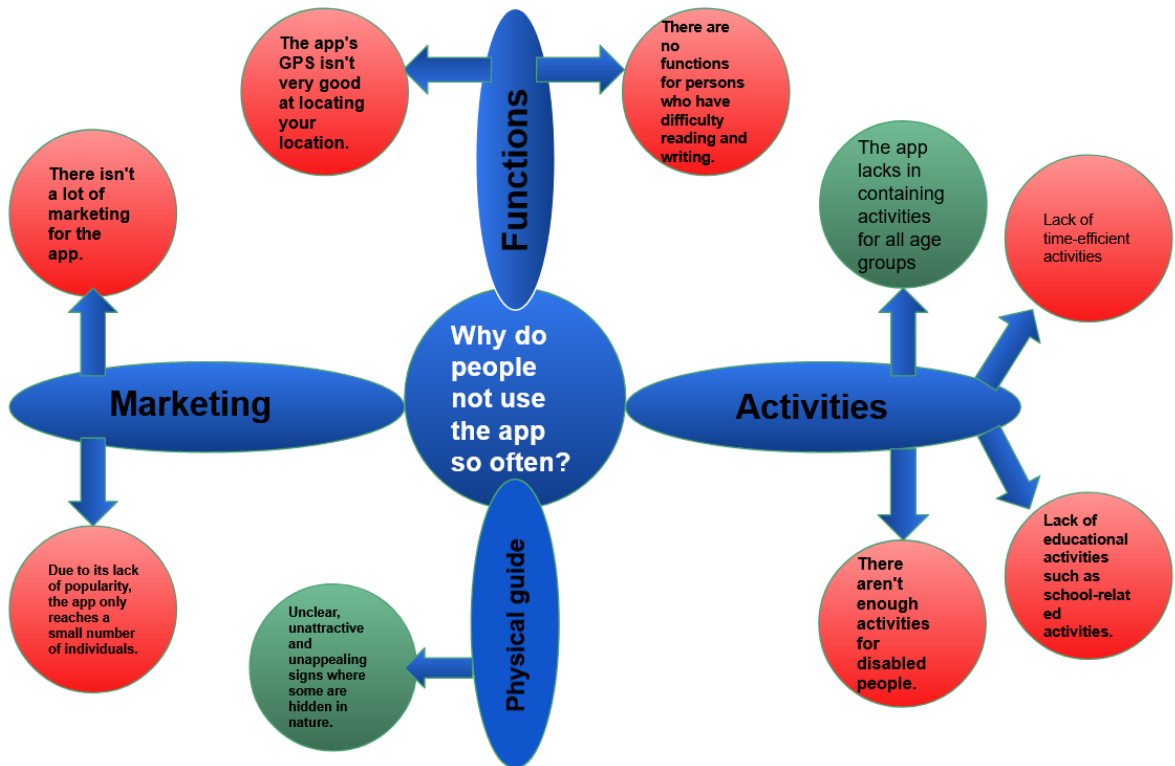


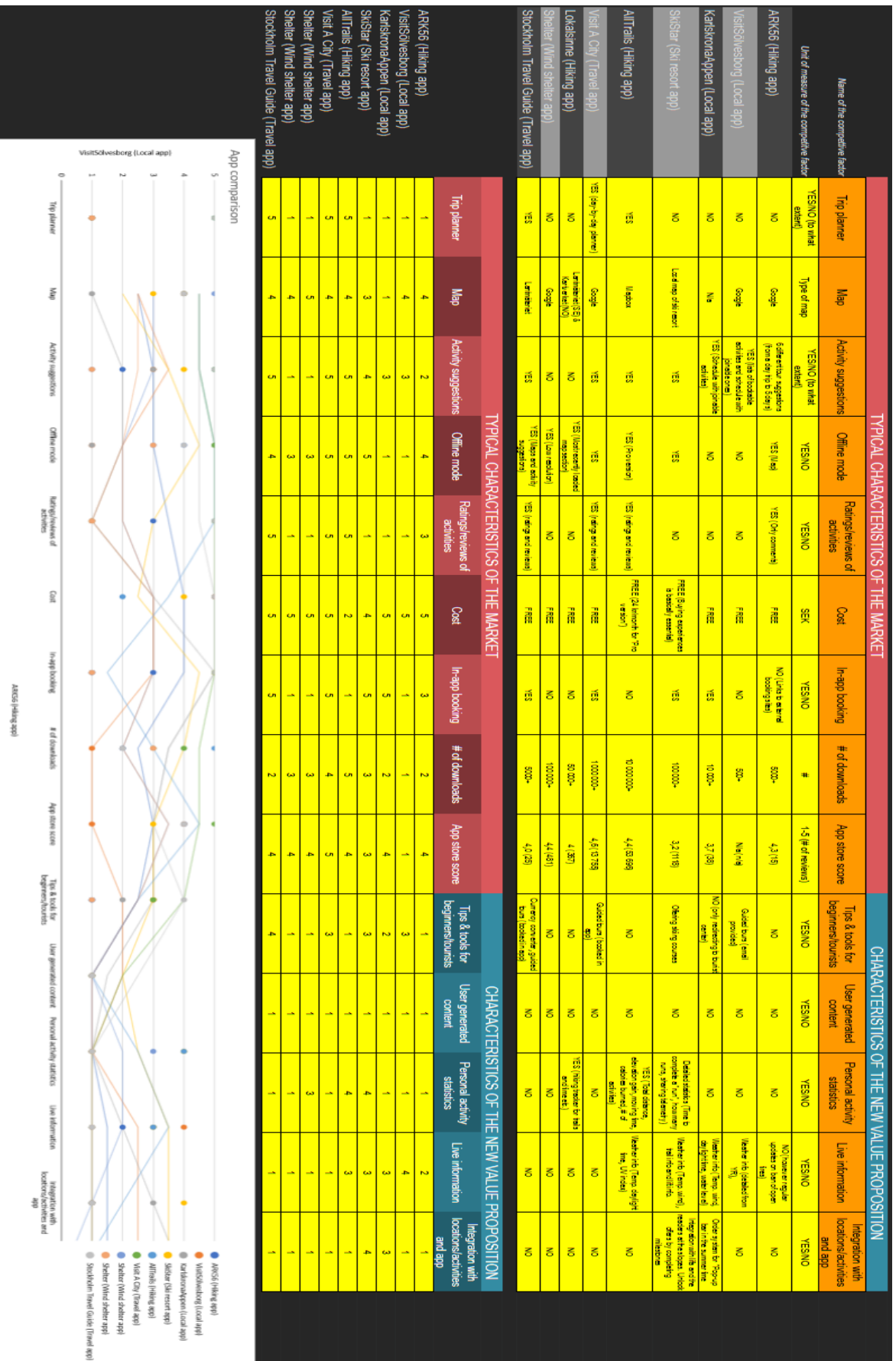
Figure 1 - Compilation of findings from the different needfinding tools.

2 - Stakeholder analysis

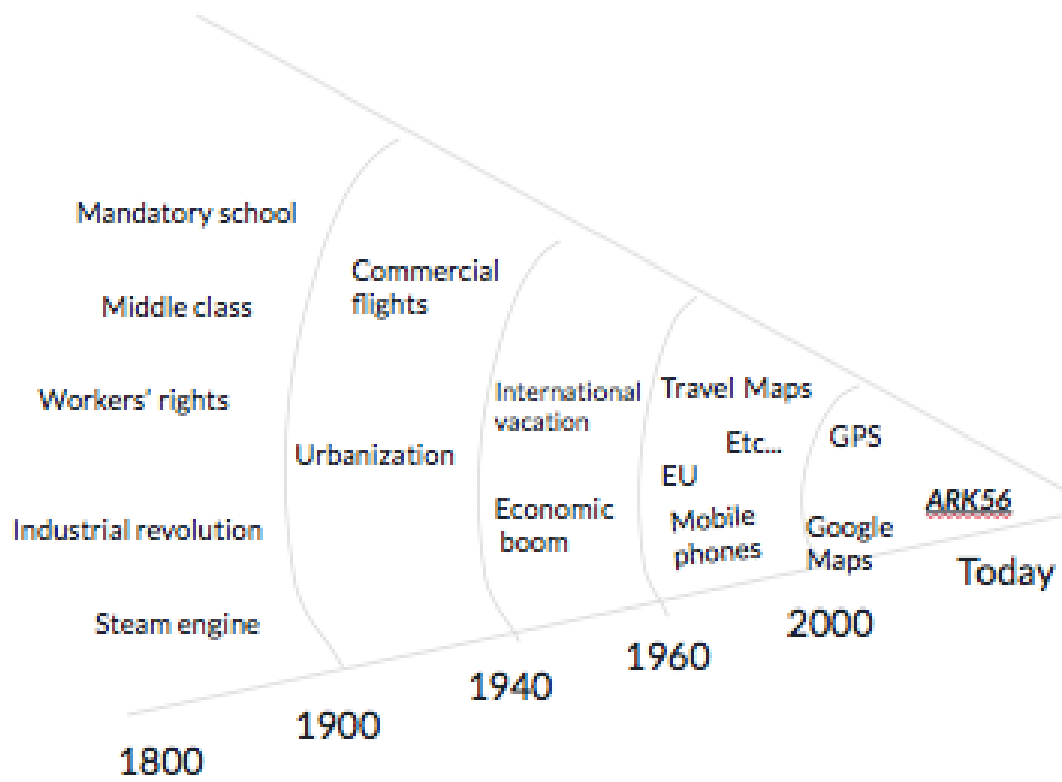
	PRODUCING STAKEHOLDERS		SUPPLYING STAKEHOLDERS			CONSUMING STAKEHOLDERS		
	<<type1>> Væk Biskings	<<type2>> ARK38 deivs	<<type1>> BTH	<<type2>> Nature apparel companies	<<type3>> Local companies	<<type1>> Biskings citizens	<<type2>> Tourists	<<type3>> Rescue personnel
INTEREST								
What is the level of financial interest in the solution?	4	5	1	3	4	2	3	1
To what extent is the stakeholder dependent on the solution in his/her operations?	4	5	2	3	2	2	3	1
To what extent is the stakeholder waiting for the solution to satisfy his/her needs?	3	4	2	1	1	2	2	1
OVERALL INTEREST	HIGH	MEDIUM/HIGH	HIGH	LOW		MEDIUM/LOW	MEDIUM/LOW	LOW
OVERALL INTEREST (numerical scale)								
POWER								
Low (1) - Medium (3) - High								
How legitimate is the stakeholder relationship with the provider of the solution?	2	5	5	1	1	3	1	1
How important for the company business is the relationship with the stakeholder?	5	5	2	2	3	4	5	1
How important is the collaboration with the stakeholder?	5	5	3	2	4	5	5	2
How powerful is the stakeholder in influencing other stakeholders?	4	4	1	1	2	5	5	2
OVERALL POWER	LOW	MEDIUM/LOW	HIGH	LOW		LOW	LOW	LOW
OVERALL POWER (numerical scale)								

Figure 2 - Power-interest analysis of stakeholders.

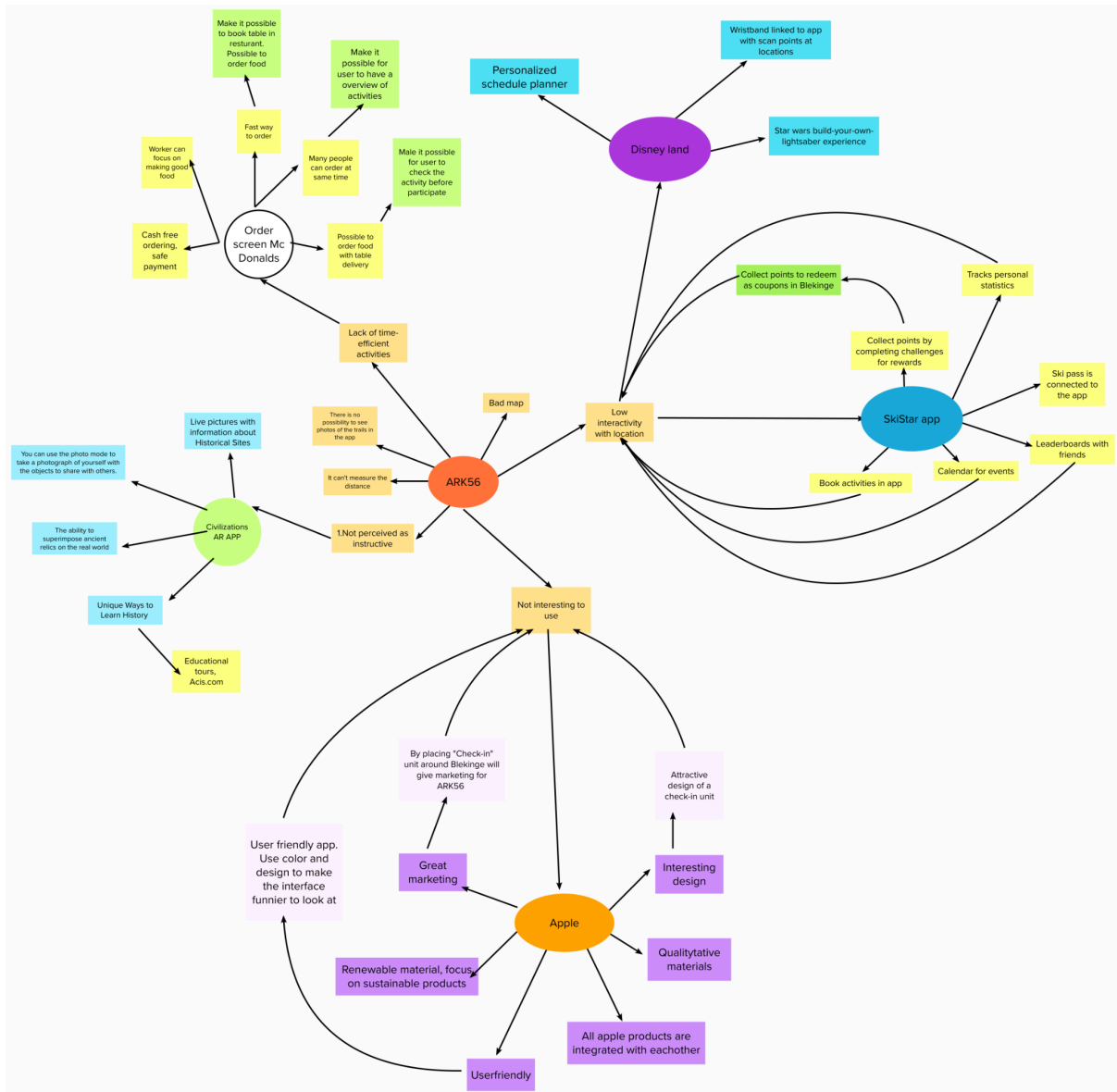
3 - Value strategy canvas



4 - Tech- and trendwatching



5 - Analogies and benchmarking

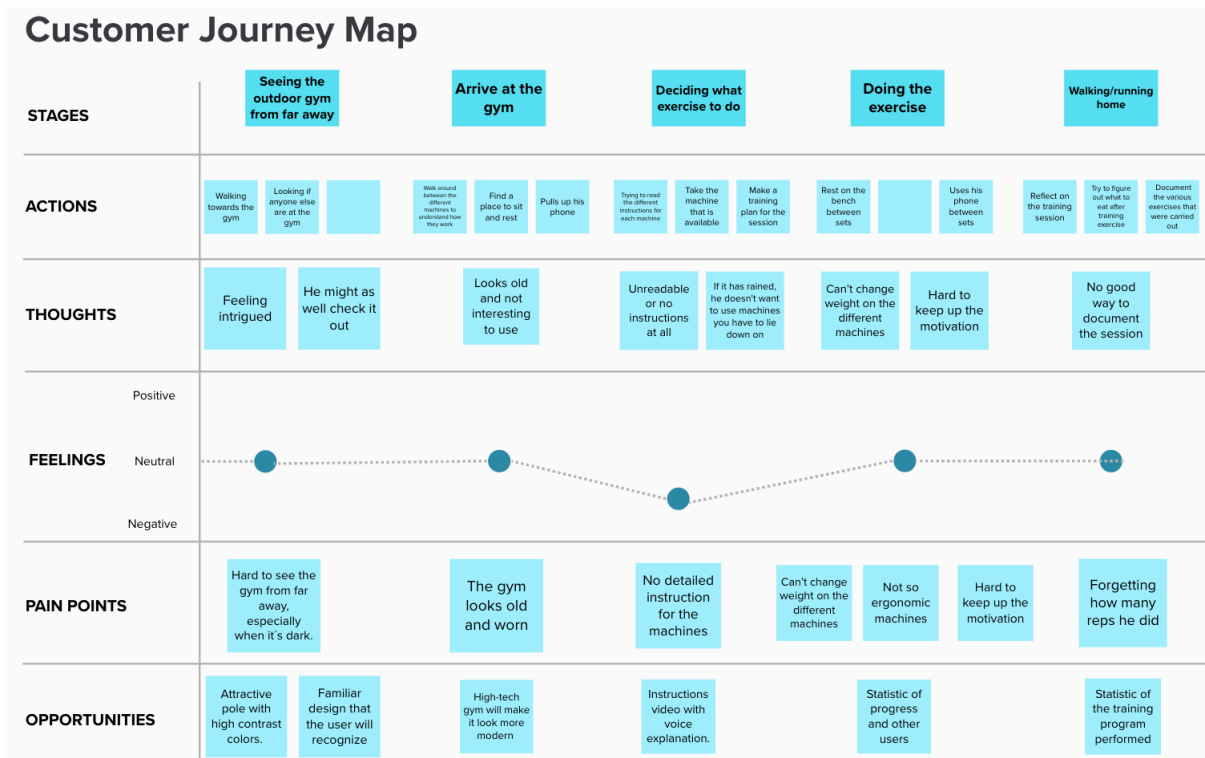


6 - Six thinking hats

		What does this idea include and what does it not include? How quickly can you prototype the idea? How feasible is the idea? In what ways is the idea in line with the Sustainability Principles? In what ways is it not? Can the idea be combined with other candidate ideas?	What is your gut feel about this idea or aspects of this idea? Do you like it (or them) or not? Can you articulate why?	Does this idea help address a Sustainability Principle issue? What are this idea's biggest potential strengths?	Does this idea have potential unintended downsides from a Sustainability Principle perspective? What are this idea's biggest potential weaknesses? Can the weaknesses be mitigated?	Can the idea be combined with other candidate ideas? Can the weaknesses be mitigated?			
	Blue - Process	White - Facts	Red - Feelings	Yellow - Strengths	Sum	Black - Weaknesses	Sum	Ranking	Green - New Ideas
	does the team share an understanding of what the idea is and is not?	Is everybody aware of their preferences and where they might come from?	Individually score each idea relative to the other ideas on this point scale: 3 for amongst the strongest, 2 for in the middle, 1 for amongst the least strong	positive number	Individually score this idea relative to the other ideas on this point scale: -3 for amongst the weakest, -2 for in the middle, -1 for amongst the least weak	negative number		Brainstorming	
Idea	Idea Description	White - Facts	Red - Feelings	Yellow - Strengths	Sum	Black - Weaknesses	Sum	Ranking	Green - New Ideas
Live weather with picture	The post will receive the information about the weather and other live information from the place. Will keep a picture every 30 min from the beach to get an update how occupied the beach is. If it able to get a place if you go there. This picture and information could be seen from the application.	- Time efficient, if totally occupied visit another place instead. - If you plan to go to a place, it would be nice to check the weather at the location before enter it.	Feel that it is interesting to know the weather before I visit the place. But do not want to be "monitored", so do not want a 4k image	Reduces the risk of visiting a place if it is full or if the weather there is bad. For example, the beach.	7	Must check how it work with publishing pictures from public places. Need to have many station to have the ability to check several places.	-3	4	
Post that count visitors at popular place	Similar to counting passed bicycles inside the city (Trossé), this post will also count passing visitors during the day. This can be seen on the post, but the information will also be updated in the app.	Make it easy for both visitors and stakeholders (visit blekinge, ARK56) to get an understanding of where people want to go.	Feels like a modern solution, where you can see both the number from the app and on the spot.	If you can check the daily number who visit the church right now, maybe you choose another day when the movement is not that high as it was this day.	8	You can not see the current number of visitors of the site, you can only see today's total visitors	-3	5	
Restaurant/activity bookings and schedule viewing	QR code linking to the respective booking schedule for a certain location/activity.	QR code is easy to implement. If restaurant/activity has their own booking system, it's easy to link to that particular system. May use stickers or LCD screen to show QR code.	It's important to make sure that people understand what the QR code is for so that people actually understand that they should use it to look up bookings/schedule.	Not very much as bookings are already digitalized or done over phone.	4	If changes are made to the website, the QR codes has to be updated. If it's a sticker, this has to be replaced. If it's some kind of LCD, it's more expensive.	-7	-3	
Digital trainer instructor outdoor gym	Voice and visual instruction to show exercises as well as coaching by voice commands.	A way to encourage the usage of outdoor gyms. Increased exposure of the app.	Feels like something that is not entirely new, but still has no readily available solutions to buy directly. Still a good way to make people recognize the app, but maybe also confuse people over what the ARK56 app really is by misinterpreting it to be a training app.	Time saving as there is no need to plan what exercises you will do. Creates more interactivity with the environment/location.	9	Depending on how "fancy" you want the solution to be (LED screen, speaker etc) it could get expensive. Not really a new idea. Is it entirely clear that this solution will fulfill the needs?	-5	4	
Collect points at different training activities (check-in) (collect rubbish?)	The user can collect point in the app by "check in" to a post when doing a training activity. For example accomplish a specific hiking trail. With the points the user gets discounts at restaurants or shops in blekinge region. The point can also be earned if you through your trash correct trashcans at the posts.	This idea include a point system which produces a behavior in the user to use the ARK56 app. It doesn't include a mandatory usage of the product but it let the user decide itself to use it or not. The earnings from the user perspective are discounts at local restaurangs and shops. The idea are feasible and the concept ae used in other applications and the cost are cheap.	Feels like a stable solution that brings joy to the user when he does his activities. We feel happy and excited	- Increases people's activity - increases the use of ARK56 - Increases the shoping activity in the Blekinge region	11	Can be misused and users may "cheat" in some way to get discounts.	-8	3	
High score for user statistics	This idea include the highscore system in the app and at the "check in" posts. The step calculator that are connected in the app register all the users steps and shows thier name on a lederboard if they have accept it in the app. The posts will also have a display that shows the name of the users who have walked the most steps that day.	This idea include a system that motivates people to go outside and exercise more. By having his name on a lederboard people will be competitive and try to beat each other.	Interesting and fun. It's a fun way to activate the population of Blekinge and good commercial for ARK56	Easy to accomplish with some simple programming. Motivated people to use the ARK56 app and do some more exercising.	9	There can be a risk that people cheat with their steps.	-4	5	This idea can be combined with competition. The person who walk the longest distans each day gets rewarded with something. For examle points, T-shirt, Socks etc.

Orientation / tip walk intended for schools.	More options for tips rounds in the app that serve as a complement to the different activities that will be held in the different schools in Blekinge, by exhibiting different questions that exist in different places in nature, students can explore many new places. In this way, students get to learn new things in a modern and fun way. Each correct answer gives a point, you collect a certain number of points and you get a discount on certain stores that are in the app, which can be cafes, restaurants, etc.	This concept incorporates a system that encourages students and schools to use the app. By doing tip rounds with school-related topics.	Feels like a new and fun way to learn new things while in nature. So you break the boring traditional way of learning in schools, and see how the different environments make students happy.	Increases students' and other people's motivation to know new information about various subjects.	9	It requires a constant updating of the various questions and information.	-4	5	5
Users can acquire information about an activity or a location by scanning a QR code.	QR code that links to tip round questions where the code is found in nature in the various stations, as well as essential information for example about various heritage places in Blekinge.	QR codes are a services that is used in various apps; they are cheap and simple to implement in the app, and they are not overly complicated, so they can be used by users of all ages.	It's exciting to search for different QR codes in nature. It's so simple that scanning the code and seeing what information it gives makes everyone pleased and motivated, youth and adults.	Time efficiency by both being out in nature and walking while learning new things and getting new information. It is easy to use by simply scanning the code. It creates a competitive environment among users.	9	For users to continue to utilize it, it requires a continual update and a huge diversity of information.	-3	6	An example of how the idea can be visualized in reality. "Users are looking for an unknown secret. Via so-called QR codes, participants receive encrypted information to their mobile on the app. A kind of riddle that must be solved to get directions to the next QR code. There are a number of QR codes, as well as clues, placed in nature you have to go through all in search of the unknown secret".

7 - Customer Journey Map



8 - Calculation of cost

Total cost from simulation = 34 098 kr

Amount of paying user from simulation = 5234

The amount of paying users is the total number of users entering the outdoor gym in one year. This number comes from the assumption that a user arrives every 2.5 hour. One thing that the simulation does not take into account is that a user can enter the outdoor gym several times over the year. Therefore the following assumptions have been made.

Assumption: Each paying user are training 2 times a week during the year, therefore:

Amount of training session for a user over one year: $2 * 52 = 104$

Actual amount of paying users = $\frac{5234}{104} = 50$

To calculate the monthly fee for a subscription the following equation was used:

$$X * 12 * 50 = 34098 \rightarrow X = \frac{34098}{12*50} \approx 57 \text{ kr/month per user}$$

9 - Sustainable template

Guiding questions	Answers
What materials are needed for for a sustainable solution?	Wood, Electronic (Small computer), Non-toxic paint.
What are sustainable suppliers?	Local lumber/Wood shops.
How is the sustainable solution produced and manufactured?	Local forest, local manufacturing.
How is the sustainable solution used and maintained?	Repainting, digital updates.
What happens with the sustainable solution at end of life?	Driven by solarcells Disassembled and recycled (wood, electronics) or upgraded/repaired and reused.
What societal needs does the solution address?	Interactivity with nature/physical locations and sharing of information.
How is maximum social, ecological and economic value provided by the solution?	Social - Increase learning, interactivity with surrounding and time efficient. Ecological - Sharing locations of recycling stations (maybe some small trash can beside pole. For example when carrying a lot of trash when hiking. Economic - some earning point system that makes it possible to earn point by doing stuff.



1. 'To be' What characteristics does your solution need to have to fit into a sustainable society?
Use the guiding questions to identify characteristics.

2. 'As is'

What are the current preconditions to designing and delivering these characteristics?
Use the guiding questions to identify challenges and opportunities in all three sustainability dimensions, across all lifecycle phases.

Lifecycle phase	Guiding questions	Ecological dimension			Social dimension		Economic dimension	
		Ecological dimension	Social dimension	Economic dimension	Social dimension	Economic dimension	Social dimension	Economic dimension
Raw material acquisition and production (sourcing)	What are current strengths and weaknesses with current materials?	e.g. metal alloys, chemical processing, land use	e.g. conflict material, hazardous substances, pollution, corruption	e.g. resilience of supplier network				
		Wood - Needs to be treated with water resistant. Electronics - Rare earth metals.	Pros: Natural materials, no toxic substances, Local material, no direct pollution. Cons: Conflict material for the electronics	Pros: Cheap part and cheap to manufacture Con: A risky investment if no one will use it.				
Manufacturing (including re-manufacturing)	What are current strengths and weaknesses with intended manufacturing processes?	material efficiency, chemical processing, water consumption, energy source	e.g. influence, competence development, stress	e.g. human capital, knowledge sharing				
		Electronics - Manufacturing require a lot of polluting chemicals and materials. Wood - Requires cutting down forests. Needs to replant.	Pros: Local manufacturing (Swedish working condition) Cons: Due to conflict materials people gets e.g., injuries, stress, accidents	Pros: manufacturing electronic is developed, cheap and easy. Wood are a cheap manufacturing as well. Con: Electronic part are asseble in China often, could be e.g., human capital, knowledge sharing				
Packaging and distribution	What are current strengths and weaknesses with the intended means of distribution?	Weakness - Needs vehicle transportation to install the stations out in nature. Strengths - A one time distribution. Would be shipped from a local manufacturer.	Pros: Due to local distribution, sweden have great working rights Cons: In the forest industry, injures are a high risk	Pros: Have just one installation cost. Con: May need maintenance				
		e.g. remanufacturability, user behaviour, energy and water use	e.g. safety, integrity, accidents	e.g. legal compliance of partner companies				
Use and maintenance (includes re-use)	What challenges or opportunities may occur related to the intended use?	Challenges - Vandalization, unexpected repairs, electronic fires. Opportunitas - Wildlife monitoring.	Pros: People are exercising more and doing activities with eachother. Cons: New kind of poeple will come out in nature more that not usually do that. There is a risk that they don't know how to behave in the nature.	Challenges: May need extra electricity during winter to work. Need to invest in infrastructure due to some will be placed in the forest.				
		e.g. ease of disassembly, number of materials, toxic substances	e.g. hazardous chemicals, working conditions	e.g., costs or benefits of waste management solutions or partnerships				
Upgrading and end-of-life	What are strengths and weaknesses related to waste minimization and material upgradeability?	Strengths - Modular, uses app connectivity as much as possible, QR codes. Wood constructions are easy to repair. Weakness - Wood may wear fast and needs to be replaced often.	Pros: Easy to build on new features on the solution. All the materia can be used in the afterlife and are compostable Cons:	Pros: The post should be able to disassemble and change broken part until new ones.				

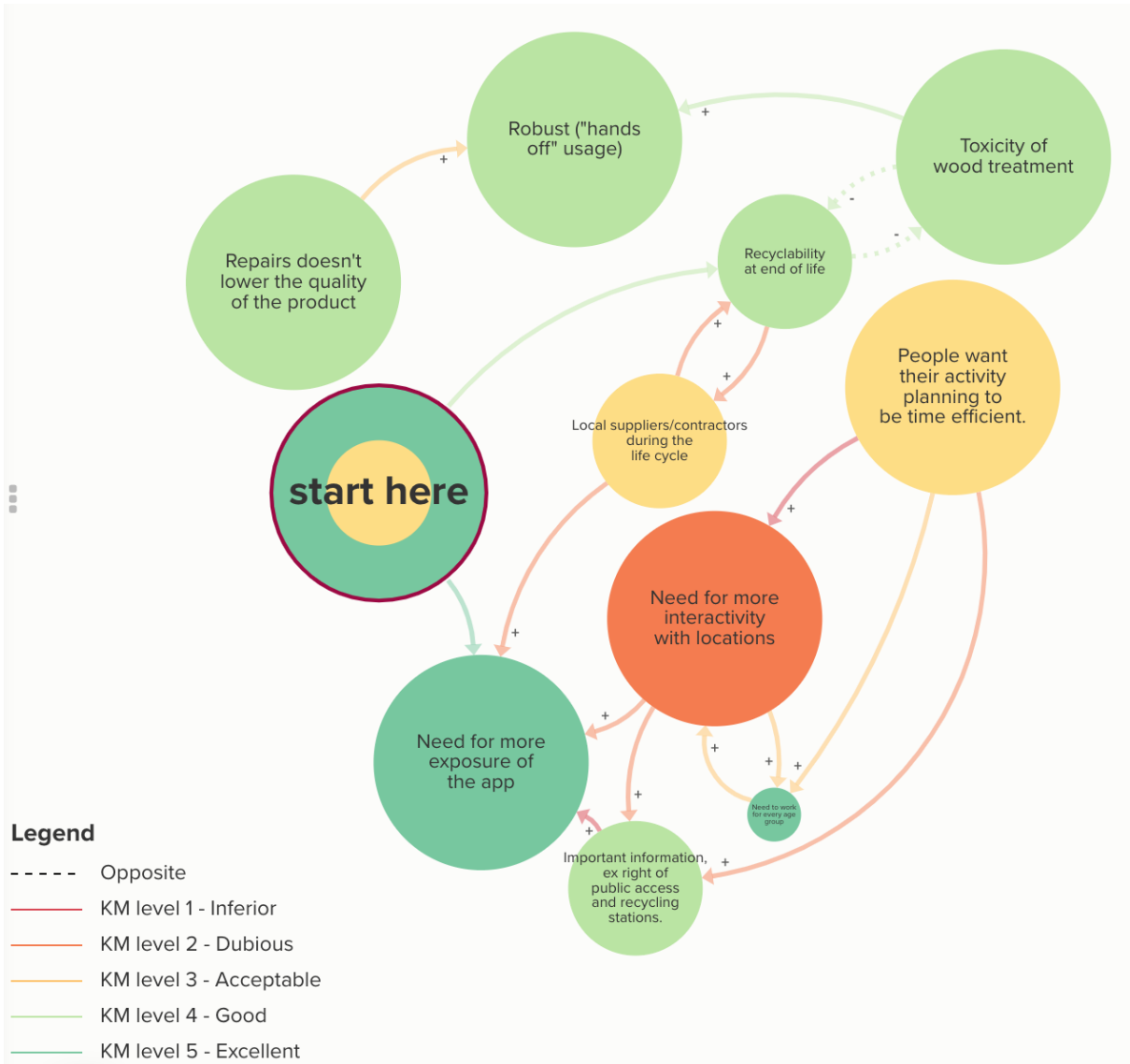
3. 'Strategies' - Leading sustainability criteria What criteria can guide our design towards meeting the needs of a sustainable solution?
 First re-define your results from step 1 and 2 into needs, or criteria, and make sure you cover all lifecycle stages and sustainability dimensions. Then select the ones you find most relevant into the list to the right. If possible

Lifecycle phase	Ecological dimension	Social dimension	Economic dimension
Raw material acquisition and production (sourcing)	Non-toxic water resistant wood treatments. Wood that is taken in a sustainable way with replanting etc.	Use material that give minimal pollution	Use pinewood ore similar wood, cheap
Manufacturing (including re-manufacturing)	Local woodworker contractor, Regular checks every 6 months to keep track of wear. User reports if the stations are totally broken (vandalized or storms).	Use local supplier and manufacturer that respect the working rights.	Produce the product locally
Packaging and distribution	One time distribution. After that, only distribution when repairs are needed (lower quantity). Try to repair several at once to avoid unnecessary trips.	Buy wood from supplier that have strong safety rules for their employees.	Minimize the packaging by let the buyer to retrieve it in the local manufacturing area.
Use and maintenance (includes re-use)	1 year without any maintenance.	Have information about right of public access and nearest recycling station to prevent littering.	Small amount of parts, need minimal maintenance and have a low drift cost
Upgrading and end-of-life	Is easily repairable with the same quality of components. The whole frame/body of the station is recyclable.	Take care of all waste, material in and of life to preventing toxic substances leak out.	Possible to change individual parts that have broke. Easy to disassemble and recycle.

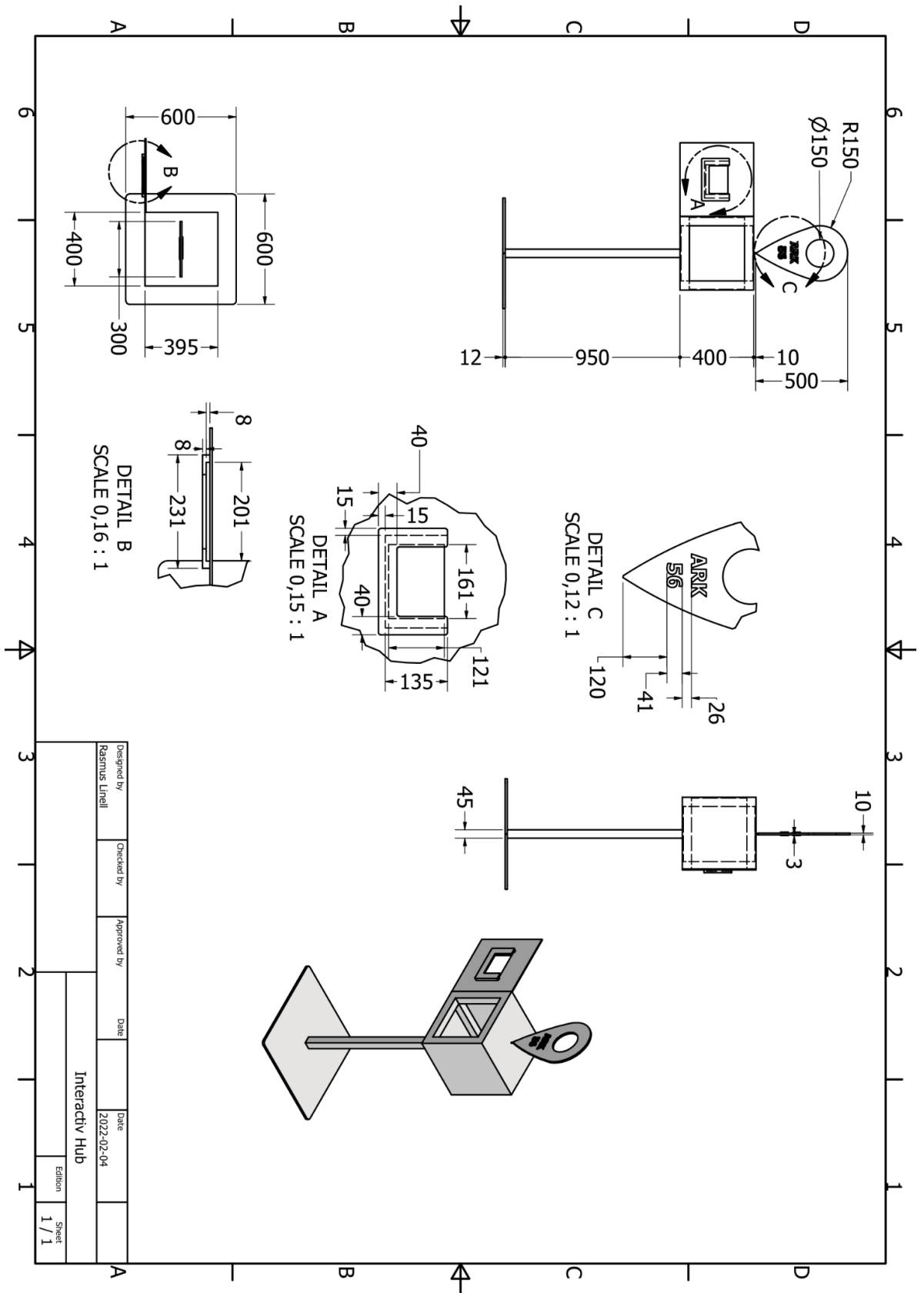
Leading sustainability criteria (LSC)	Comment
LSC 1 Recyclability at end of life	Easy to disassemble, few different kinds of materials
LSC 2 Robust ("hands off" usage)	Can sustain at least 1 year of function without needing maintenance.
LSC 3 Toxicity of wood treatment	No toxic treatments of water resistant chemicals.
LSC 4 Local suppliers/contractors when manufacturing and repairing	Only use supplier/contractors in Blekinge.
LSC 5 Important information, ex right of public access and recycling stations.	Learn people how to behave in nature
LSC 6 Repairs doesn't lower the quality of the product	When repairs are made, the product should still have the same durability and visual looks.
LSC 7	

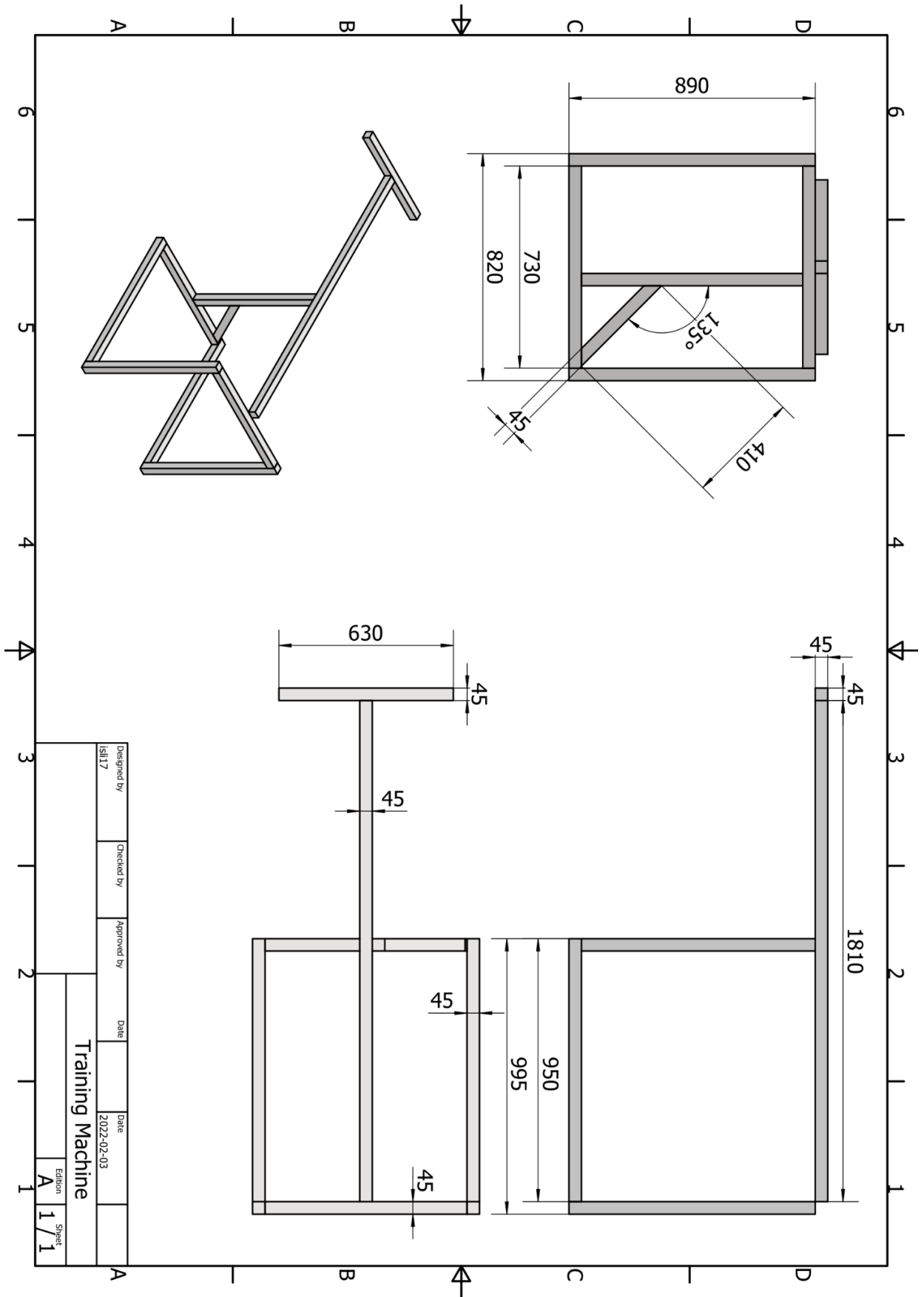
Step 5: Indicate priority and knowledge maturity and propose actions (TEAM)

1) Copy the sustainability criteria and solution needs from step 5. Discuss and make changes (if you find it necessary) using input from the CLD that you created in step 4 by going through step 2-4 again.		2) Now weight the criteria, i.e. indicate level of importance. Comment on what basis you assigned the weighting. The weighting can help you prioritize which criteria to select in case you find conflicts between them (i.e., "trade-offs") at a later stage in the design process		3) After you have listed and assigned weights to the criteria, estimate how certain you are about the weight. Use the maturity scale (1-5) to indicate the maturity level and comment on what basis)		4) Indicate whether the criteria should be further assessed to reach higher knowledge maturity, and how. If maturity level is low but you are still confident in the weighting, please comment that as well)	
#	Main needs and leading sustainability criteria (NX = need, SX = sustainability criteria)	Weight (critical, essential, nice to have, irrelevant)	Comment	Maturity level (1-5)	Comment	Proceed with the criteria for analysis or action (yes or no)	Comment (type of analysis or action and motivation)
S1	Recyclability at end of life	Essential		4		yes	Need to research specific materials to be used to determine the recyclability
S2	Robust ("hands off" usage)	Critical		4		yes	Look up what water resistant treatments are not toxic for
S3	Toxicity of wood treatment	Critical		2		yes	
S4	Local suppliers/contractors when manufacturing and repairing	Nice to have		3		no	
S5	Important information, ex right of public access and recycling stations.	Nice to have		4		no	
S6	Repairs doesn't lower the quality of the product	Essential		3		no	
N 1	People want their activity planning to be time efficient.	Critical		3		yes	Need to motivate decisions more (revisit needfinding)
N 2	Need for more exposure of the app	Critical		5		yes	Need to test more prototypes in different environments
N 3	Need for more interactivity with locations	Critical		2		yes	
N 4	Need to work for every age group	Nice to have		5		yes	Test what activities the different age groups like



10 - Drawings





Designed by	lsll17	Checked by		Approved by		Date	2022-02-03
Training Machine							
						Edhen	Spec
						A	1/1

11 - Code

```
from guizero import *
from time import * #sleep and datetime is used
import RPi.GPIO as GPIO

GPIO.setmode(GPIO.BOARD)
sensor = 7 # pin number on button
GPIO.setup(sensor, GPIO.IN, pull_up_down=GPIO.PUD_UP) # Defines the button and defines the value 1
as a rise in voltage from GND to (in this case) 3.3V

#-----Input reps-----
global page, result
result=0
page=1 #Sets fpage as frontpage for app

def inputAdd(): #Functions for first page of app where you chose amount of reps
    global result #Declares the variable "result" as a global variable
    result +=1 #Adds 1 to the value "result"
    text_keypad.value=str(result) #Converts interger to string and names it text_keypad.value

def inputSub():
    global result
    result -=1
    if result < 0:
        result = 0
    text_keypad.value=str(result)

def inputOK():
    global page, result
    if result > 0:
        page = 2
        app.destroy()

# -----Counter-----
#Initial values
count = 0
cal = 0
count_cal = 0

#Trainer settings
# chosen_rep = result
scalar_cal = 0.7 #The scalar of calories for one repetition
```

```

chosen_cal = 8 #Goal of calories (does not have a page on interface to chose goal, like the reps)

def counter(): #adds values to the counter
    global cal
    global count_cal
    global count
    if GPIO.input(sensor) == GPIO.HIGH: #if the button is pressed
        sleep(1)
        count += 1 #adds int value to count
        count_cal += 1 #adds int value to count_cal
        #count and count_cal are separate because of a problem with multiplying with a text string (which
        occurs when the value is changed to display "finished")
        cal1=count_cal*scalar_cal #multiplies int with chosen scalar to avoid conflicts with count being
        assigned "Finished"
        cal=round(cal1, 2) #Rounds to one decimal

    if count >= result: #if count is equal or larger than the goal, then its inished.
        text_reps.value="Finished" #displays the text "finished"
    elif count != result: #if count is not equal to goal then just assign string as usual
        text_reps.value=str(count)

    if cal >= chosen_cal: #Inequality because scalar causes problems otherwise
        text_cals.value="Finished"
    elif cal < chosen_cal:
        text_cals.value=str(cal)

    text_reps.after(100, counter) #run def again after 100ms

def reset(): #reset function that makes the relevant variables zero and converts to strings
    global count
    global cal
    global count_cal
    count_cal=0
    cal=0
    text_cals.value=str(cal)
    count=0
    text_reps.value=str(count)

def exitProgram(): #function that changes what window is opened
    global __name__
    __name__='Shitstick'
    app.destroy() #destroys the first page "app" to be able to open a new one

```

```

while __name__=='__main__': #while loop that can be interrupted with break function to open another
window
    app=App(title='ARK56 Digital Trainer',
            height=400, width=800,
            bg="#FFA200",
            layout='auto' #grid style layout remove #grid=[] if auto
            )

#-----App window fpage-----
if page == 1:
    text_keypad=Text(app, "xx", size=40)
    text_keypad.text_color="#4B3300"
    text_keypad.after(50, inputOK) #rerun after 50ms

    center_box1=Box(app, align="bottom", layout="grid", grid=[0, 0]) #creates common box for buttons
bellow

#sizes of buttons by padding around letters in pushbuttons
    keypadsize=40
    padding_x=16
    padding_y=3

    SubButton=PushButton(center_box1, text="-", command=inputSub, #defines the buttons and how
they are positioned. "center_box1" puts the button into the common box
                        padx=padding_x, pady=padding_y, grid=[0, 1])
    SubButton.text_size=keypadsize #sizes of letters (changes buttons)

    okButton=PushButton(center_box1, text="OK", command=inputOK,
                        padx=padding_x, pady=padding_y, grid=[1, 1])
    okButton.text_size=keypadsize

    AddButton=PushButton(center_box1, text="+", command=inputAdd,
                        padx=padding_x, pady=padding_y, grid=[2, 1])
    AddButton.text_size=keypadsize

```

```

#-----App window counter-----
elif page == 2: #changes page if variable page is set to "2"
    center_box2=Box(app, layout="grid") #common box

#Repetition counter
reps=Text(center_box2, 'Repetitions', size=30, grid=[0, 0])
reps.text_color="#4B3300"
reps.width=15

text_reps=Text(center_box2, "xx", size=40, grid=[0, 1])
text_reps.text_color="#4B3300"
text_reps.after(50, counter) #calls function counter after 50ms

#Calorie counter
cals=Text(center_box2, 'Calories burned', size=30, grid=[1, 0])
cals.text_color="#4B3300"

text_cals=Text(center_box2, "yy", size=40, grid=[1, 1])
text_cals.text_color="#4B3300"
text_cals.after(50, counter)

#reset button for counter
reset_button=PushButton(app, align="bottom",
    padx=10, pady= 10,
    text="Reset",
    command=reset, #references def reset()
    grid=[0, 2]
)
reset_button.text_size=40
reset_button.text_color="#4B3300"

#Exit button
exitButton=PushButton(app, align="bottom",
    padx=10, pady= 10,
    text="Quit",
    command=exitProgram, #references def reset()
    grid=[1, 2]
)
reset_button.text_size=40
reset_button.text_color="#4B3300"

app.display() #displays app in loop

```