Redesigning Sport Data Valley's conceptual framework and user interface to improve UX

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February - July 2021

Acknowledgements

I would like to give a huge thank you to both of my internal and external supervisors Dennis Reidsma and José Carlos Coutinho, for guiding me through every step of this graduation project, not only by the means of feedback but also by caring about my well-being and motivating me to keep on pushing forward during the toughest times of these six months. I would also like to show my gratitude towards my critical observer, Randy Klaassen for the critical questions raised during my defense, which truly helped me polishing some of the final sections of this paper.

Then, I would also like to thank Pradeep Gopalakrishnan, my Creative Technology mentor during my first year of bachelor. It is in part thanks to him that I decided to finish this degree, which turned out to be the best academic decision I have ever taken.

Lastly and definitely not least, I want to give a special thanks to my family and my girlfriend; for always being there, for always putting up with me, and for always willing to lend a helping hand regardless of the situation. ¡Os quiero!

It has been an honour and a pleasure to work hand-to-hand with the whole Sport Data Valley team, which made me feel at home since the very first day and has taught me innumerable things about working in a real-life environment. Thanks to all of you too.

Abstract

Delivering a good user experience is the ultimate goal of any product, physical or digital. However, in an increasingly digitalised word, a common misconception occurs where designers confuse the terms user experience (UX) and user interface (UI) and use them interchangeably. When in reality, UI is just a small part of UX. This study looks into the different ways in which the user experience of Sport Data Valley, a cloud-based sports data analysis platform, can be improved beyond simply redesigning the graphical interface of the site. In the context of this project, improving UX mainly refers to the usability and the understandability of the platform.

To find the different ways in which the UX could be improved, a look was taken at existing literature and competing platforms, as well as pin-pointing the most severe issues in the current application by the means of usability testing with users belonging to at least one of the targets users groups of the platform (athletes, coaches or researchers). Based on these findings, three new elements were designed, built, and tested: a new conceptual framework of the platform, a new sharing system, and a new interface.

The results suggest that the new implementations had a positive impact in the usability of the platform and comprehension of the data sharing process. However, the late discovery that users were not able to tell what the ultimate goal of Sport Data Valley was, shone light into why clients are having difficulties understanding some of the features found in the platform. Demonstrating that a good UX is built from the moment users hear about your product (e.g.: marketing, landing page, etc.), and not only when they start using it.

Contents

Chapter 1

Introduction

1.1 Sport Data Valley

In 2014; the Dutch ministry of Health, Welfare and Sport created the Sport Topteam. A cohort of national sports representatives, municipalities, and scientists that were given the task of utilising sports data *"not only to generate innovations that bring gold medals at the Olympic Games"*, but also to generate innovations in the sector of professional and recreational sports. Finally, in 2015, Sport Topteam decided to expand their team and founded a bigger agency that would strive for the same goals and ambitions, Sportinnovator.

To date, Sportinnovator has been offering athletes, coaches and federations high-quality data analytics and other data related services through the use of state-of-the-art technology and methods. However, as mentioned in the previous paragraph, the agency does not only want to cater professional athletes, but also recreational athletes and teams. Which is what has led to their newest initiative: Sport Data Valley.

Sport Data Valley (SDV) is a cloud-based data platform that aims to become the national go-to tool for sports data analysis and visualisation. SDV allows all athletes, coaches, institutions, and researchers to upload all their sport related data and have a centralised platform in which to store, share and analyse it. The analytical tools offered in SDV aim to bring insights into injury prevention, athlete well-being and physical performance in a huge variety of individual and team sports. At the same time, the platform aims to become a valley of sports data in which researchers can obtain all kinds of sports data for their investigations.

1.2 Problem Statement

Although still in constant development, Sport Data Valley has already been launched and it is up and running for everyone who wishes to sign-up. The platform already contains plenty of data and analytics related functionality and their team is working daily to develop newer and more innovative ways of visualising data.

Howbeit, upon its launch, SDV found that users were unable to use their platform effectively and intuitively – i.e.: delivering a poor User Experience (UX). The company then concluded that this was caused by the lack of focus on the user-software interaction during the initial design and development phase of the platform, leading to a confusing and hard to navigate User Interface (UI).

The objective of this research has been defined as follows: *Providing Sport Data Valley with a new and tested redesign of their platform or novel feature that will allow users to intuitively navigate and utilise the web-application.*

The main challenge of this graduation thesis will be to create a high-fidelity prototype of the redesigned platform that will allow the team to test and determine whether or not such changes will be beneficial for the UX of the app. Additionally, the redesign or new feature should not only focus on the users, but also take into account other stakeholders like the development team. The solution must fit within the current platform and it should not cause major disruptions with the current design or back-end of Sport Data Valley. In essence, the final product must be technically achievable for the current team.

1.3 Research Questions

The global research question of this bachelor thesis is the following: *How can the user experience and overall usability of the Sport Data Valley platform be improved by changing the front end of the application such that users are able to better access and comprehend the functionalities that this one offers?*
In order to address this question in a structured manner, a series of sub-questions were formulated:

1. What are users currently struggling to do and understand when using the SDV platform?

2. How are other people/companies/competitors visualizing sports data in the most effective ways?

3. What are the key UI elements from the Sport Data Valley platform that need to be redesigned and how can this improve the UX?

4. Has the redesigned user interface or the implementation of a novel feature made a positive impact on the UX and usability of the Sport Data Valley platform?

These sub-questions will be dealt with throughout the Contextual Research, Ideation and Evaluation phases, respectively.

1.4 Report Outline

This paper is divided into nine different chapters that are representative of the chronological order of how this graduation project unwrapped. First of all, the report starts with the exploration phase, where the main goal is to define and refine the problem statement, as well as deciding what the core scope that the paper will cover. This exploration phase is subdivided into three components. First, the introduction (this chapter), where the broad problem introduced by Sport Data Valley is introduced. Secondly, contextual research is performed in order to become acquainted with some of the key components that could be helpful later in the realisation phase (e.g.: relevant literature, state of the art technology, etc.). Lastly, the ideation chapter will cover, amongst other, the initial usability tests ran with the current platform and at the end it will revisit the problem statement to refine the core scope of the paper, based on the findings from all the chapters thus far.

The exploration phase is then followed by the realisation phase, composed by chapters 4 through 6. Chapter 4 *Conceptual Map of SDV's IA*, is used to map out and create a visual poster of the current conceptual framework of Sport Data Valley (the reason why this was done will be discussed in the upcoming chapters), while chapters 5 and 6 are used to explain the design specifications needed for the solution to-be made and the actual realisation process of the final product.

Finally, the evaluation and conclusion phase will close the project (chapters 7-9). Where the final product will be tested and the results will be discussed and used to come up with a response to the evaluation research question and the global research question of the project (both formulated in section 1.3). Limitations of the study and future work/recommendations will also be discussed during these chapters.

Chapter 2

Contextual Research

2.1 Sport Data Visualisation: Literature review

2.1.1 Introduction

The use of data and data analysis has become a key practice for both bigger and smaller corporations in order to maximize performance and revenue. According to Forbes, more than 50% of enterprises are currently using data analytics to some extent [1].In the sports industry this is no different, where data analysis has also become a powerful ally.

Over the past three decades, performance of athletes has hit a historical plateau [2]. Achievements are no longer a matter of raw skills and strength, but now also external factors such as technological advancements in sports equipment are major contributors to an athlete's success.

Recently, data has also become one of these tools. An example of this are the Golden State warriors, one of the first teams on the NBA that decided to invest in data analysis, which greatly contributed to the winning of subsequent league championships in 2015, 2017 and 2018 [3]. This is why *"now more than ever, sports teams are leveraging skilled sports data analysts to create a competitive advantage both on and off the field."*- Jordan Sperber [4]

Currently, the people involved with the analysis and interpretation of this data are dedicated data scientists and sports analysts. Hence, only bigger organizations and teams are able to get the most out of their data. However, thanks to technological advancements (e.g.: smart bands, smartphone training apps, etc.), almost everyone has easy access to sport data. This means that the benefits of sports data analysis could be brought to every athlete or team by the means of apps like Sport Data Valley (SDV). In order to improve the SDV platform, it is key to understand what types of sport data types are out there and what relevant insights are currently being obtained from the analysis of such data.

This chapter consists of four parts. During the first two sections, the review will focus on discovering what sport data types are most relevant for performance analysis and how they are currently being analysed and visualised. The third section will look at the future of sport data analysis and what are the latest trends in the sport data industry. Finally, the study will conclude with the main findings from the previous three sections and discussing what novelties of

sport data analysis and visualisation could be brought to the SDV platform.

2.1.2 Sport Data Types

Acquisition of sport related data is now easier than ever. Although elite teams and athletes have been recording data related to performance and in-game actions for quite some time already; thanks to all the recent technological advancements, logging sport data has also become accessible for recreational athletes by the means of sensors in our smartphones or smart-bands. As a result of this, researchers now have access to a continuously-expanding sports data repository, allowing for the discovery of new approaches and methods that could help with sense-making this data [5].

Such radical increase in the amount of data available has made it a necessity to create different categories, based on the type of information stored in each of the data-sets. Based on the literature and papers reviewed [5] [6] [7], the following three categories were extracted:

- **Discrete data:** Involves in-game data like goals, fouls, substitutions, etc.
- **Tracking Data:** Involves data acquired from sensors related to space, time and motion
- **Metadata:** Involves data related to anthropometry or information about external events affected by a game (e.g.: how many people are tweeting about certain match)

Discrete Data

Event tracking in sports has been around for a long time. Back in 776BC, during the Ancient Olympics, spectators were already recording the outcomes of the running competitions [8]. Ever since, the methods for recording this type of data have been evolving and becoming more sophisticated. Nowadays, the most common procedure to record discrete data is by the means of a box-score sheet or a scorecard.

Discrete data exports an ordered summary of the events that happened during a sports event. We consider events any action that has had an impact on the outcome of the game. These may include but are not limited to: fouls, offside, yellow and red cards, goals, substitutions, and many more. The one thing that all of these events have in common is the fact that they happen in a discrete moment that can be annotated, hence the name of the category "Discrete Data".

Although referred to with different terms (C. Perin et al. used the terms "Box-score data" while M. Stein used the terms "Event Data"), in essence, the logging of discrete data results in *"a statistical summary of a game"* [5].

Tracking Data

Tracking data has become accessible to almost anyone. Thanks to developments in the technological sector, consumers now have access to relatively inexpensive tools that allow them to collect data regarding their physical activities (e.g.: pedometer, heart-rate, speed, etc.) . This type of data is obtained through

video or sensors and it often collects live information about the positions or motion of players and/or the ball itself.

The hardest challenge is to process and sense-make this kind of data. As argued by Stein et al. [6], as well as Perin et al. [5] the extraction of understandable data from video or sensors is a non-trivial task. Mainly because the sensors are usually programmed to record data multiple times per second and at the end of a match, the raw data takes the form of hundreds of thousand of entries. Thereafter, the use of external tools such as software is necessary in the compiling and sense-making process of the data.

Tracking data has the tightest link with player performance. As observed from nearly all literature in this paper, the analysis and visualisation of tracking data allows for the creation of models that can estimate values related to expected performance of a team or individual players.

Metadata

All the other data that does not fit into the previous categories, falls into metadata. The nature of metadata varies a lot, especially in today's society where information is constantly flowing and being created. The best approach is to subdivide metadata into another two subsections: *Social Media* and *Human Physiology and other metrics*.

Metadata related to social media is not relevant for the scope of this paper, and thus will not be further discussed. Human Physiology and other metrics on the other hand are actually used for performance analysis purposes. Anthropometrics play a big role in performance expectancy and injury prevention. According to the The National Institute for Occupational Safety and Health (NIOSH), *"Anthropometry is the science that defines physical measures of a person's size, form, and functional capacities"*.

As it will be explored in section 4 of this review, data related to human physiology and athlete capabilities are becoming key when predicting events such as injuries. Moreover, other factual data and metrics such as weather conditions or size of the playing area also bring insights on how to reach peak performance or when deciding what strategies might work best.

2.1.3 State of the art analysis and visualisation

Unlike in the previous section, sport data analysis and sport data visualisations cannot be as easily differentiated by type. As discussed by Perin et al., Grasseti et al., Macdonald and Vaz et al. [5] [9] [10] [11], different types of data are often combined with each other to provide a richer view on the situation/s that want to be analysed. The only paper that discusses visualisations per data-type is [5] by Perin et al. where the authors mention the use of event density maps such as heat maps or dot maps (Appendix A). These charts visualise the spatio-temporal data points (x and y coordinates and time) inside of a graph decorated with landmarks to make it resemble the playing field, allowing coaches to clearly see where and how often certain actions occur, as well as see the concentration of actions that a player has performed during a match.

As mentioned at the beginning of this section, the most common practice is to combine two or more data types to create much more accurate prediction

models. As explained by Grasseti et al. and Macdonald [9] [10], combining discrete data/box-score-data and tracking data facilitates the task of sense-making given that discrete data gives context to the other type, allowing specialists to associate coordinates with real-life actions and trajectories (e.g.: determining which sequence of coordinates corresponds with a positive outcome such as a goal or a corner kick).

The development of prediction models has become crucial to estimate data such as points expectancy or injury prevention. Examples of point predicting models discussed in [9] and [10] include the so-called Expected Possession Value (EPV), Expected Possession Value Added (EPVA) and Adjusted Plus-Minus (APM). In essence, all of these can be understood "*as a weighted average of the value associated with each possible decision the ball handler could make (pass, shoot, dribble, etc.), weighted by the probability that the ball handler will make that decision.*"- Brian Macdonald [10] and they are mostly used in free-flowing sports such as American football, basketball, or football.
Similarly to density maps, these models are regularly visualised by the means of a diagram that resembles the playing field of the given sport to represent the locations of players and the ball, along with bar or line charts showing the number of expected points based on that specific player and ball distribution (Appendix B). The more data sets are available for a specific team or player, the more accurate the prediction models will be.

Lastly, anthropometric data is not being represented in any visually interesting manner. This kind of data is usually displayed by the means of tables, and the only metrics used that are related to human physiology are body height and body mass as seen in both studies from Vaz et al. And Forte et al. [11] [12]

Anthropometric data alone cannot be used to accurately predict performance. As Vaz et al. conclude in their paper: "*objective measures can be useful for quantifying and evaluating player anthropometric characteristics and physical fitness performance progress*" [11]. For the purpose of their study "Using Anthropometric Data and Physical Fitness Scores to Predict Selection in a National U19 Rugby Union Team", the slight differences in mass and height between recruited and non-recruited players actually transformed into slightly better performance throughout specific physical tests, important when recruiting athletes to play at international levels. On the opposite hand, because Forte et al. [12] focused on performance of recreational female volleyball players that had stopped training for a period of time, the height and mass of the subjects provided little to no insight about physical performance. Thereafter, this type of data can become useful for predicting slight performance differences, useful for elite athletes but not so much when looking at entry level athletes.

2.1.4 The future of Sport Data

The rapid improvement of sensors and their increasing availability is opening an uncountable number of doors. During the previous section, it was mentioned that prediction models were crucial for the tasks of point predicting and injury prevention, although the latter is yet to be discussed in this review.

Sport data analysis currently focuses on point prediction. However, as it is understood form the information provided by Aroganam et al., Rossi et al.,

and Vaz et al. [13] [14] [11], recent studies have been putting their scope in combining anthropometric and tracking data with the aim of developing new prediction models and frameworks that could help with injury prevention.

From the literature reviewed for this paper, two approaches were taken regarding the future of injury prevention. The articles from Aroganam et al. [13], and Vaz et al. [11] remark the importance that anthropometry and the development of movement specific sensors (e.g.: sensor that measures arm movement) will have within this analysis field. For example, in baseball, there already exists jerseys with embedded sensors that allow analysts to detect arm movement and technique, which are crucial to prevent sprains (e.g.: using the wrong technique increases the chance of injury and decreases peak performance) [11].

On the other hand, there are the studies that dig into utilising already available data to create novel injury predicting models. This is the case of paper [14], where Rossi et al. look at the possibility of "*injury forecasting in soccer with GPS training data and machine learning*"- Rossi et al. In essence, the authors carried out an experiment where a number of players were followed and tracked during their training sessions for a set period of time. At the end of the experiment a total of 23 injuries were reported, which were used as criteria to assess how accurate the rules/framework created via machine learning was. The average accuracy of the model was higher than 90%, which demonstrates how readily available technology can be used to develop very accurate models for injury prediction.

2.1.5 Conclusion

Obtaining pre-knowledge around the topic of sports data analysis and visualisation is a crucial step towards better understanding about what the end-users of Sport Data Valley might want to see or how they want to see it, as well as what data and materials the technical developers could be handling on a daily basis. The goal of this literature review was to investigate what kinds of sport data types are available and which are the most relevant for predicting data related with performance.

From the literature used in this paper, it became apparent that sports can be categorised into three different groups, namely *discrete data, tracking data and metadata*. Where tracking data can be arguably considered the tightest linked to performance given its potential to be used for in-depth analysis. However, in all of the works cited, the authors encouraged and remarked the importance behind combining different types of data when performing an analysis; most commonly discrete and tracking data.

Data visualisation is currently not the main scope of the sector. Although it is rapidly gaining attention, most of the found works look into developing prediction models rather than visualising data in interesting and novel ways. Mostly 2D field map visualisations were found in the literature reviewed with the exception of a small example of a 3D visualisation introduced in paper [5]. This opens up the door to further investigate novel ways in which sports data could be visualised by using modern technologies such as VR or AR, and introduce this novelty into the Sport Data Valley Platform.

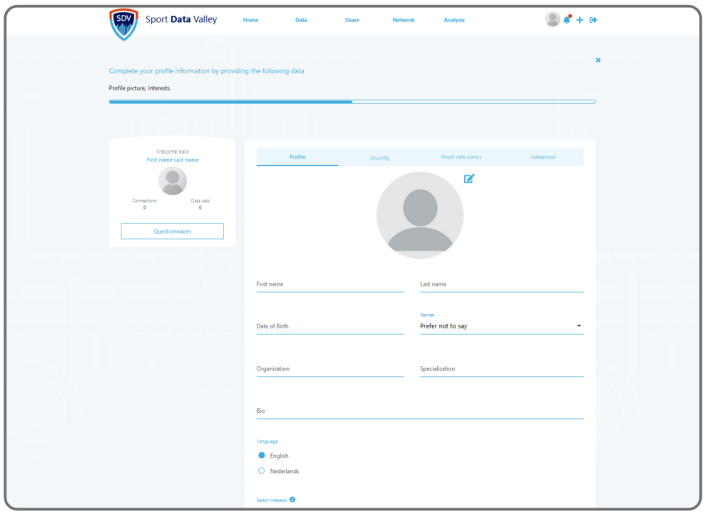
2.2 Status of the current platform

As described earlier, SDV is a cloud-based tool that allows for the visualization and analysis of data. It is centred around the world of sports; enabling coaches, athletes, and researchers to visualize information from over ten different kinds of sports. During this section, a look will be taken at the status of the platform as it currently is, by the means of listing and briefly explaining its features and structure. The order in which this section will flow is based on the same order that a regular user would face when signing up and using the application for the first time.

2.2.1 Registration

The registering process is the standard found in most online platforms and websites. The user enters their email along with the chosen password and validates the account via a confirmation link that is sent to their email address. After successfully confirming their account, users are then redirected to a page in which they can perform the initial set-up of their profile.

Figure 2.1: Initial set-up page



Inside the set-up page (see figure 2.1), the user is asked to fill in fields such as *"First name"*, *"Last name"*, *"Date of Birth"*, the preferred language (English or Dutch), the sports one is interested on, etc. Everything flowing in a cohesive way. Finally, a number of slider buttons can be found at the end of the page, used to enable or disable certain features and settings such as *"Allow my data to be anonymized and shared so it can be used for sports research"*, *"Make my profile public"* or *"Enable questionnaires"*. This is where the first usability issues can be observed.

Firstly, the slider *"Allow my data to be anonymized..."* is locked, although it looks the exact same way as the rest of the working buttons. When you try clicking it or sliding it, nothing will happen, which makes it look like there is a functionality issue in the page, potentially giving a bad first impression of the platform. Only when the user taps the information icon next to the button,

they will find out that this feature is currently not available due to the fact that it is still under development.

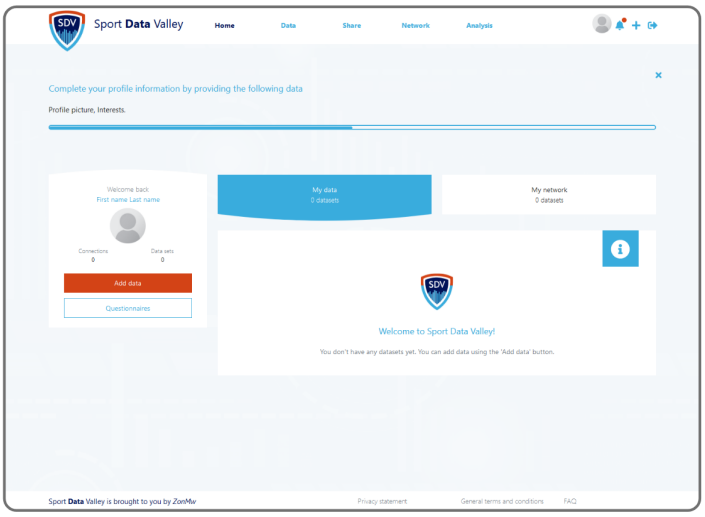
Lastly, the way in which the *"Questionnaire"* button is displayed might also cause some trouble to SDV later on. As explained by the development team, the *Questionnaires* feature allows coaches to send out scientifically approved questionnaires to their athletes, making it one of the key functionalities that the platform offers. However, there is no text or description that explains this to the user, making it seem that this button is simply asking if you give consent to the company to send you questionnaires about the platform (i.e.: requesting feedback from you), and possibly causing a large part of you consumers to turn off this feature.

2.2.2 Homepage

After completing the profile set-up, users are prompted to the homepage (see figure 2.2). The page itself is very dull and unattractive, it only contains a profile overview on the left side of the screen that allows users to upload data or fill in one of the aforementioned questionnaires. And a text-box on the right side saying that *"You don't have any data-sets yet"*.

The issue here is the fact that there is nothing inviting the users to perform an action in the platform, potentially leading to a feeling of confusion and uncertainty about what should be done next or what even can be done with the application. The homepage is the first thing a client sees every time they log in. Hence, having an empty and uninviting front cover will probably negatively affect the user experience by losing their interest.

Figure 2.2: Homepage



2.2.3 Data

The data page is the second one in the navigation bar and its main purpose is to serve as a location where to upload the sports data. Users have a section where they can drag and drop or manually select the files they want to upload, a search bar to look for a specific data-set, a calendar to look at their upload

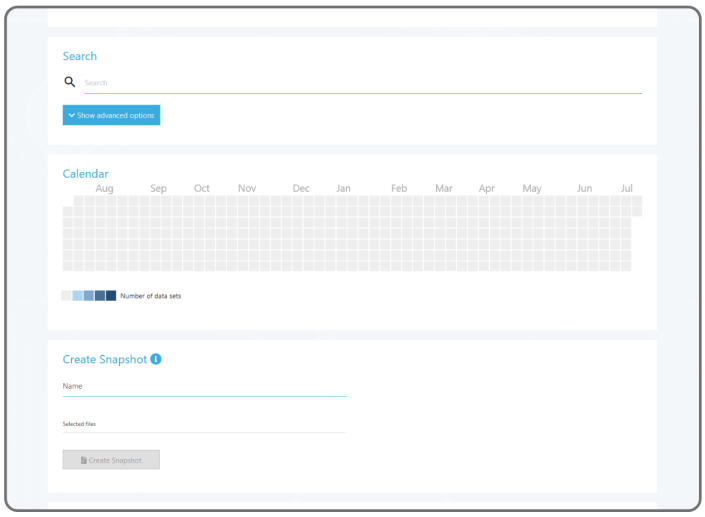
activity and an option to create a snapshot of the selected data-sets (see figure 2.3).

Uploading data is easily accessible and straightforward. However, there is no information about what type of data can be uploaded to the platform. Information regarding this topic should be given to the users to avoid conflict situations such as finding out that all of the data you have was recorded in a non-accepted format.

The search functionality is good, but it is structured in a strange manner. The output from the search is not displayed directly under the search bar, instead, users need to scroll down all the way to the bottom of the page to see it, making it seem like the search functionality is broken (because the output is not even shown in the same view-port).

Finally, creating snapshot allows users to download a data-set or group of data-sets locally, which is a nice functionality especially for coaches and researchers. The only concern that arises is the wording used for this feature since the word *"Snapshot"* may be too technical for the target audience. The use of this type of jargon is something that should be looked at when performing usability tests.

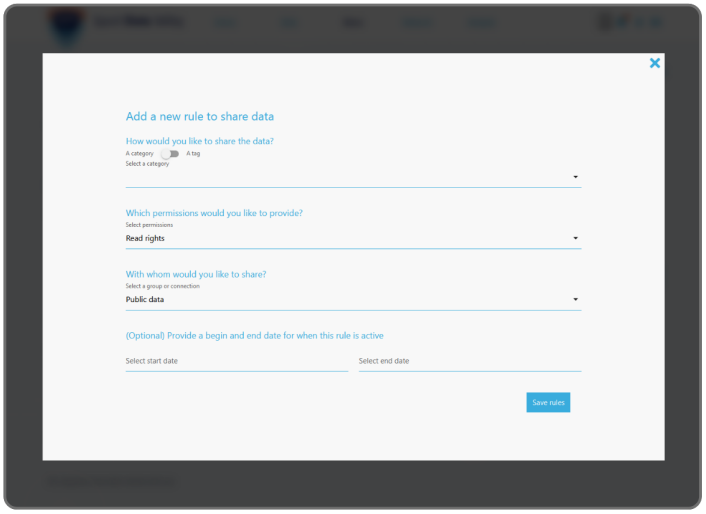
Figure 2.3: Data page



2.2.4 Share

As its name indicates, the sole purpose of the share page is to share data with groups or individuals (see figure 2.4). Although there are not many elements within this specific page, it still manages to be most confusing section of the entire platform (from a personal perspective). The way data sharing works is by creating *sharing rules*. These rules can be added by pressing the button *"Add a new sharing rule..."*, this will open up a window where the user can then select what data he/she wants to share based on category or tag, with whom to share it with and the read/write permissions. The process of creating a new rule is not too complex, however it would be beneficial to question why use such technical terms and why separate the data uploading and data sharing pages?

Figure 2.4: Sharing rule pop-up window

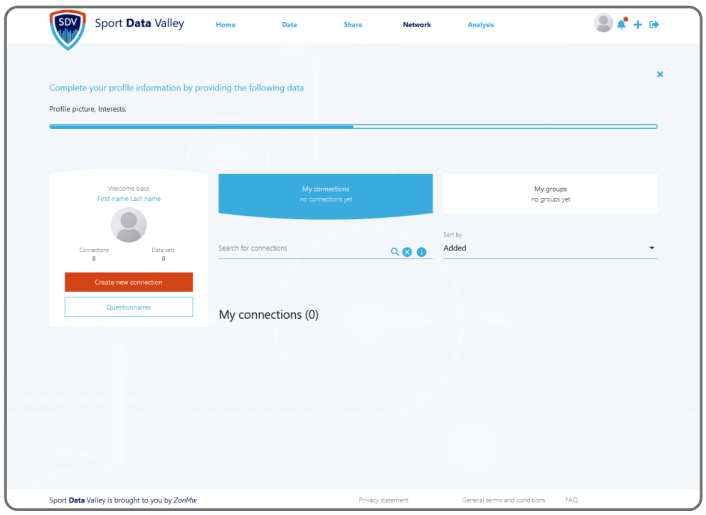


2.2.5 Network

The Network page is place that can be used to see and add new connections (similar to friend requests) and see and create new groups. The layout is the exact same as the home page (see figure 2.5). On the left-hand side, there is a card with an overview of the user's profile and two buttons; one for creating a new connection and another one to fill in questionnaires? The purpose of this profile overview is a bit confusing, why would someone fill in a questionnaire from the Network page? And why is there a *"Create new connection"* button if there is already a user search option right next to it?

Similarly to creating a new rule, the process of adding someone or creating a new group is simple enough. The main problem relies on the poor organisation of interface and the lack of back-thought when implementing the different elements in the page (e.g.: same functionality twice). This again is something crucial that should be fixed, given that the data sharing amongst the different target users is the main pillar on which the platform is based.

Figure 2.5: Network Page

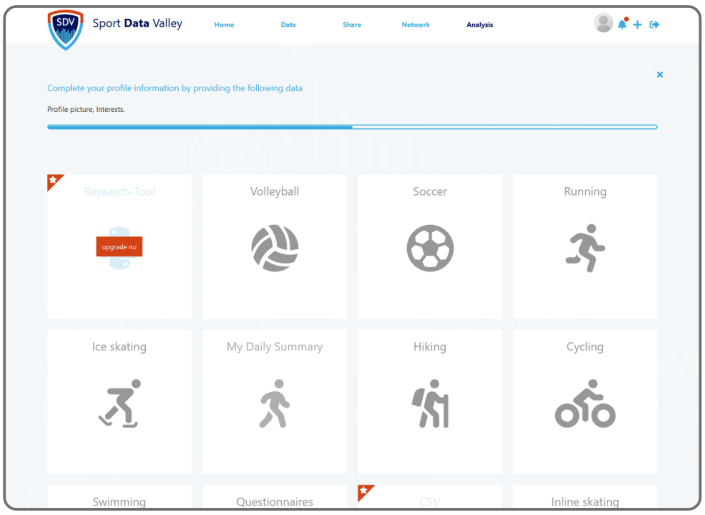


2.2.6 Analysis

The last of the main sections of the SDV platform is the Analysis page, where users can select the data they want to analyse/visualise based on the sport (see figure 2.6). For example, if a user wants to analyse their latest running data, then they would simply select "Running" and proceed to select the data-set that they want to work with.

The analysis page is by far the best looking of the entire platform. There is little to no text and the navigation happens by the means of visual icons that represent the different sports. Nonetheless, there are some concerns regarding the visibility of this page due to the fact that it is the last on the navigation bar. According to the team, this page is the one shown during marketing campaigns and presentations because of how well it manages to picture the essence of the platform as a whole, which makes the decision of putting this page last on the line an even more confusing design decision.

Figure 2.6: Analysis Page



2.3 Competing platforms and services

In order to improve the Sports Data Valley platform, it is important to gain knowledge and understanding about what other state-of-the-art products there are currently available on the market. The main aspects that will be explored are the types of plans that each competitor offers, this will give insight on the target user base; the variety of sports that each competitor is able to analyse; and lastly, the graphical user interface to see how it compares with SDV.

It is worthy to mention that all of these competitors were analysed by individually testing their premium versions, and by doing individual research. Therefore, the findings shown below come from primary experience and not simply from secondary sources.

2.3.1 TrainingPeaks

TrainingPeaks is a company founded in the late-90s by athletes and coaches and aimed towards athletes and coaches. The company has a number of products and services that are all related with the world of sports, data analysis and planning. The main two products that they offer are *TrainingPeaks.com* and *WKO5*.

TrainingPeaks.com is a web-based platform and it has four types of plans:

- Athlete: Free and Premium plans (from $9.92/mo)
- Coach: Basic (from $19 /mo) and Unlimited plans (from 49$ /mo)

As their names indicate, one of them is intended for athletes while the other one is directed towards coaches. The layouts for both of the target user groups are very similar but differ ever-so slightly in order to offer a more personalised and focused experience. Both plans follow the same core structure with four items in the navigation bar: Home, Calendar, Dashboard, and ATP (Annual Training Programme).

The Home page is the only page that differs a lot from athlete to coach. In the case of the athlete (see figure 2.7), they are greeted with what seems to be a text-heavy and confusing site. After a few seconds of inspection though, it is easy to recognise that the page is divided into three columns. The left column acts as a "Help Panel", inside of it the athlete can find pre-made training plans, helpful blog articles, and a short overview of the upcoming events and goals. The central column can be seen as the *interaction* panel, where most of the user-application interaction takes place. This panel essentially show the user his/her planned workouts for the day or for the next day and asks them to fill it in in case they have already completed the workout session. Inside of this column, there are always at least two buttons, making sure that the user can do something within the page. Lastly, the column on the right side shows a summary of performance during certain periods of time, as well as a small list showing the athlete's peak performances.

On the other hand, the coach's home page displays an emptier interface. Similarly, it follows a three-column structure (see figure 2.8). The left column is a collapsible menu in which the coach can add new athletes or groups, as well as view a list of the athletes that are already linked to the coach's account.

Figure 2.7: Trainingpeaks Homepage Athlete

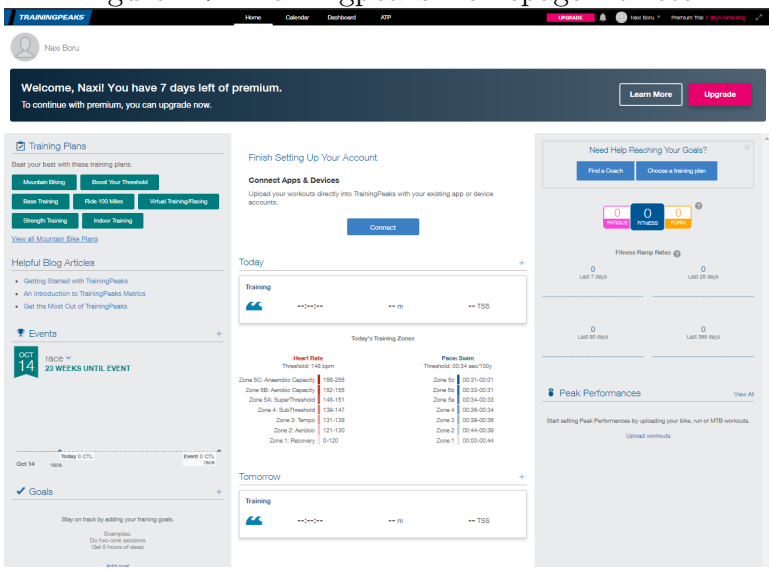
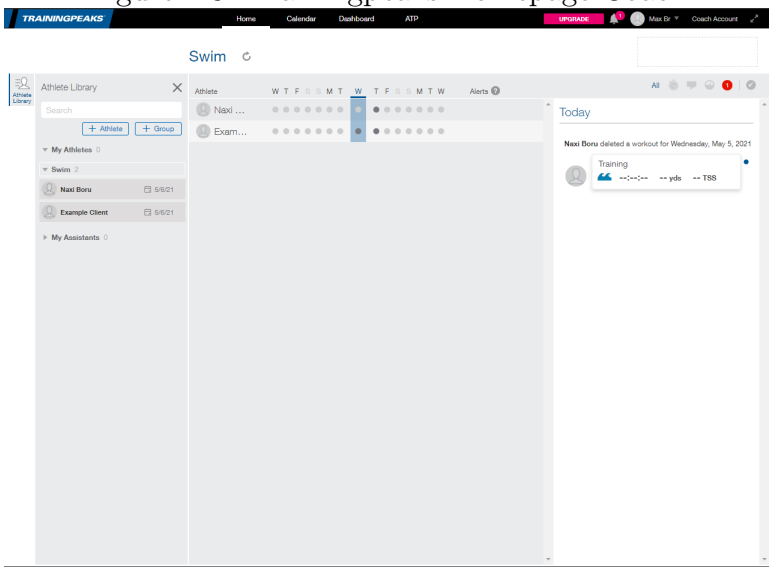


Figure 2.8: Trainingpeaks Homepage Coach



The middle column shows the list of athletes of the selected groups, and also provides a simplified weekly schedule that shows whether or not the athletes have uploaded any activity on a given date. The third and final column shows a brief summary of the workouts that the selected athlete/s have completed (duration, length, and training stress score).

The calendar page (see figure 2.9) shows a calendar with all the scheduled training sessions and upcoming events. From this calendar, both athletes and coaches can upload their data: athletes can upload their own and coaches can upload their athletes' data. The only difference is that athletes get to see the full upcoming month schedule, while coaches only see weekly schedules (this is because it shows a list of the weekly schedule of all the athletes within a group). The right-most side provides a weekly performance summary in both users' UIs.

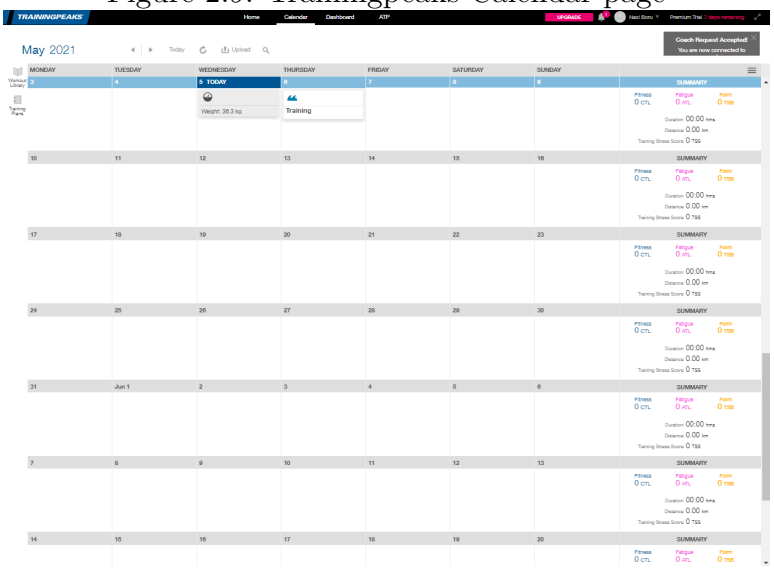
The Dashboard page is almost identical from both perspectives. The graphs and summaries that are shown by default are the exact same (although this can

be customised based on what the athlete and coach want to pay attention to), the only difference being the same collapsible menu on the left side of the page found on the coaches' interface, where he/she can select what athlete to analyse.

Lastly, the ATP panel allows the users to create Annual Training Plans. Again, the pages are almost identical for both of the user groups. The only difference being the left-side menu on the coaches' interface.

In both plans, the users have access to specialised questionnaires and sport specific data input that will give different insights depending on the sport type (10+ sports). If a sport is not in the list, the user can always select *"other"* and input general data and still be able to get valuable insights and visualisations.

Figure 2.9: Trainingpeaks Calendar page



When it comes to researchers, TrainingPeaks does not have a platform where they can obtain public data. However, they do offer their own proprietary software called WKO5, that is supposed to offer a much higher analytical power than their TrainingPeaks.com plans. Unfortunately, WKO5 could not be tested because it needs to be purchased separately (one off $169).

2.3.2 Sportlyzer

Founded in 2010, Sportlyzer is a sport-tech company that provides a web-based application aimed for amateur clubs to organise and log training sessions and memberships. Unlike SDV or TrainingPeaks, Sportlyzer does not focus on sport data analysis, but more on the managerial and organisational aspect of sports clubs.

Sportlyzer offers a single type of plan that can be used by entire clubs. The pricing of the plan varies depending on the size of it (there is a free option available with limited features, or the premium option starting at $30/mo). Once, the club has signed up to the platform, there are three account options with three different interfaces:

- Coach: Full access to features (web or smartphone app)

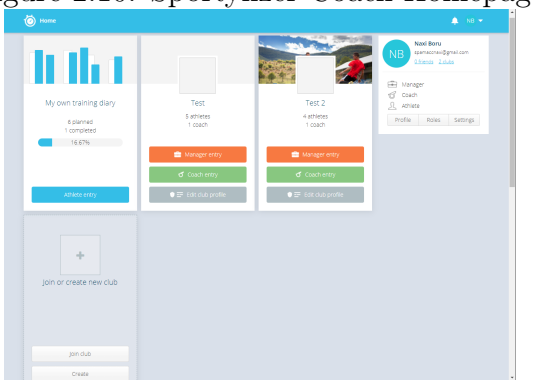
- Athlete: Limited access to features (smartphone app only)
- Parent: Limited access to features (smartphone app only)

Athletes and parents only get access to the smartphone app, where they can upload data regarding schedule and availability, attendance and contact details. Coaches on the other hand, have full access to a number of useful features:

The coach homepage is simple and easy to understand. It is structured in cards/rectangles; one card displays a brief overview of the user's profile (name, email, contacts, etc.), another card is dedicated for the coach's own data (in case he/she wants to analyse their own performance) and the rest of the cards display all the clubs that the coach works for (see figure 2.10). After selecting a specific club, the interface changes completely and now displays a fully customizable dashboard showing information such as athlete birthdays, training attendance sheets, upcoming event and event invitations. At the top of the page, it can be observed that there are eight different pages inside the nav bar: dashboard (the page that was just described); athletes page where the coach gets an overview of all the athletes in the different teams, as well as send a direct message to them; calendar, where the coach can create and update events (e.g.: training schedules, competitions, etc.); planning, which is where the data gets inputted for all the different athletes (duration, distance and effort); tests, a functionality similar to the questionnaires offered by SDV, where the coach and send tests and questionnaires to the athletes (unlike SDV, Sportlyzer allows the coach to change the questions of the surveys, meaning that these are not scientifically proven); the stats page is supposed to show some statistical data about the teams, however, it is unclear even after testing out the functionality how it works/what it is supposed to display; and finally, a messaging tab where coaches can send messages to their athletes (straight to their Sportlyzer account, not to the personal email).

As it can be seen from the interface exploration, there are no tools with a focus on data analysis. The only information and charts that can be analysed are the ones showing the duration, length, and effort of the individual workouts, which will not give much depth into areas such as injury prevention or performance improvement. Also, when it comes to researchers, the platform does not offer anything specifically for them, nor there is something that could be especially useful for that target group.

Figure 2.10: Sportylizer Coach Homepage



Chapter 3

Ideation

3.1 Design Research Question

"What are the key UI elements from the Sport Data Valley platform that need to be redesigned and how can this improve the UX?"

3.2 Initial idea

Based on what has been discovered in the exploration phase of this project, it has become apparent that the Sport Data Valley platform has certain design flaws that require to be fixed in order to improve the delivered user experience. However, as expressed in the conclusion of the aforementioned phase, the current way in which the platform deals with data seems to be the main cause of confusion amongst the users. Because of this, the choice of working towards improving how the app and its users deal with data (sharing, storing, tagging, etc.) was made.

The initial draft idea focuses on re-designing and improving the three aspects that were found to have the biggest impact on the issue: data (uploading and sharing), intuitiveness, and homepage. When it comes to working with data and intuitiveness; the brief plan is to find a way to automatise the tagging and sharing procedures. For example, as users upload datasets to the platform, they are instantly given the option to add tags or select a group with which they want to share the data with. By doing this, all those steps are gathered together, and the users no longer need to visit different pages to carry out these tasks. Finally, to address the issue regarding the homepage and it being empty and uninviting, the new homepage should successfully prompt users to upload new data and create new groups by the means of inviting graphical elements.

3.3 PACT Analysis

A PACT analysis aims to look into the **A**ctivities and **C**ontext in which **P**eople use **T**echnologies. The whole purpose of such analysis is to determine the requirements that an interactive product should have, in this case, the SDV web-app.

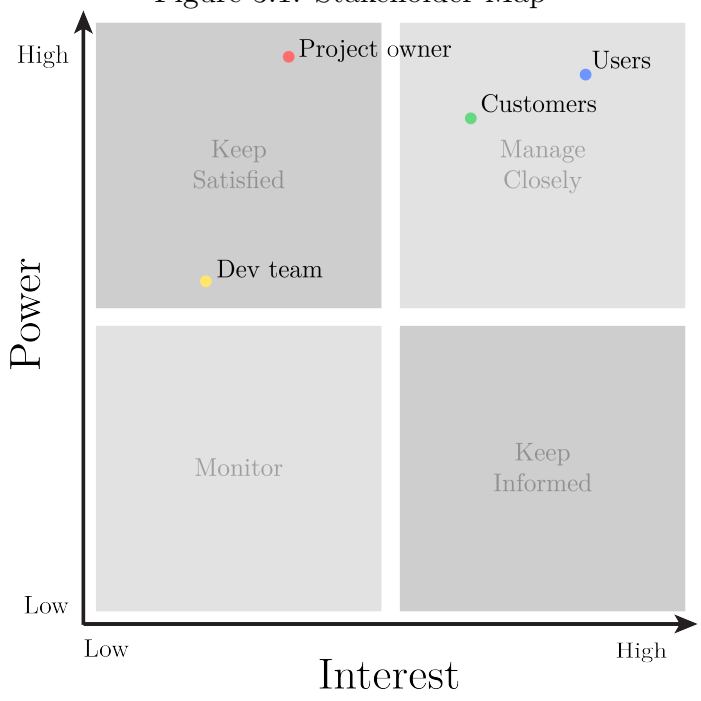
3.3.1 People

Stakeholders

The stakeholders of Sport Data Valley are the following:

- **Users:** They are the individuals that will make use of the platform and most, if not all, of its features. As it will be discussed later in this section, there are three different types of target users: athletes, coaches, and researchers.
- **Customers:** Anyone that buys a service from SDV is a costumer. The difference between customers and users is that, as a costumer, you do not necessarily need to make use of the platform. For example, a company (such as a sports team or a research institution) might decide to purchase one of the offered plans for their employees. Also making them part of the stakeholder group.
- **Development team:** Composed by the developers, they are in charge of translating the visual designs and features into code. In essence, developing the product from a mock-up to a working solution. As it will be discussed later in this chapter, it is important to be able to communicate easily with the development team, since they will provide valuable information about what is technically possible to implement and what is not, key when deciding what will become part of the new redesign and what will not.
- **Design team:** Ideally composed by a number of designers. This team is in charge of the research and design of the graphical user interface (GUI). In the case of this project, this team is composed by a single individual (the author of this thesis).
- **Product owner:** This person is the one in charge of passing or rejecting projects such as new possible features or redesigns. He ensures that all groups participating in the creation of the product are aware of what is happening. Therefore, it is important to maintain tight communication with him when it comes to making design choices.

Figure 3.1: Stakeholder Map



As previously mentioned, there are three main target user groups. These will be further explained below:

- **Athletes:** Almost any athlete can become a user of the platform. Individuals that seek to obtain deeper insights into their performance, athletes that are working with a coach or personal trainer and thus need a place to share their data, etc. These are all examples of users that match the profile of Sport Data Valley. SDV will facilitate the storing, sharing and analytical tools that these athletes might need.

- **Coaches:** Hinted in the previous paragraph, coaches are the second main target user group that SDV aims to tackle. Whether you are the coach of a football team and have fifteen athletes to take care of or a personal coach, SDV offers the necessary features and tools to store, analyse, and compare datasets in an orderly manner, as well as request information directly from your athletes.

- **Researchers:** The last user group are researchers. The main feature that makes Sport Data Valley unique from its competitors is the fact that they have included researchers directly into their platform. Found directly in the name of the project, the platform aims to become a *valley* of information where researchers can come to obtain any kind of sports data that they might need for their studies. Furthermore, the platform also offers industry standard tools for in depth analytical tools such as the possibility of connecting Jupyter notebooks directly with SDV.

User Characteristics

Besides separating stakeholders into different groups based on power and interest, it is also important to identify the possible characteristics that the users

might have. By recognising these, designers are able to design a product that is better tailored for the users' needs and short comes.

- **Cognitive characteristics:** The target users of the product can range from young athletes to older adult/senior coaches. According to recent statistics by the Washington Post, teens and young adults spend an average of seven-and-a-half hours in front of a screen daily [15], hence it is safe to assume that they will have less issue learning how to work with a new digital tool. The older user group, however, will probably not feel as comfortable working with a fully digital tool. Therefore, it is important to have this difference in computer literacy in mind when designing the new user interface and new procedures. Aspects like memory, attention span or learning capabilities must also be kept in mind during the redesign of the platform. Furthermore, as seen during the usability tests, the level of experience with similar tools varies vastly from person to person. A balance must be kept to ensure novice users are able to learn and enjoy using the platform, while allowing the more expert users to fidget and also enjoy the application.

- **Physical characteristics:** Age does not only play a role in computer literacy gaps; it also negatively affects certain physical capabilities such as eyesight, hearing loss, etc. For example, the platform should be operable by users with eye problems like colour blindness, as of right now, it is unknown whether SDV is colour blind friendly or not, but it should definitely be kept in mind during the redesign. For those with weaker eyesight (e.g.: older users or users with glasses), the UI should allow for easy navigation. Working with iconography and visual elements instead of text should be a priority, since not only it will reduce the cognitive load on the users, but also make it easier to create cognitive biases and improve learnability. Of course, text will be inevitable in some parts of the website, so this one should be easily legible by everyone (aspects to be kept in mind: font family, size, and colour). Finally, the platform should also be designed for the users with hearing loss. Elements such as notification sounds should also be transformed into visual cues or any other type of haptic feedback such as vibrations. Because SDV can be used in both computers and handheld devices, it is important to adapt this for all technologies.

- **Cultural characteristics:** Although Sport Data Valley originated from an initiative by the Dutch government, it is also being offered in English. This should be respected and kept in mind during the redesign of the platform.

3.3.2 Activities

This section of the analysis lists and explains the most important activities that should happen within the redesigned platform. These are ranked based on frequency (how often the task is expected to be performed) and importance (key feature vs additional feature). Although PACT analysis looks both into the current situation and possible future scenarios, only the latter mentioned

will be explored below. This is because the current status of the platform has already been thoroughly inspected in section 2.2.

- **Upload data** (Regular — Key): Data is the fuel that the platform uses to run, no data means that all the key features and functionalities. The process of uploading data is a key component of the platform, hence the importance of making it as easy and accessible as possible.

  The current plan is to have two ways to manually upload data: Directly from the homepage and from the data page. These two locations have been chosen strategically based on the results from the usability tests and the research in chapter 2.

  The new upload menu will look similar to the one currently in use, but it will also implement a number of new functionalities. To begin with, the menu will indicate what types of files can be uploaded to SDV, like this, the chances of users uploading non-accepted file types will be minimized. Furthermore, upon successful upload of a dataset, the users will be instantly given the opportunity to fill out details such as title, add tags and select the groups to share that data with. By doing this, the processes of uploading, organising, and sharing data are simplified and merged together, reducing the number of steps taken by the users (since these no longer need to navigate through three different pages to achieve all three tasks).

- **Add connection** (Occasional — Extra): As mentioned in the previous task, users have the capability of sharing a dataset or datasets with others. This mechanic is particularly important for coaches and researchers, as this step is what will enable the chance to create groups and teams later on.

  Users will be able to add new connections straight from the homepage and access and manage their connections from their profile page. By doing this, the dedicated network page will be removed from the navigation bar. The navbar should contain quick links to features or sections that are used often; adding connections, however, is not a task that is expected to happen regularly. Users will likely only add new connections when they first sign up to the platform in order to create their first groups, or on a monthly/yearly basis, when new team members need to added/removed.

- **Create group** (Occasional — Key): Groups will become a key component in the redesign of the platform. Since the network page will be completely removed, groups will be accommodated inside of the homepage, and they will look visually similar to how the different sports are shown in the analysis page in the current platform. Thereafter, groups will also be created straight from the home page. When creating a group, the user should be able to give it a name, a description, upload a cover image and add the different members from the connection list.

  Groups will become a useful feature for all of the users. Coaches will be able to organize their different teams, athletes will be able to compare themselves with other team members, and researchers will be able to create groups in which their subjects can share their data into.

- **Share data** (Regular — Key): Last-but-not-least of the key activities, sharing data. There should be two ways in which data can be shared, depending on whether the datasets have already been uploaded to the platform or not. If the data has not been uploaded to SDV yet, then the users will have the chance to select the group/s with which they want to share it with, directly from the upload menu. If on the other hand, the dataset/s have already been uploaded to the platform, users can then head towards the data page, where they will be able to select the sets that they want to share, and who to share them with.

3.3.3 Context

Depending on the type of user and the activity, the context in which such activity occurs can differ greatly. Because of the nature of the platform, it is possible that users will access the platform from different places and devices. The new redesign should account for all of these different contexts.

- **Physical Environment**
  Because the platform aims to cater three very different user groups, the physical environment in which activities may happen go back and forth between indoors and outdoors, also affecting the device in which the interaction with the product happens. For example, athletes might prefer to upload their data directly after a training session, meaning that they will most likely use the platform from a smartphone or a portable device such a tablet. On the other hand, when coaches and researchers decide to visualize the sports data, they will probably do it at home by the means of a desktop computer or laptop. Hence, it is important to adapt elements such as font size, contrast, etc. in order to improve fields like legibility to fit both of these contexts.

- **Social Environment**
  When it comes to the social environment, Sport Data Valley needs to deal with the privacy concerns tied with the storing and sharing their users' data. However, this has little to do with the UI of the platform. Still, other privacy concerns also need to be kept in mind when re-designing the front-end of the platform. For example, when an individual athlete uploads a dataset to a team, he/she might not want this data to be seen by the rest of the team, thus it is important to always give the users the full control over who they share they data with.

- **Organisational Context**
  Because Sport Data Valley opens the door to researchers, this adds another layer of complexity when it comes to the organisation and management of the data. In theory, all users have the option to allow researchers to access the datasets that they have uploaded to the platform (of course, after signing a consent form and anonymising all the data), making this platform a very interesting service for this specific user group. Just like in a real-life scenario, users are/should be given the option to withdraw their consent if they do not feel comfortable sharing their datasets anymore. The problem

is, in these types of scenarios, the participant needs to communicate with the researcher in order to stop the consent. In the case of Sport Data Valley, since the platform does not offer any means of communications amongst users, the participants can terminate their consent at any moment without prior notification, which could greatly disturb the workflow of researchers as they would lose all the work they have done within the platform. Thus, it is very important to find a way to protect the rights of both of these groups.

3.3.4 Technology

Technologies are crucial elements when designing interactive systems, they are essentially the elements that designers work with in order to create these interactions. These technologies are analysed by putting them into three categories, namely input technologies, output technologies and communication.

There are different technologies that users can utilize to access the platform. They can use desktop computers, laptops, smartphones, or tablets; and these can be running different operating systems (such as Linux, Windows, or Macintosh), browsers (e.g.: Safari, Google, Firefox, Edge, etc.). In essence, the technology choice can differ vastly from user to user, therefore it is important to take into account the most relevant and popular ones in order to ensure that the final product will function properly for the majority of the users. Below, three tables can be seen with a collection of all technologies used in the current platform.

Table 3.1: Input technologies

Technology	**Description**
Keyboard	During tasks such as naming datasets or searching for new connections, inputting alphanumeric data is a must. Keyboards (whether they are physical or virtual in the case of handheld devices), are the input technologies that enable this activity.
Mouse	Sport Data Valley was designed to be navigated by using a mouse or trackpad. The web-app features digital buttons, sliders, quicklinks, etc. That are meant to be interacted with by the means of a cursor (controlled by the mouse/trackpad). Generally, mice are used along with bigger screen sizes (since they are used on laptops and computers). Combined, this allows users to have pixel perfect accuracy.
Touchscreen	Touchscreens allow users to use their fingers (and in some cases, dedicated styluses) as input devices, the same way that a mouse is reflected as a cursor on a display. The use of someone's own fingers allows for exceptional control, however, fingertips cover a bigger area than a cursor, so this needs to be taken into account when creating buttons for touchscreen devices.
Smart bands/watches	A vast percentage of the data that will be inputted into the platform will come from data files logged by smart bands or smartwatches.

Table 3.2: Output technologies

Technology	**Description**
Display	The display is by far the biggest and the most crucial output technology. Depending on the device that is being used, displays can vary a lot in size. Currently, the platform is better optimised for desktop use, meaning that the platform will look and work best in bigger screen sizes (1332px). Bigger screen sizes also mean that the designer will have more space to work with and a more accurate input (mouse). Nonetheless, the sizes and aspect ratios of these devices can also vary a lot (e.g.: 16:9 and 21:9), this must be kept in mind and allow for the redesign to be responsive. On the other hand, the platform can also be used straight from the user's smartphone, meaning that the redesign also needs to be optimised to be, not only displayed, but also comfortable to use when using fingers as input instead of a mouse.
Browser	Mentioned at the beginning of this technology section, users will also access the platform from different browsers. When designing components such as animations or other micro-interactions, this is something that needs to be taken into account, since not all browsers interpret the code in the same way. According to recent statistics [16], the share of Chrome, Safari and Firefox combined is roughly 85% of the market, making it crucial to *at least* ensure that the platform is optimised for these three platforms.
Speakers	Speakers or any sound output technology are used to notify the user in case something new happens in their account (e.g.: new questionnaire request sent by the coach). This is not-platform specific, but rather it will use the standard notification tone from the user's device.
Vibration	Vibration will be used for the same purpose as speakers, notifying the users when something new happens in their account. Vibrations are specific to mobile phones and handheld devices, as it is rare to see this feature in laptops or desktops.

Table 3.3: Communication technologies

Technology	**Description**
Server	Because this is a cloud-based application, the platform needs to be in constant connection with the server to retrieve and upload data. Connection to the internet is mandatory to make use of Sport Data Valley.
APIs	When it comes to inputting sports data, users have two options: import manually or link another sport platform an automatically synchronise when new data is logged inside of the given platform. Sport Data Valley currently allows users to connect to the following platforms: Fitbit, Strava, Garmin and Polar by using their respective APIs.
Local	Importing data manually happens when a user uploads a data file from his/her own device to the platform. In order to do this, Sport Data Valley must have a way to bridge the app with the users' local storage.

3.4 SDV through the user's lens

3.4.1 Usability Labs

Goal

The aim of these usability tests is to gain information about how intuitive and easy the platform currently is when tested by real potential users. The ultimate goal is to be able to exactly pinpoint the issues that appear when real users try and work with the platform. Once these are clearly identified, it will facilitate the task of deciding what route to take when it comes to improving the platform.

Methodology

Due to the current circumstances regarding the COVID-19 outbreak, all of the usability tests were carried out remotely. In the case of this project, this did not pose much restrictions given that the product to be evaluated is of digital nature. The users were asked to follow a script (the script used was developed by Sport Data Valley, only minor changes were applied by the author of this paper) from which they need to complete a total of fourteen tasks belonging to five different categories:

1. Registration
2. Network and Group Creating
3. Data Sharing
4. Questionnaires
5. Data Analysis

Refer to Appendix C to see full script

Because the goal of this usability test is to obtain qualitative information regarding what features the users are able to access and understand, the *think aloud* protocol was used, followed by an unstructured interview at the end. During a *thinking aloud* test, participants are asked to use a product while continuously saying-out-loud what they are thinking when performing the given tasks (Usability Engineering Book, Jakob Nielsen). This method of testing will, in theory, allow to observe where exactly the users have trouble and why. Finally, it is also important to mention that the usability labs were moderated; meaning that at least one member of the design team was present to answer question and help the user in case he/she is unable to complete a task.

Participants

The participants were chosen by the Sport Data Valley team and consisted of individuals that represented part of the user target group. Age, gender, nationality or any other type of demographic data was not directly used when screening the participants. The only characteristic all participants had in common is the

fact that they were all employed or recently employed as coaches or any other managerial positions within a sports organisation.

SDV carried out a total of eight tests with eight different participants. However, only the last four are the ones analysed in this section due to the fact that the previous ones were carried out before the start of this graduation project.

Findings

A substantial number of errors and flaws were found from the usability tests and interview sessions. Due to the nature of the methods utilised – usability tests and unstructured interviews –, several challenges arose. Some examples of these challenges include, but are not limited to; the Hawthorne effect , which concerns "*the effects of reporting on one's behaviour by answering questions, being directly observed, or otherwise made aware of being studied*" – McCambridge et al [17], or the limited sample size of testers used in the study. Although human-computer interaction researcher Jakob Nielsen, from the Nielsen Norman Group, shows how four users are enough to discover 80% of the usability problems present in a design and emphasizes how the best results come from tests with no more than five users [18], the four subjects all belonged to one-third of the target audience: coaches. The script that was followed was highly focused on tasks specific to this user group; therefore, carrying out another two usability test sessions with five athletes and five researchers would have been the ideal plan for optimal results.

Amongst these challenges, the fact that all the analysis and processing of the data was carried out by a single person (myself) was probably the biggest. Hence, a set strategy and priorities had to be made to ensure the preciseness and relevancy of the findings. The main approach to this was to pay attention and annotate when and why a *breakdown* took place. As explained by Winograd and Flores [19], breakdowns occur whenever a user shifts focus due to an unexpected event or flaw in a design, leading to this user to reflect on why this problem is occurring. These breakdowns were identified during the live tests and especially from the recordings of the think aloud sessions, and were used to create the table of severity seen below (Table 3.4). The severity of the issues identified rank from zero = I do not agree that this is a usability problem, to four = usability catastrophe [20]. Based on the frequency, the impact, and the persistence of the problem.

Table 3.4: Problems ranked by severity

Problem ID	Description	Severity
#1	The plus icon (+) on the top-right section of the website header is very confusing. Users are unsure of the purpose of this icon. It is unclear whether it is to add a new connection, add new data, create new group, etc.	2
#2	Users do not know how to share data with a group or other individuals	4
#3	Pill menus found at the "complete your profile" section were not fully functional	2
#4	Users do not know how to send questionnaires to their athletes	4
#5	Users open data dashboard directly from "Data" page, instead of using the dedicated "Analysis" page	2
#6	Users do not know how to operate the dashboard to perform tasks such as comparing different athletes' datasets or looking at data from multiple days (trends)	3

Before discussing the problems seen above in depth, it is worth mentioning that the average task completion rate of all users was of 60%. Meaning that out of the thirteen tasks that can be found inside of the usability script, five were not completed or completed partially. This number is extremely high and already shows the severity of the design issue surrounding Sport Data Valley.

Starting with the lower severity problems (#1 and #3), both of them are caused by misleading visual elements within the platform. In the case of #1, the plus icon at the right side of the navigation bar (Figure 3.2) is very ambiguous.

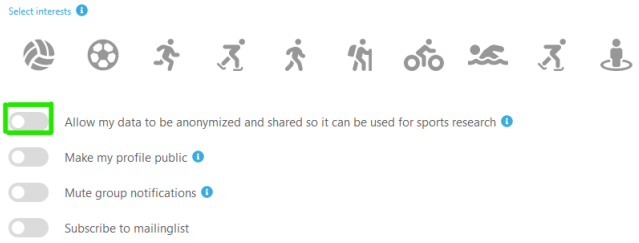
Figure 3.2: Plus icon on the right side of NavBar (highlighted in green)

With no cues hinting the purpose of this icon, three out of the four testers tried to use it for an unintended purpose. This problem did not cause any major breakdowns' and after the first realisation, users never encountered anymore, making it a non-persistent issue.

Problem #3 refers to the sliding button highlighted in figure 3.3, which caused confusion for two of the users. Currently, the functionality of that menu is non-existent given that the feature that it is trying to activate or deactivate is still under development and not yet available in the platform. When users tried to interact with it nothing happened; no error message appears and it is visually identical to the rest of the working menus, causing the aforementioned confusion. Although this problem appeared in 50% of the tests, it can be easily

fixed by greying the menu out or simply removing it from the page until the feature is actually added. Hence the low severity of it.

Figure 3.3: Locked slider button



Problems #2 and #4 are by far the biggest flaws of the platform. Problem #2 being encountered by **all subjects** and problem #4 by three out of the four participants. Both of these are related to the sharing system of the platform, a feature that happens to be crucial for the working of SDV. If the sharing and communication between coaches, athletes and researchers is not seamless, then the whole purpose of the product is defeated.

When subjects were asked to share a data-set with the group they had created, they all failed. In one of the cases, even after several minutes of exploring and actually finding the appropriate location where data should be shared from (the share page), the subject was still unable to figure out how to perform the task and had to resort to the moderators for help. In 100% of the cases, users tried to share data straight from the "Data" page. After not being able to find a way to do so, half of them just gave up, while the other half made their way through to the "Share" page. However, this still was not enough for any of them to successfully complete the task, caused mainly by the jargon used throughout this page (e.g.: *"Add new sharing rule"*).

Lastly, problems #5 and #6 are both linked to the task of visualising a dataset. Problem #5 shows how users opened a dataset directly from the "Data" page; although not wrong, the company preferably wants users to access these dashboards from the analysis page (hence why there is a whole page dedicated to it). This issue is not so severe since most participants were able to complete the task successfully, just through a different route than desired. Problem #6 on the other hand, shows that even the analysis page and structure of the dashboard pages is extremely confusing for users (especially when performing tasks involving more than one data set. E.g.: comparing two datasets). The small icons are hard to find (e.g.: the plus button to add a second file) and the text heavy menus often scared participants away.

3.5 User Scenarios

As mentioned in the section above, the participants used during the usability tests only represented one third of the target user group (coaches). The categories of *athletes* and *researchers* have not been tested in the current platform. Thus, it is necessary to at least develop a number of personas and user scenarios that belong to those two categories.

These were developed having in mind all of the findings from the usability tests, PACT Analysis and Status of the current platform.

Isabel Jannet
Amateur Runner

Personal Information

Age:	23
Education:	BSc Sport Sciences
Occupation:	Sports Advisor
Technologies:	Laptop, iPhone 11 & Apple Watch

Other characteristics

Casual — Type of jogger — Ellite

Low — Digital Literacy — High

Who is Isabel Jannet

Isabel Jannet is a Sports Advisor for a private sports company. She loves doing sports, in particular running. She is currently preparing to run the Amsterdam Marathon, so she goes training at least ve days per week for at least 1-2 hours. During her trainings, Isabel uses her Apple Watch Series 3 combined with the o icial Apple Fitness app to log data regarding heartrate, duration, GPS location, etc.

This will be the third time Isabel competes in the Amsterdam Marathon, but this year she decided that she wants to set a new personal best, and has since begun looking for a platform that will allow her to visualise and analyse her own running workouts.

Obstacles

- Isabel wishes she had someone to compete with to stay motivated

How will Isabel interact with the plaform?

Questions Isabel will ask:
- How can upload my data into the platform in the most e icient way?
- From where can I access the SDV platform?

How will Isabel use the platform?

As mentioned, Isabel's goal is to beat her personal best time during the Amsterdam Marathon. She will use her Apple Watch (connected to the Apple Fitness app) in order to track her speed, heartrate, duration and location. After her rst workout, she proceeds to try and upload her data to the platform, but with no luck given that the platform does not o er direct synchronisation between Apple Fitness app. Exporting and uploading the data les is not an option for her, since that would waste too much time; after a quick google search, she nds that she can easily link her Apple Fitness acount with Strava (another app that o ers performance insights and charts, and this one can be linked with SDV). After this workaround, Isabel nally manages to get the data into Sport Data Valley and proceeds to use the visualisation and analytical tools o ered from her laptop. This is her usual work- ow: Isa uses her smartphone to synchronise the data and to respond to her daily questionnaires, she then uses her laptop to perform all the analytical tasks she needs.

Stefan Siemen
Amateur Football Player

Personal Information

Age:	16
Education:	Finishing highschool
Occupation:	Student
Technologies:	Galaxy S20 & Vest Tracker

Other characteristics

Casual — Type of footballer — Ellite

Low — Digital Literacy — High

Who is Stefan Siemen

Stefan Siemen is a 16 year old international student playing for his neighbourhood football team from Maastricht. He has been in the team for the last three years and their league results could be improved. His coach has convinced the club owners to invest into vest trackers so the club could start better monitoring their player, with the ultimate goal of getting into the top 3 teams at the end of next season.

Stefan is passionate about football and his team, but he is not that interested into personally looking at his own datasets or graphs, although he is happy for his coach to take care of that.

Obstacles

- Stefan does not want this task to consume too much of his time.
- He does not want his team mates to have access to his datasets

How will Stefan interact with the plaform?

Questions Stefan will ask:
- How can I only share my data with the coach?
- Can I upload my data from my phone?

How will Stefan use the platform?

During every training and football match, Stefan needs to wear a vest with a tracker embedded into it, which logs information regarding heartrate, GPS location inside of the football pitch and speed among others. At the end of the activity, Stefan takes his vest o and connects it to his smartphone wirelessly via the app o ered by the vest company. From that same app, he can export the data as a json le that he can later upload to SDV and share with his coach.

His work ow is thereafter as follows: connect vest to app > export data as json le > import json le to SDV via his smartphone > share data with his coach. This ow happens 2-4 times per week, depending on the scheduled training sessions and matches.

Alexander Romein
Phd. Candidate

Personal Information

Age:	54
Education:	MSc Sport Sciences
Occupation:	Sport Performance Analyst
Technologies:	Laptop

Other characteristics

Low — Digital Literacy — High

Who is Alexander Romein

Alexander (Alex) Romain is a 54 year old male that has built a good reputation in the world of sport data analysis as a freelancer. However, he has now decided that he would love to achieve the goal of becoming a phd in his eld of expertise. He recently got accepted into a project which involves analysing data from the eld of track biking. Alexander is in charge of collecting and analysing his own data, but due to COVID-19 times and the fact that the project owner is a modern company, he is essentially forced to work with digital tools.

Obstacles

- His digital literacy is not the best due to his age.

How will Alex interact with the plaform?

Questions Alex will ask:
- Where can I collect relevant data from?
- How can I analyse all of this data?

How will Alex use the platform?

The main reason that pushed Alex to work with SDV was the facilitation of all the data he needed. He just has to sign up for a researcher plan and instantly get access to hundreds of relevant datasets. Alex will then look through these datasets and pick the ones that suit his research the most. Once he has done that, he can proceed to send consent forms to all the neccesary users and wait for their response. Finally, after receiving consent, he can start using the tools o ered by SDV to analyse the datasets.
Some new questions that arrise for Alex include:
- Is there a way for me to communicate with these athletes personally?
- Can I export this datasets locally to work with my own tools? Or am I limited to the tools o ered by Sport Data Valley?

3.6 Chosen Core Scope

Thanks to the results obtained during the usability tests, it has become obvious that the problems Sport Data Valley faces are not only being caused by an unsuitable user interface. The fact that users find it hard to share data and even understand how the sharing works already suggests that there are problems found in the deeper layers of the platform. The project will then focus on improving the usability of the platform, as well as paying close attention and making sure that users are aware of how their data is being used by the platform (i.e.: sharing, public sharing, researchers getting access to their data, etc).

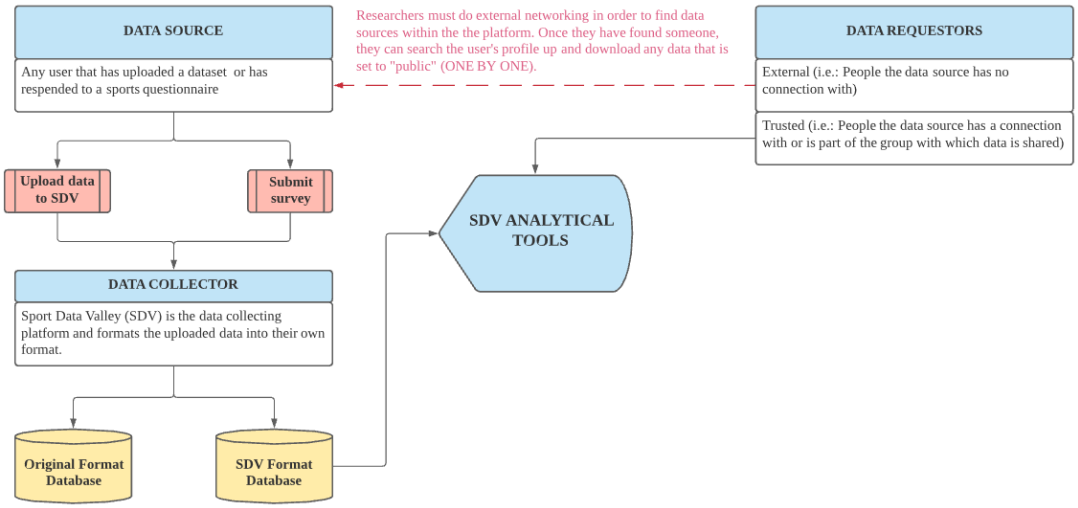
The core scope of this project will no longer focus on "making a pretty face" for the platform, but instead, work with a bottom-up approach. In the following chapters, a look will be taken at the naked structure of the platform (the conceptual framework and information architecture) to discuss and see if there are any major problems that could be causing the issues encountered in the previous chapters. When this is done and most of the issues are identified, a decision will then be made regarding what the final product will consist of (e.g.: developing a new feature, designing a new interface, etc.) and how it will be evaluated (e.g.: evaluating usability vs evaluating comprehensiveness of the platform).

Chapter 4

Conceptual Map of SDV's IA

During this chapter of the project, a conceptual map of how the platform deals with data (e.g.: uploading, sharing, or storing) has been developed (See Figure 4.1). The different elements of the diagram will now be broken down and examined in order to be able to fully comprehend the strengths and shortcomings of these processes. Later in this project, these findings will used to develop a possible new and improved version of how SDV works with data.

Figure 4.1: Conceptual framework of the current platform



4.1 Breaking down current conceptual map

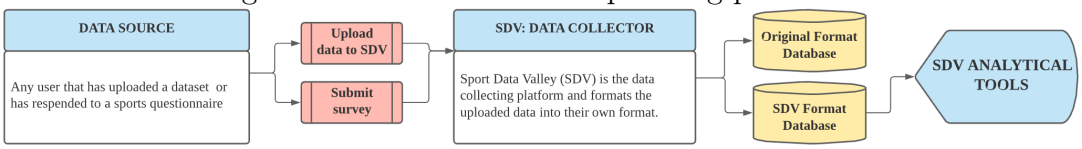
As it can be seen in the figure above, the conceptual map makes use of colours to categorize different aspects and affecting elements of the data sharing workflow. Elements marked in blue represent the core entities of the map, namely the data sources, Sport Data Valley (data collector and analytical tools) and data requestors; data sources refer to any user that uploads data to the platform, SDV acts both as data collector and analytical tool provider since it is the entity in charge of gathering, storing and visualising the datasets, finally, data requestors refer to any users (i.e.: coaches and researchers) that use the platform to obtain sports data from other people. The yellow elements represent the two

databases that SDV uses to store the uploaded files based on format – original format or SDV's own format –. Finally, the elements in red represent different actions that a user can take when interacting with the platform. It is worth to mention that this general diagram has been heavily simplified to only show the most important steps of all the processes involving data. Any other important sub-processes will also be broken down in the sub-sections below.

4.1.1 Uploading and visualising own data

Uploading and visualising own data is the most basic and essential procedure of the entire platform. The series of steps needed to accomplish this task can be seen either in the left side of general conceptual map (Figure 4.1) or in Figure 4.2 below, which shows a diagram that focuses solely in this procedure.

Figure 4.2: Architecture of uploading procedure



There are two ways in which a user can upload data to the platform, these depend on the type of data that wants to be submitted into the platform. If an athlete wants to submit data regarding a specific sport or workout, they can either import their file/files locally from a device that can run SDV (i.e.: a smartphone, tablet, or computer with access to internet and a browser), or they can also connect their accounts from other platforms to automatically upload and synchronise data to Sport Data Valley (e.g.: linking ones' Garmin account will allow SDV to automatically fetch data from their database, allowing users to integrate their favourite devices directly into the platform). Certainly, the filetypes of all of these datasets is likely to vary depending on the used sensors, brand, platform, etc. Thus, SDV runs it through a process that translates all the files into a proprietary format and then proceeds to store both the original file and the formatted file in two different databases (yellow elements in Figure 4.2).

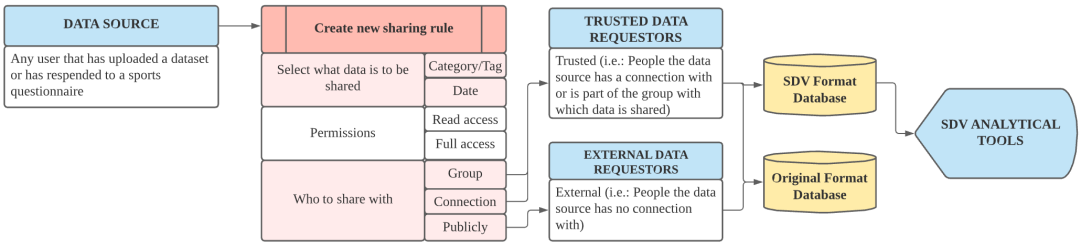
Lastly, one of the proudest features Sport Data Valley offers are their scientific questionnaires, this is the other way in which users can input data. Questionnaires are basically composed of a series of inquiries that have previously been scientifically proven to give important insights to coaches and researchers about their players/subjects. Because they are an in-platform tool, users do not need to upload separate files but instead, fill out the questionnaires inside of the web-app. Finally, users will already be able to make use of SDV's analytical tools to inspect their own data.

4.1.2 Sharing data

In the current status of the platform, the process of sharing data is the one that caused the biggest struggles during the initial usability testing sessions. Before digging deeper into these flaws, an important division regarding who the data

source is sharing data with needs to be made clear; again, there are two different categories: trusted connections and public data. In both cases, the user needs to create a new *"sharing rule"* (refer to section 2.2.4) and select what data is to be shared based on category or tag, and date. After specifying what datasets to share, the data owner can then select with whom to share it with (trusted connection or publicly) and what permissions are attached with the shared files (read rights or full access). Figure 4.3 depicts this whole procedure visually.

Figure 4.3: Architecture of sharing procedure



This type of information architecture is causing the platform a series of shortcomings and bottlenecks when it comes to sharing data. For example, users can only share multiple sets of data at once if a) they all belong to the same sport or b) the datasets to be shared all contain the same tag (e.g.: share all datasets that have the tag *"marathontraining2020"*). The issue with this situation is that it is taking away flexibility from the platform and especially from its users. What happens when an athlete forms part of two teams *"Running 800m"* and *"Sprint 100m"*? He will be forced to either share all running workouts (regardless of the category) with both teams and then manually un-sharing all the individual workouts, or he will need to manually upload and tag every single dataset before sharing (which could become tremendously tedious for an elite athlete that works out at least twice per day).

4.1.3 Fetching data

Fetching data has not been as thoroughly tested as sharing data during the usability tests. However, from talks with members of the development team of Sport Data Valley and from own inspection and analysis, it is has become very apparent that this process could perhaps be the most overlooked on the entire platform. In the same fashion as the section *"Sharing data"* above, the same two categories will be utilised for fetching data.

Trusted Sources

This is the only category that was indeed investigated during the usability testing sessions, where coaches were asked to analyse a series of files that had been shared with them inside of a test group. There were no major concerns raised while the subjects performed this task (at least not regarding the actual fetching of the data). However, there were some problems when it came to understanding *where* this data had to be fetched from (refer to section 3.4.1 to understand issues related to the user interface).

Fetching public data

Fetching public data refers to the action where external data requestors (users that have no connection with the data source) try to obtain data from the public dataset pool. For simplicity and clarity purposes, these external data requestors will be referred to in this section as **researchers**. The reason behind this decision is because this feature was mainly thought out by SDV to allow researchers to use the platform as a "*valley*" where to find data to be used for their studies – hence the name Sport Data Valley. According to the team and also discovered during section 2.3, this feature is actually one of the most, if not the most, unique selling point of the platform. Unfortunately, this also happens to be the most overlooked and left-aside feature of the platform, causing numerous gaps in the information architecture of the platform too. Firstly, SDV does not offer anywhere a centralised location in which researchers can access the public data pool. This means that the only way for researchers to find public datasets is by doing external networking. They need to individually search and contact their own subjects and then hope these have publicly shared datasets in their profiles or request them to make them public. This raises a series of questions: what is the point of SDV then? As it seems right now, Sport Data Valley is just an extra step on the way of researchers. Why would researchers not simply ask for the datasets straight away? Given that they have already gone through the trouble of essentially recruiting subjects. This alone already shows the degree of severity surrounding the particular issue of fetching public data. Nonetheless, more issues can be derived from the situation described above.

Assuming that a researcher has found and received a positive response from a subject that has a SDV account. He/she can now search up the individual's profile and see a list of all the subject's publicly available datasets; this is when a series of new issues appear:

- **No filtering tool:** The researcher has no access to filtering tools, meaning that he/she will need to manually inspect all of the datasets and select the ones that might be of interest. Although this might not be an issue for profiles with little public datasets, it could very well happen that the subject has hundreds of public datasets from a wide range of different sports, making the manual filtering an insanely time-consuming task.

- **Single file downloads:** Once the researcher is done with the filtering task and assuming the chosen datasets have been publicly shared with full access permissions, now he/she can proceed to download them, but only one file at a time. The platform does not allow researchers to create multi-file snapshots of all the selected datasets, once again making the task tedious for the users.

- **Adding datasets to profile:** Researchers might not find it necessary to download a dataset, but instead, saving it to their SDV profile to be analysed with the tools offered by the platform. Unfortunately, this is not possible with the current architecture. If researchers want to analyse a certain dataset, they will always need to go to the subject's profile and find it again. This means that if a researcher has a project involving twenty athletes, he/she would need to recurrently look up the profiles and

datasets every time (see Figure 4.4 for a conceptual map of how this process looks like). Alternatively, researchers could download (if the datasets are shared with full access) and re-upload those datasets to their own profile for quicker access, collaterally causing the loss of information regarding what dataset belongs to who (see Figure 4.5).

Figure 4.4: Accessing public datasets as a researcher in current IA

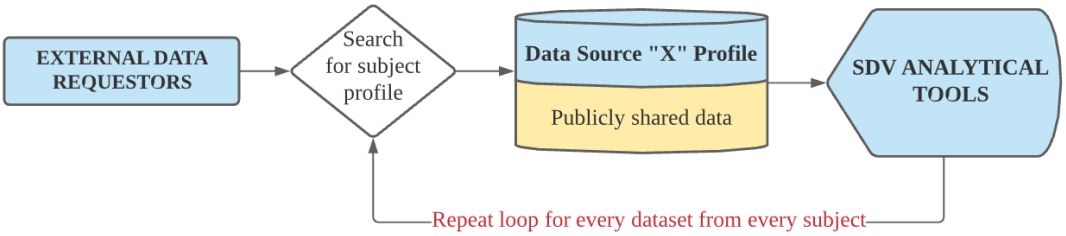
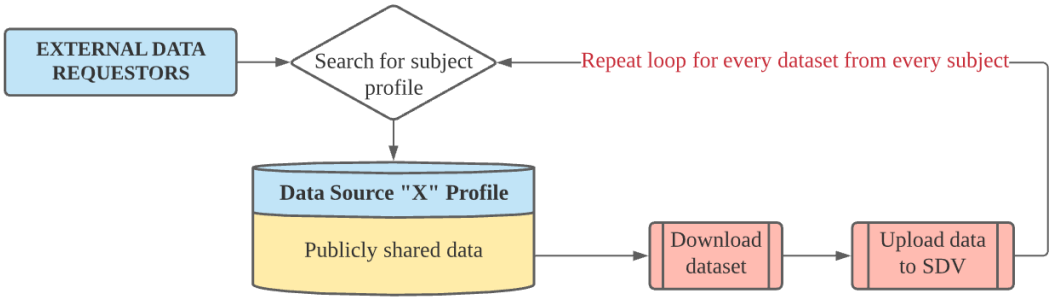


Figure 4.5: Adding public datasets as a researcher in current IA



Lastly, another feature that is included in the "Researcher Plan" (the most expensive plan on the platform at €45/month) is the possibility of creating and sharing consent forms within the platform. However, as it can be seen from figure 4.4, the consenting procedure is currently broken, as any user with a researcher plan has free and uncontrolled access to all the public datasets in someone's profile. Allowing and actually facilitating a potential unethical behaviour from researchers and ultimately putting the privacy of all SDV users at risk.

Chapter 5

Design Specifications

In this chapter, the final specifications and requirements will be determined based on the findings from the ideation phase, talks with the Sport Data Valley team and chapter 4 "Conceptual Map of SDV's IA". Some of the specifications that can be found below include aesthetics, functionality, feasibility, etc.

5.1 Aesthetics

The Sport Data Valley platform has already been on the market for some time, meaning that the company and the product itself are already built following a set design language. It is then important that the final redesign resulting from this project also does follow this style as closely as possible. Like the word *redesign* indicates, the goal is to re-peat and iterate on the current design in order to improve it, not to come up with an entirely new product.

In this section, the different pillars of the current style will be broken down and saved to be used later in the realisation phase.

- **Colour palette:** Sport Data Valley's colour palette becomes very apparent once you sign up for an account. There are three core colours: orange, blue and white. And the style then plays around with different tonalities and a saturation to finally arrive to the colour palette seen figure 5.1.

- **Typography**: This involves all the text that can be seen in the platform. The font currently in use is "*Segoe UI*", a free-to-use font developed by Microsoft and used across a variety of their products.

- **Iconography:** The platform makes constant use of icons, often as visual cues to aid the users while navigating the application. These icons tend to be on the thicker side and they were all obtained from free SVG icon libraries.

- **Modularity:** Although not editable, the user interface clearly divides the different areas with which users can interact as different modules. These modules can be easily distinguishable since they have a contrasting colour compared with the background colour (white)

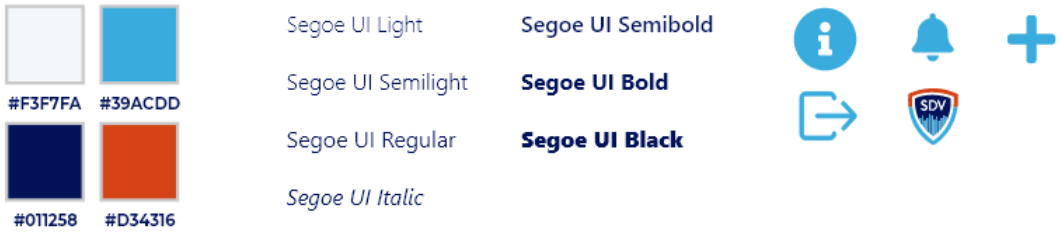


Figure 5.1: Sport Data Valley UI Kit

5.2 Design Requirements

This section lists both functional and non-functional requirements that the final product should have. The requirements were then ranked by using MoSCoW's prioritization categories [21] in order to see what can and cannot be achieved during the time frame of this project.

Table 5.1: Add caption

Requirement	**Must**	**Should**	**Could**	**Won't**
Use the same margins as current platform (10% margin on each side until 1332px wide)	X			
Use the same design language as the current version (see section 5.1)	X			
Avoid getting rid of any feature currently available in the platform		X		
Translatable (current platform offers Dutch and English language)	X			
Use the same interface for all target user groups	X			
Improve the intuitiveness of the platform		X		
Allow users to understand how their data is being treated	X			
Take into account and accommodate parallel developments that the team might be doing*		X		
At least mimic the interaction with the most important new elements	X			
Make it easier for researchers to access and utilize public data	X			
Make it easier for all users to upload and categorize/share data	X			
Simplify the information architecture of the platform as a whole	X			
Testable before implementing it into the final platform	X			
Transferable and editable at the end of this project		X		
Technically feasible to implement in case SDV decides to		X		
Treat other areas of less importance (minor UX/UI fixes)			X	
Responsive (design can be adapted to mobile devices, tables, or computer screens)				X

Chapter 6

Realisation

6.1 Developing new IA and conceptual map

During chapter 4 "Conceptual Map of SDV's IA", the current information architecture of SDV was broken down and visualised by the means of a conceptual map. This one was later inspected and analysed to identify the most severe flaws on the platform. In this section, a new conceptual map will be developed that aims to solve most, if not all, of the issues encountered in the aforementioned chapter.

As discovered previously, the process of uploading and visualising one's own data in the platform caused no confusion during the usability tests, which also explains why the conceptual map for those specific tasks looks simple and easy to follow. Therefore, this part of the general conceptual map of the new IA will be kept the same (see figure 4.1 in chapter 4). The data sharing and retrieving process for all target user groups, however, has been completely reconstructed. The new information architecture is built upon two novel elements that, if SDV were to fully adopt, would become two of the main pillars of the platform: a folder system and an anonymous public data pool.

6.1.1 Folder system

When handling large amounts of data, organisation is key. However, keeping things organised is something that Sport Data Valley does not currently allow; currently, the fastest and most intuitive way to find a specific dataset amongst your own files or the files shared with you is by doing a search based on name, date, sport and/or tag. Although this way of searching for a dataset or datasets certainly works, it can also become a tedious task for a user with a large number of files. Thus, this raised the question of *how can users better organise their own data whilst not making the platform even more complex than it already is?*, which then led to the idea of implementing folders.

The concept of folders is nothing more than a metaphor and a more understandable and easier to grasp name for directories. This metaphor was first introduced around the early-mid 1980s by firms like Xerox, Apple, and Microsoft when they first released their very own and first-in-the-industry GUI based operating systems [22] [23]. Where these companies tried to recreate a virtual version of a physical desktop, which involved (amongst others) the use

of folders and binders to store different files in them. Ever since, the concept of folders has been adopted and adapted by essentially any existing operating systems, regardless of if they are aimed for bigger devices such as laptops (e.g.: Windows, Mac OS or Linux) or smaller devices such as smartphones (e.g.: IOS or Android). This makes it the perfect artifact to try and implement into the platform, because although it would be a novelty within SDV, most of the users will already be familiarised with working and organising files into folders, potentially making the learning process much simpler and increasing the acceptability of the feature. Furthermore, relatively older products compared to SDV such as Google Drive or Dropbox, also make use of a shared folder system, making this an even more fitting solution for the platform given the fact that this alone tackles two key issues: organisation and shareability.

The users will now then be able to create two types of folders, personal or shared. In folder types, users will be able to simply upload datasets directly into them, which means that the platform will automatically tag and organise the files based on what folder or folders a specific dataset belongs to.

- **Personal folders:** These are the standard folders that almost everyone should be familiar with from using their computers or smartphones. They are individual and private repositories, meaning that any files uploaded to this type of folder will only be accessible by yourself and from your own account. Upon upload, the user will be able to specify further details about the dataset being uploaded such as title, sport type or date.

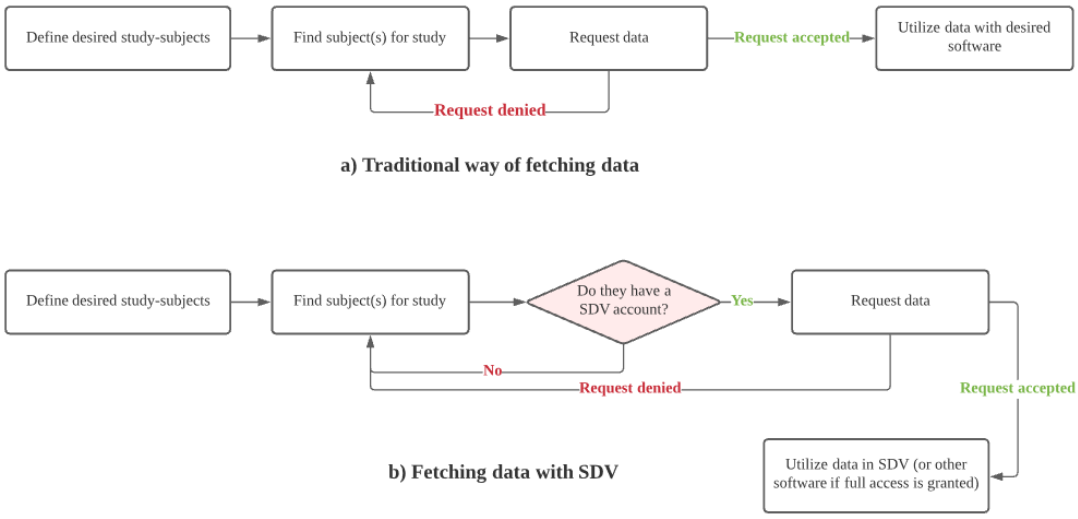
- **Shared folders:** Following the same logic as the shared folders that can be found in other cloud platforms such as Google Drive, this type of folders are repositories that different users have access to, meaning that all the files found in that repository can be accessed by anyone with such rights.

  Whoever creates the shared folder will be the administrator and owner of that given folder. During the creation process, the owner will be able to edit fields such as name of group, avatar/logo, category (categories are not only limited to sports; for example, if a researcher wants to create a shared folder to use with other fellow researchers, he/she can select the *"research"* category), team members, or add a description of the group.

6.1.2 Anonymous public data pool

The second new element to be suggested is the anonymous public data pool. As found in chapter 4 and from the personas in chapter 3, Sport Data Valley has currently left aside one third of their target user groups: researchers. Although the platform markets itself as a web-app perfect for athletes, coaches, and researchers; the latter group really has no big advantages when using SDV to acquire data when compared to the traditional way (See figure 6.1 to observe differences).

Figure 6.1: Fetching public data - Current vs New Framework



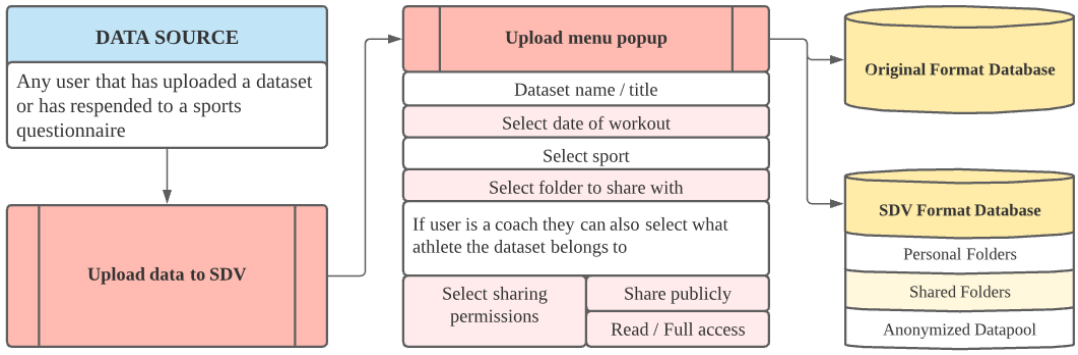
The proposed solution to tackle this problem would be to create the aforementioned public pool of anonymised data, which as its name suggest, is essentially a repository where all the datasets that have been uploaded publicly to the platform can be stored and fetched by users with a researcher plan (when a dataset is uploaded publicly, it also implies that it has been completely anonymised). More on the role and specific functioning of this data pool in section 6.1.4.

6.1.3 New data sharing

With the new information architecture, there are two completely new ways in which data can be shared in the platform. They can be divided into two situations: uploading and sharing data in one go, or sharing data post-uploading.

Upload and share data

Figure 6.2: New data sharing architecture



Thanks to the implementation of shared folders, the action of uploading and sharing in one single process would be available in the platform. As it can be seen in figure 6.2, when uploading a file to SDV, the users will now face a popup menu in which they can specify sharing rules in a clear, fast, seamless, and

centralised manner. Inside of this menu, users will be able to fill in details such as dataset name, date, sport (this will make sure the appropriate dashboard is used when analysing this file), **select folder** (by selecting a shared folder, the dataset will also be shared with all the members from that folder automatically) and sharing permissions (i.e.: share publicly and read/full access).

Share data post-uploading

As mentioned at the beginning of this section, the process of uploading data into the platform would not be changed. Indeed, users can still upload data the same way that they are used to with the current platform. The whole sharing popup menu explained previously can be skipped and users still have the possibility of uploading a dataset to the platform without sharing it or adding it to any folder. These datasets will be accessible directly from "data" page, where users will have the option of selecting single or multiple files and directly editing all the details mentioned above.

With the reconstructed IA and these two new ways of sharing files, the issues discussed in section 4.1.2 would be completely resolved:

- Data can be shared in one go and in one centralised location. The sharing process is no longer fragmented and found throughout different sections of the web-app, hopefully allowing users to be much more efficient when performing this task.

- Users have complete flexibility over their shared data. Sharing multiple datasets will no longer be dependent on the sport type of those given datasets. To illustrate the problem better, the same example as in section 4.1.2 will be used; What happens when an athlete forms part of two teams *"Running 800m"* and *"Sprint 100m"* and wants to separate the running data from these two categories? With the new sharing process, this is no longer an issue. The athlete will be able to upload and share these datasets with the desired individual folders.

6.1.4 Fetching public data

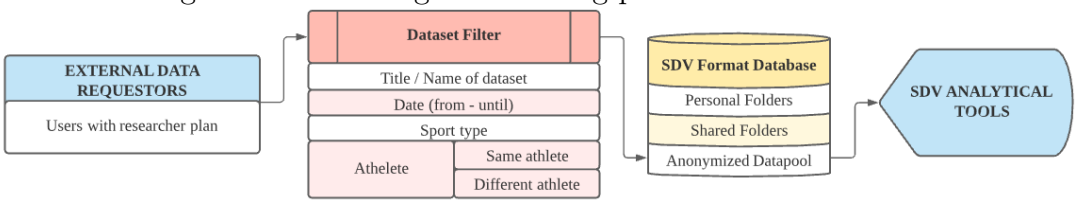
During section 4.1.3 Fetching data, a division was made between fetching data as a trusted source and fetching data from the public domain. However, because the earlier one did not pose any major problems when it comes to information architecture, it will not be discussed during this section.

REMINDER: Fetching public data refers to the action where external data requestors (users that have no connection with the data source) try to obtain data from the public dataset pool. For simplicity and clarity purposes, these external data requestors will be referred to in this section as **researchers**. The reason behind this decision is because this feature was mainly thought out by SDV to allow researchers to use the platform as a "*valley*" where to find data to be used for their studies.

As discussed in section 4.1.3, the action of fetching public data raised numerous problems and created multiple gaps in the architecture of the platform,

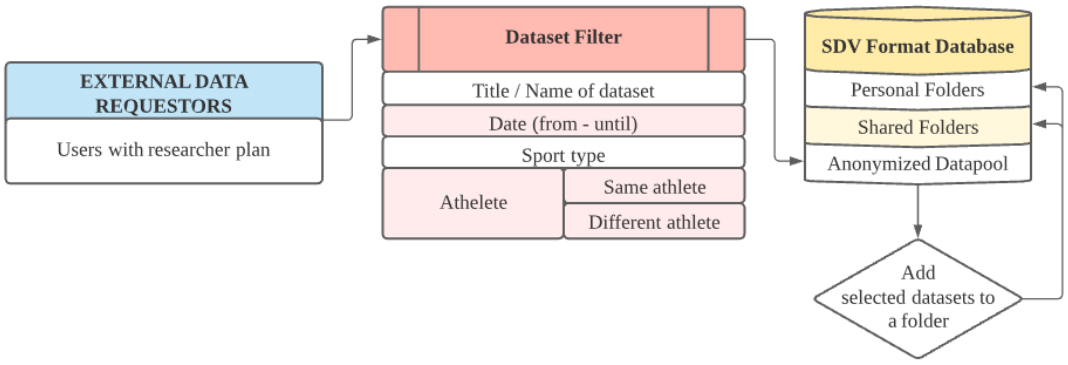
sometimes even rendering a full feature useless (e.g.: consent forms). The implementation of an anonymised data pool was designed to fix most of the issues raised. Firstly, it allows for the creation of a centralised location where researchers can access all the public datasets (more on this topic and where this pool will be located in section 6.4.2), completely removing the need to do any external networking, which already simplifies structure of the platform and the process of fetching data massively. Although not final, the idea is to show the public datasets as a list similar to the one that can be found in the current platform under the "data" page, this would allow researchers to **filter** and **download multiple files** at once, features that are not available with the current version of the platform (see figure 6.3 for a visual representation of the new public data fetching procedure).

Figure 6.3: Filtering and fetching public data - New IA



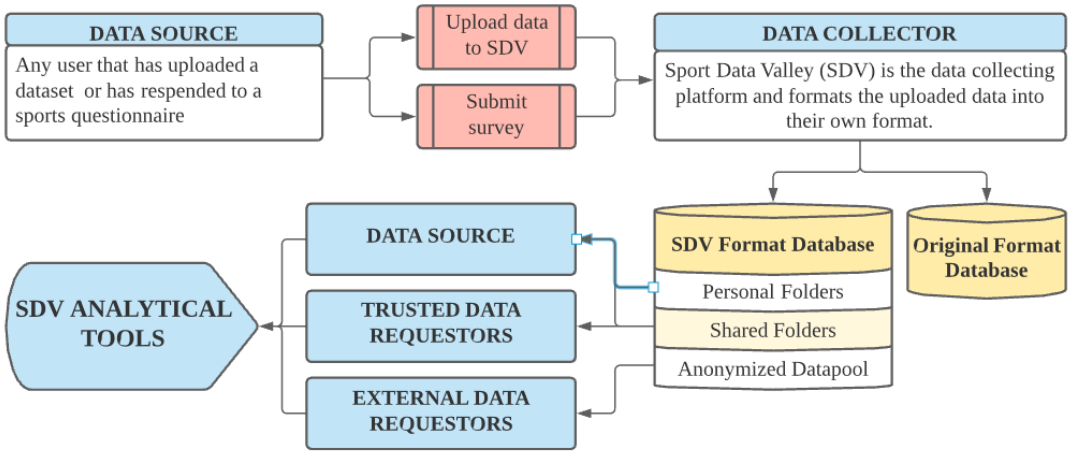
Furthermore, the combination between the public data pool and the folder system creates a synergy that unlocks the possibility of adding datasets straight into a folder in your own profile, solving the issue of having to download and re-upload the datasets in order to be able to access them quickly from one's profile. Refer to figure 6.4 to observe a flowchart of how researchers can now add public data straight to their profiles.

Figure 6.4: Adding public data to researcher profile - New IA



Lastly, the feature of sending consent forms to users will no longer be needed for now. Thanks to the new anonymous pool and fetching system, the data sources and external data requestors will be completely detached from each other (as it can be observed in figure 6.5, showing the general view of the entirety of the new architecture). This means that with the redesigned platform, public datasets will be completely anonymous, making the GDPR no longer applicable for this particular scenario.

Figure 6.5: Complete overview of the new conceptual framework



6.2 Software and tools

During the realisation phase of the project, a number of different software and tools were utilized for the different tasks. These tasks can namely be divided into Visuals & Wireframing, and Hand-off.

6.2.1 Visuals & Wireframing

Adobe Illustrator

Adobe Illustrator is a well-known software made by the Adobe team. The program is used to create vector graphics and will hence be used for that same purpose during the realisation phase. This specific software was chosen based on two reasons; a) vector graphics can be resized without losing any image quality. In case the company wants to modify any of the graphical elements, they will be able to do so without compromising quality, b) illustrator vector files are directly transferrable to Adobe XD (wireframing software explained right after this one), making it easy to work simultaneously across both programs.

Adobe XD

Adobe XD is a wireframing software that is also offered by the Adobe team. The program offers a lot of powerful tools to use during the prototyping process for both the design part (designing graphical user interfaces), and the interaction part (crucial to perform high fidelity user tests later on). Similar to illustrator, Adobe XD also works with vectors instead of pixels, allowing the company to resize and re-adapt elements without losing any quality. Furthermore, the software also allows to export the final product as a website that can be accessed by anyone who has access to the link and password, making it simple to share and test remotely.

6.2.2 Handoff

Design handoff refers to the final phase where designers need to transfer their final product (in this case the Adobe XD mock-up) to the development team. Usually, this step causes some trouble to both the design team and the development team, given the fact that they both need to find a middle ground to meet and perform the *handoff* (i.e.: Designers should not simply hand over design files that will be hard to read by programmers, while programmers should not expect an almost already coded product). This is where software tools such as Zeplin come into play.

Zeplin.io

Zeplin.io is a tool design exactly for the purpose of making hand-off easier. Once done with the final Adobe XD file, this one can be uploaded directly to Zeplin and will automatically generate code snippets that can be facilitate the task of implementing the new design right into the code. Zeplin can export CSS, SASS, Less and Stylus for web; Swift, React native and Objective-C for iOS; and XLM

and React Native for Android. Zeplin will then be used during the final hand-off to try and make the solution as easy and technically feasible as possible.

6.3 Low-fi prototyping

Now that the tools and design requirements have been determined, the actual redesign of the graphical user interface can commence. During this section, a look will be taken at the low-fi prototypes and paper sketches designed using the new information architecture as a starting point.

6.3.1 First design delivery

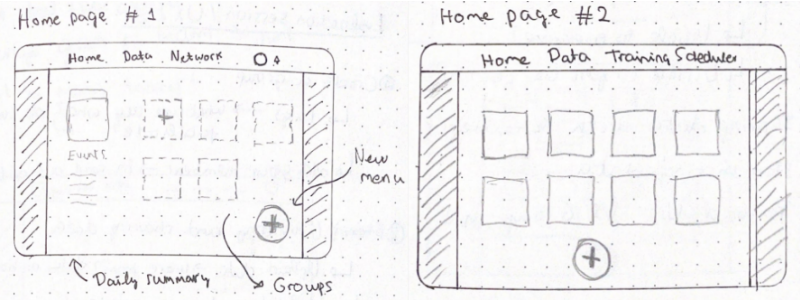
From the initial usability testing, it became apparent that the whole Sport Data Valley platform was too fragmented. During most of the tasks, users felt the need of having to navigate through multiple menus and pages in order to be able to find the proper location for the task. One could even argue that the page was so confusing that the strategy of some of the participants was to perform a breadth-first search through the page, clearly showing how complex the interface is. To re-freshen some of the findings from section 3.4, the things that were hardest to find for users were:

- Where to share a dataset and how to use sharing rules
- Where to find and send sport questionnaires
- Where to access the appropriate dashboards to analyse a dataset

Furthermore, a common complaint amongst participants was that the homepage was rather empty, complicating things already from the beginning of the tests. The homepage of any website is the first impression that a user gets from your product; if this one is uninviting and poorly designed, chances are that those users will lose interest and engage less with the platform.

The initial idea that resulted from those findings was to basically start peeling layers away from the platform, with the aim of beginning to expose those elements that are now hard to reach. Apart from bringing those features *closer to the surface*, all the tasks tied to those features are all key to the platform, thus finding a way to implement them directly into the homepage of the platform could also be beneficial and eventually tackle the two issues at once. The first sketches that resulted from this idea can be seen in figure 6.6.

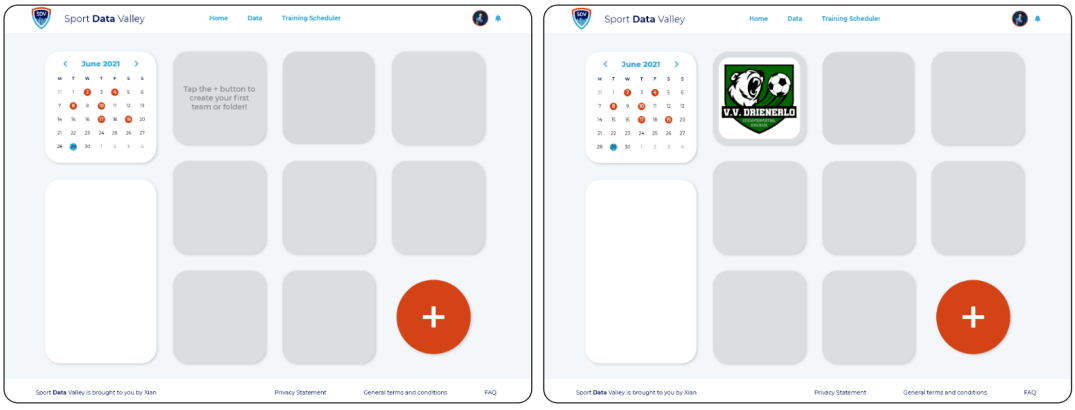
Figure 6.6: Sketches of possible Homepage #1 and #2



Both of the paper models (Homepage #1 and Homepage #2) feature two completely new elements: tiles and a new circular button. The empty tiles represent the possible folders that a user can have (please refer back to the beginning of this chapter to read more on the new folder system). Users would in theory tap in an empty tile in order to create a new folder/group or tap on an existing folder in order to open it up and interact with it (e.g.: create a questionnaire, add dataset to the folder, add member, etc.). Secondly, the circular button is expected to become a key component of the new redesigned platform. The button will be a simple circle with a "+" (plus) icon in the middle and once it has been tapped, it will expand and become a menu where most important tasks can be performed – these tasks will all involve some sort of adding mechanic, hence the plus icon in the button (e.g.: add a new member or add new questionnaire).

The main difference between both of these sketches is the layout. The sketch of Homepage #1 follows a similar structure to the homepage of Trainingpeaks mentioned in chapter 2. The page is divided into two columns; the left column could contain information about upcoming events, workout data (e.g.: average heartrate, distance, etc.), while the column on the right would contain all the folders and empty tiles. The sketch of Homepage #2, however, follows a more minimalistic language, where the only elements visible would be the folders and empty tiles, and the circular button. Although the second homepage design might seem cleaner, and likely easier to understand due to the little amount of information being shown to the user, it is believed that it lacks any *"hooking"* element that will grasp the attention of the users. Thereafter, the first homepage was the one chosen to be developed further (see figure 6.7).

Figure 6.7: Visually accurate Homepage #1 variant



Feedback from SDV

After creating an aesthetically high-fidelity version of the new homepage, this one was then presented to the Sport Data Valley team for feedback. The general response was positive, most of the members showed interest towards the look and concept of using tiles in the platform. One of the members even underlined the fact that one of the platforms that is integrated with Sport Data Valley (Garmin Connect) uses a similar tile design structure in their UI, which could potentially make it easier for users to navigate the platform, given that they might already

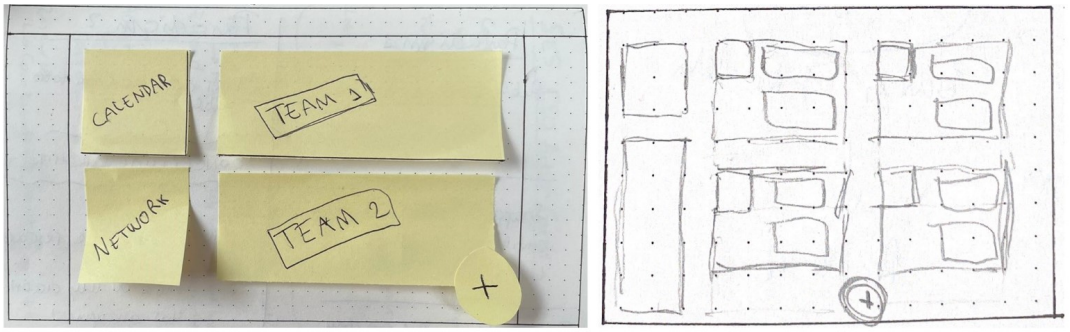
be familiar with a similar interface. Another aspect the team liked about this design is the fact that it accommodates features that are currently not out yet in the platform, showing the flexibility that a tile system could bring to the table. For example, the training scheduler is a tool that is still under development, and it essentially allows coaches to create workout schedules for their athletes. This specific feature was also implemented into the design by the means of a calendar tile located on the top left corner of the homepage.

On the other hand, there were also a few concerns raised by this new homepage. Firstly, a common question amongst all the team members was, how useful is it to have eight different slots for folders in the homepage? What happens if a user only has two folders, or a coach only manages a single team? The whole page would then be just as empty and as unappealing as the current version of the platform. Secondly, although everyone agreed on the importance of fixing the sharing paradigm, the main functionality of the platform is the **analytical tools**. With the new homepage, there are no cues or elements that "show off" these tools, hence the team requested if it would be possible to show some of these analytical insights somewhere in the homepage.

6.3.2 Second design delivery

A second iteration of the initial design was made based on the feedback obtained in the previous section. After processing all the comments, a total of three new variants were designed. These can be seen below, along with a brief explanation of what changes were exactly made.

Figure 6.8: Two new variants of homepage layout



a) Two folder tile variation

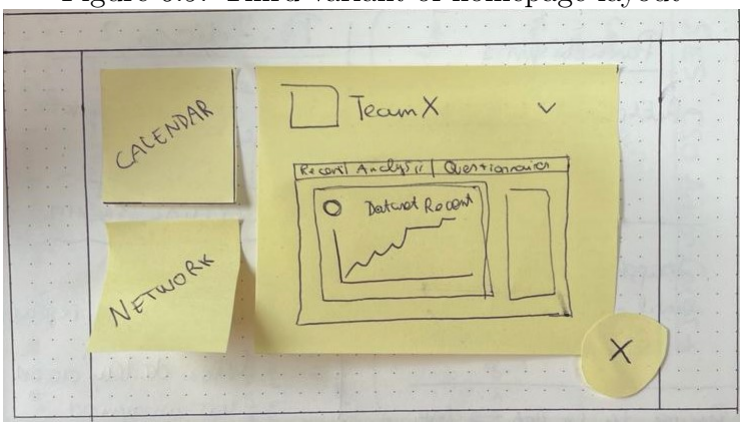
b) Four folder tile variation

The first two variants depicted in figure 6.8 are a simple adaptation from the initial design. The same tile system was kept, but instead of having eight different empty slots, only two and four tiles (variant *a* and *b* respectively) were kept. Using bigger tiles would create more room, allowing to include some of the elements requested by SDV during the feedback session. For example, an overview of the latest dataset uploaded to that specific folder could be displayed or, if the folder belongs to a team, a brief workout summary of all the athletes could be shown (i.e.: exposing and showing some of the analytical tools that Sport Data Valley offers and showcasing the tools available in the platform).

Both of these variants, however, do not fully solve the issue raised by the question *What happens if a user only has "X" folders, or a coach only manages*

a single team?. Indeed, bigger tiles will at least offer the chance to decrease the amount of empty space, but it is probable that some of the users will only need one folder/team (e.g.: an athlete that only belongs to one team, or a coach that only manages a single team), which means that even with two tiles, 50% of the allocated space would be wasted. Hence the need for the third and final variant.

Figure 6.9: Third variant of homepage layout



This last version perfectly demonstrates the design cycle followed during this final ideation and low-fi prototyping phase. Each idea was evaluated by putting it against the same question, and the answer to that question was then used to iterate and improve the designs accordingly, leading to the interface shown in figure 6.9. An obvious observation is the apparent decrease in tiles from version to version; where the very first proposition offered up to eight tiles to be used for folders and groups, and has since been decreased to four, two and now one tile. Ideally, the interface could be adaptive or perhaps even allow users to define the number of folders that are shown on their homepage, making the platform's interface somewhat flexible, while still keeping the same UI for all target groups. For the sake of simplicity though, it was decided to use one single tile as the standard for this project.

Figure 6.10: Final layout designed in Adobe XD

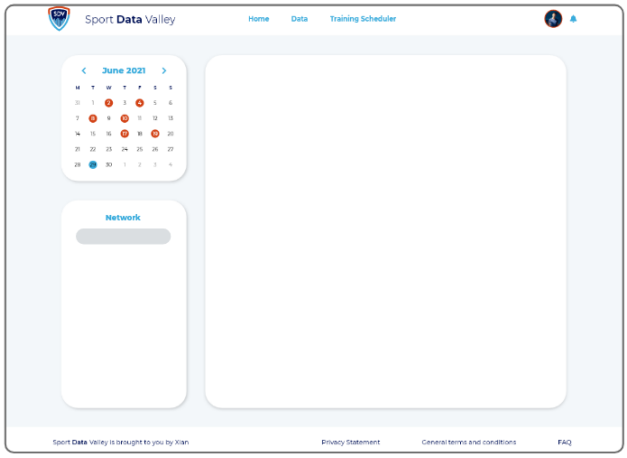


Figure 6.10 shows how the final tile arrangement will look like for the high-fidelity prototype development. In the top left corner, the same calendar tile

was kept as it was concluded that it aligned nicely with the future features that will be offered in the platform, making this UI future-proof. Right beneath, there is a slightlier taller tile dedicated to networking. Although networking is no longer something needed in the platform if the new IA is adopted, the implementation and development such framework is likely to take some time, and since one of the requests from SDV was to make sure that the new UI is directly implementable, all these features still need to be somehow included into the redesign.

Lastly and probably the most important module, the folder tile. This one was still kept on the right-hand side of the display; due to time constraints, it was not possible to include placeholder elements inside of the tile, nonetheless, it is easy to see how much space is now available compared to the previous variants, giving the designers and the team the opportunity to fit almost anything inside of that area.

6.4 High-fi Prototyping

This section will cover the refining of all the components that made it into the final design variant. Namely the **"+" button**, deciding and implementing what elements will be available inside of the **team tile** and lastly, restructuring the data page to include the **anonymised public data pool**. Furthermore, the high-fidelity prototype needs to be testable. Improved aesthetics are great; however, they are not enough to test and evaluate whether the user experience has improved or not. Therefore, the key human-platform interactions related to sharing data will also be designed and implemented during this section.

6.4.1 Refining UI and components

Plus Button

The plus button has been previously referred to as one of the new key elements in the platform, given the fact that it will play a very central role when it comes to working with the new folder system. Its main purpose is to act as a shortcut between folders (especially shared folders) and the different actions that can be done in them. It is therefore a crucial task to determine the most appropriate actions to be included inside of this new button. These actions were chosen in the basis of two criteria: a) what tasks were the most troublesome during the usability testing, b) what are the basic tasks that are expected to happen within these folders and groups. Read table 6.1 for the list of actions the button will include.

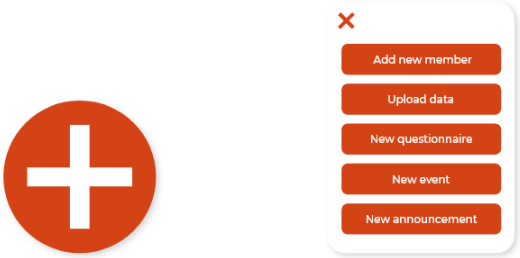
Table 6.1: Actions that will be included in the "Plus" Button

Action	**Criteria**
Add group member	Basic mechanic of shared folders
Upload dataset to folder	Basic mechanic and extremely troublesome during testing
Send new questionnaire to group	Basic mechanic and extremely troublesome during testing
New announcement	Basic mechanic currently available in SDV
Add new event	(Coach only) Will become a basic mechanic once the training scheduler is launched

Regarding the look and feel, the button will be circular in shape and will be filled with the orange tone from the colour palette settled in the design requirements chapter, section 5.1. This choice was based on colour psychology and, of course, the available colour palette to maintain a consistent design language. Although some studies suggest that saturated oranges and red tones tend to evoke the feeling of "do not touch" in people [24], it is also true that the shade of orange that SDV uses is flashier and stands out the most when compared to the other colours in the palette, making it the better option for the purpose of standing out and capturing the users' attention. Moreover, the "do not touch" feeling will be tried to be countered by using a bold white plus symbol in the

middle of the button, with the goal of triggering the user to “tap for more” (see figure 6.11).

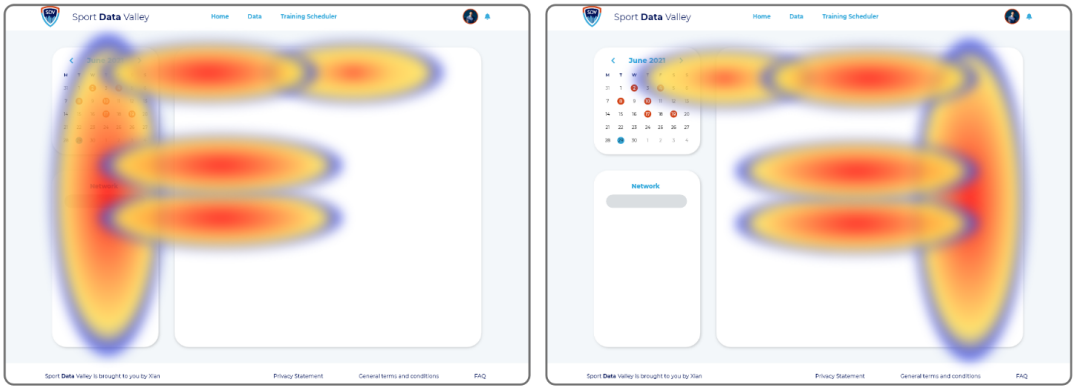
Figure 6.11: ”Plus” button states



a) Inactive button b) Tapped button

The positioning of the button was also a choice that had to be thoroughly thought-out. As Nielsen Norman (amongst others) discusses, there are several different patterns in which users tend to read and scan websites or screens [25]. One of the most common patterns is the so called “F-Pattern”, in which users scan the contents of a website in an f-shape pattern. If this one is overlayed on top of the current design, figure 6.12 is then obtained (this overlay is an approximation, assuming users will indeed perform an F-shape scan over the page).

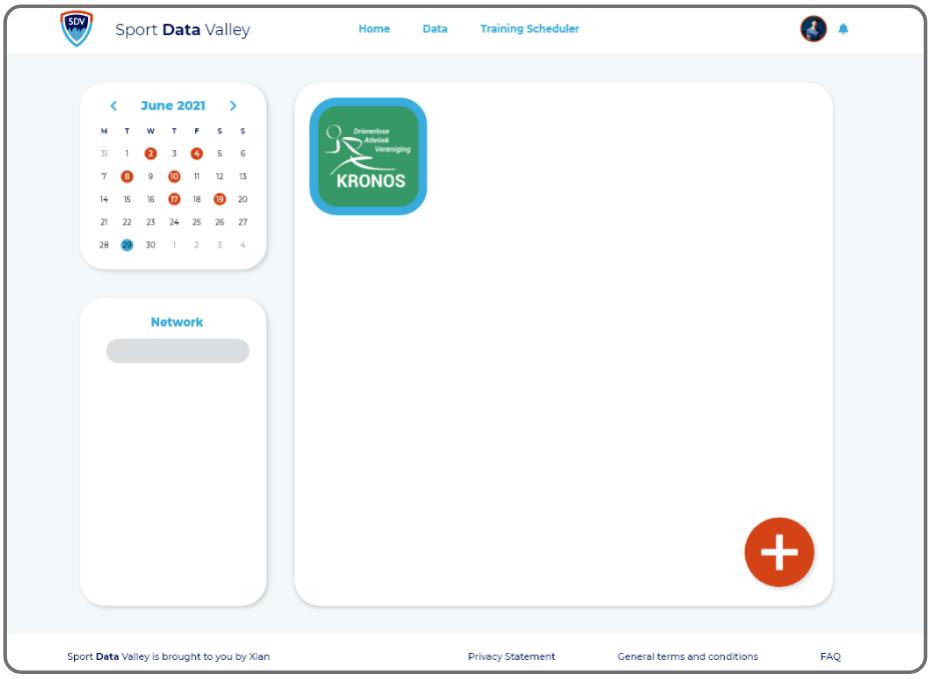
Figure 6.12: F-Pattern Scan simulation over new layout



a) F-Pattern Scan on redesign b) Inverse F-Pattern Scan on redesign

As it can be observed, the F-pattern can happen in both directions. If this simulation is then combined with some basic usability rules for handheld devices (e.g.: elements located in the lower sections of touchscreen displays are easiest to reach and require the least effort from users), it can then be concluded that the best location for the plus button would be the lower right corner of the screen.

Figure 6.13: Positioning of "Plus" button



Folder Tile

Thanks to the iterations performed during the low-fi and final ideation section, the folder tile now has a lot of empty space that can be used to showcase some of SDV's most useful features right in the homepage. As of right now, the tile only contains the plus button mentioned in the previous section and the rest of the elements to be included are yet to be decided. With the homepage being completely redesigned and the implementation of new elements such as the button, network tile and calendar tile, all the changes to the interface have been rather disruptive. Because of this, it has been decided that the direction and goal for the design of this tile will be to stay as conservative and classic as possible.

The idea is to try and re-use already existing elements and place them right into the tile. The goal with this is to make sure old users do not need to re-learn how to navigate the site from scratch, as well as facilitating the task of transferring visuals into code, since developers can just reuse the already existing snippets. The element that was decided to be included is the group menu (figure 6.14) because it is believed that it will have the biggest positive impact in usability. Recalling what was discovered during the usability tests, some users found it complicated to reach a group's management menu (menu where the members, questionnaires and recent data of that group can be seen). Therefore, bringing this menu forward to the homepage and exposing it should in theory solve the issue of users struggling to access it. The content of the different tabs of the menu has been slightly modified to fit the new interface (read table 6.2).

Lastly, the same findings regarding the F-pattern scan were used to determine the positioning of the menu and a few other important elements such as name,

folder image and folder description. The final layout of the tile can be seen in figure 6.15.

Table 6.2: Tabs to be included in new menu of folder tile

Tab	**Content**
Board	This panel will contain a quick overview of the most recent uploaded data (e.g.: the pace, distance, and route of a running workout), as well as an announcements board where coaches can pin messages to be delivered to all the athletes/member of that group. The tab essentially contains the exact same elements as the "Activity" tab from the current platform.
Analyse	The analyse tab will show a list of all the datasets that are available within that folder. Coaches and researchers can filter these datasets and select multiple files to be analysed based on properties such as athlete, sport type, date, etc. This tab will not be visually developed since it falls beyond the core scope of this project
Questionnaires	This tab is the same as the one currently found in the platform, where users can check the ongoing sport questionnaires, manage them or send new ones.
Settings	The same as the current version. A place where to look at the current settings of the shared folder/group and to change them if necessary.

Figure 6.14: Group menu currently used in SDV

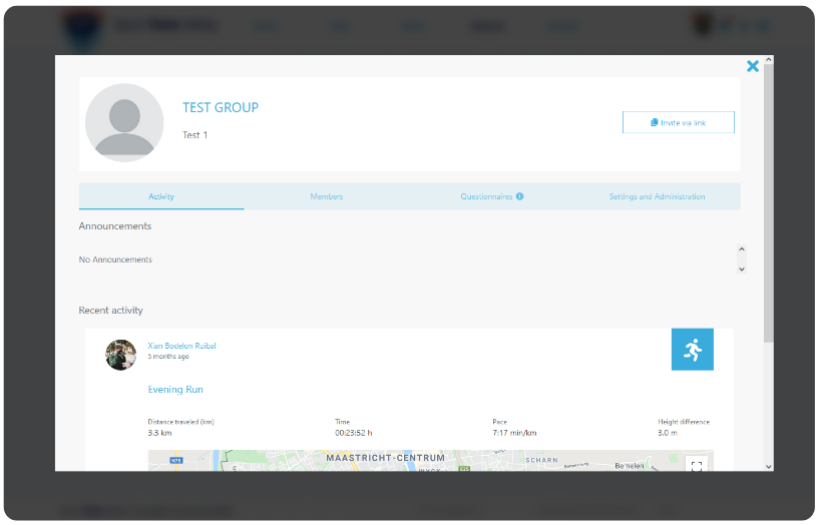
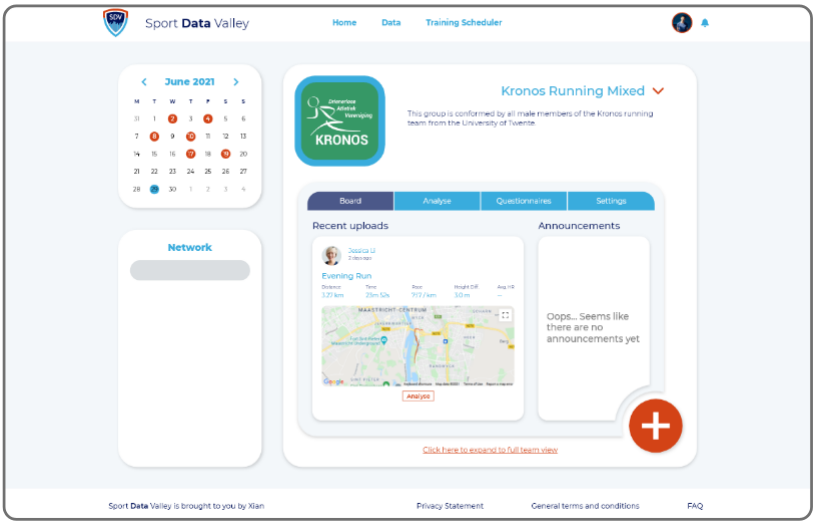


Figure 6.15: Complete layout of folder tile



6.4.2 Human-Platform Interactions

This section will cover the development of the interactions that will be tested during the evaluation phase of this project. All of the interactions that will be described below are linked to the topic of data sharing within the platform, the core scope of this graduation thesis. Each subsection will treat an individual interaction, describing the hierarchy of the steps that need to be taken and the though process behind how these interactions were designed.

1. Adding new folder

The action of creating folders is a key pillar of the new redesigned and it must be made clear to all users what these folders are and how to create them. For the purpose of this project, the homepage will be completely empty, and users

will need to interact with the site as if it were their first time in the platform. Therefore, the first screen that they will face will be an empty home screen with nothing but the calendar tile, an empty network tile and an empty folder tile.

The first design challenge is then, to get the user to create his/her first ever folder. There are a few ways in which this can be accomplished:

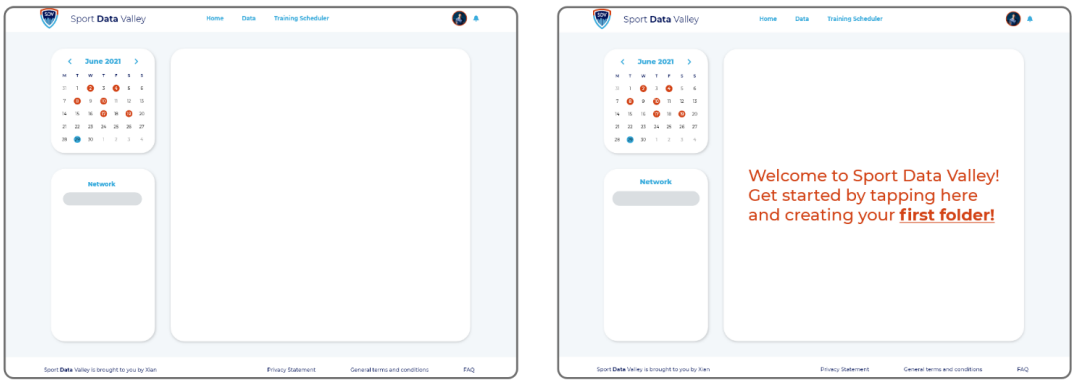
1. **Forcing the user:** Forcing the user to create a folder the first time that he/she logs into the platform is probably the easiest and fastest way to ensure users learn about this new feature. However, this could also backfire as users might feel too restricted during their first time in the platform, which might not be the best first experience. Furthermore, not all users will want to organise their files in folders at first, so forcing people to do something that they might not use in the future is also not the best idea.

2. **Visual cues:** Using visual cues to lure the users into creating a folder would be far less restrictive, although it comes with the challenge of the possibility that not all users may perceive the cue. For the context of this project though, where users are encouraged to explore and play around with the interface, this option is the one that will be used (refer to figure 6.16 to see the message used as visual cue).

The second design challenge is to find a way to ensure that users learn what folders are and how they work. This was done by simply implementing a wizard/assistant to explain all the necessary information during the setup of the first folder (see figure 6.17 for the storyboard of the wizard).

Finally, the last step to successfully create a folder is to fill out the details of this one. The options that a user can tweak in the current version when forming a group (the closest thing to a folder) include name of the group, description, anonymised group toggle (if this one is on, only the owner of the group will be able to tell what files belong to what athlete) and group avatar. In addition to that, the new folder menu will also allow to select category (e.g.: type of sport or research purposes) and directly add people to the folder (if other users are added, this one will become a shared folder; otherwise, it will stay private); making it possible to create a group folder in one step instead of two as it currently works in the platform.

Figure 6.16: Implementation of visual cue



a) Homepage without cue

b) Homepage with cue

Figure 6.17: Wizard storyboard

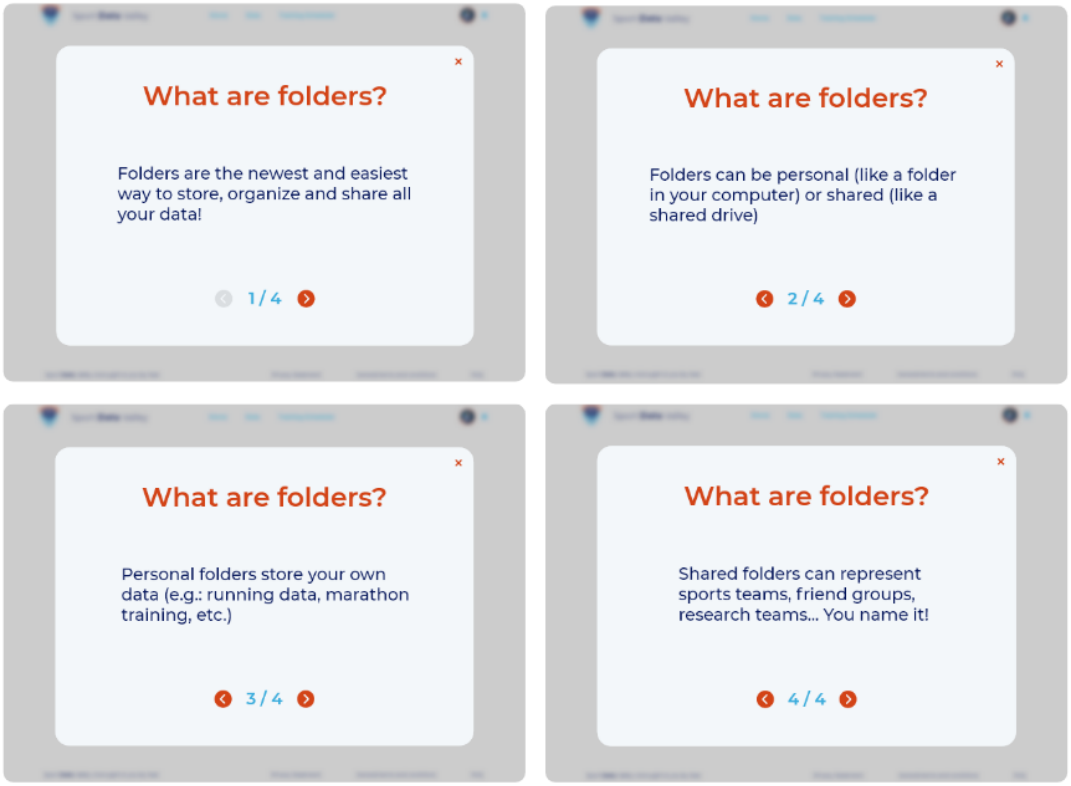
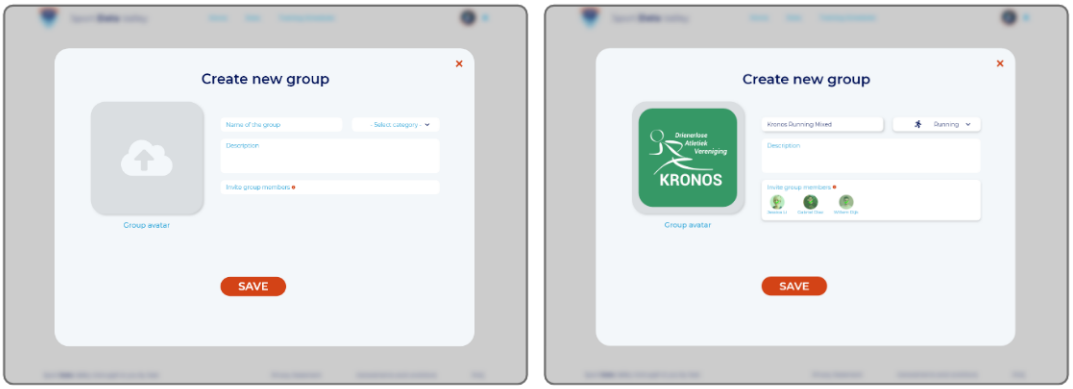


Figure 6.18: "Create new group" menu layout



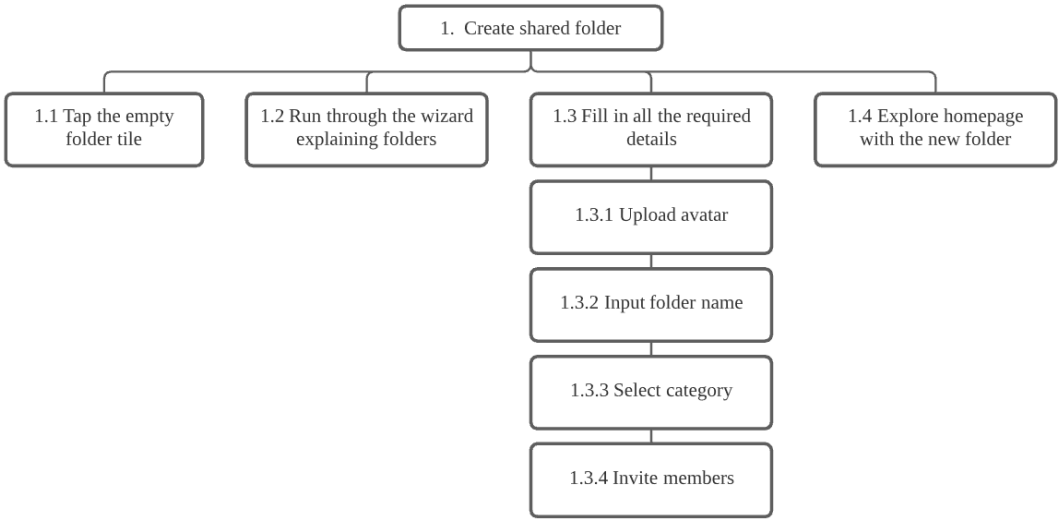
a) Unfilled 'Create new group' menu

b) Filled 'Create new group' menu

Hierarchical interaction breakdown

In this small section, all the interactions that have been implemented are shown in hierarchical order (order of actions is enumerated. If an action is not enumerated, it means that action can be performed at any moment)

Figure 6.19: Hierarchical task analysis of creating a new folder

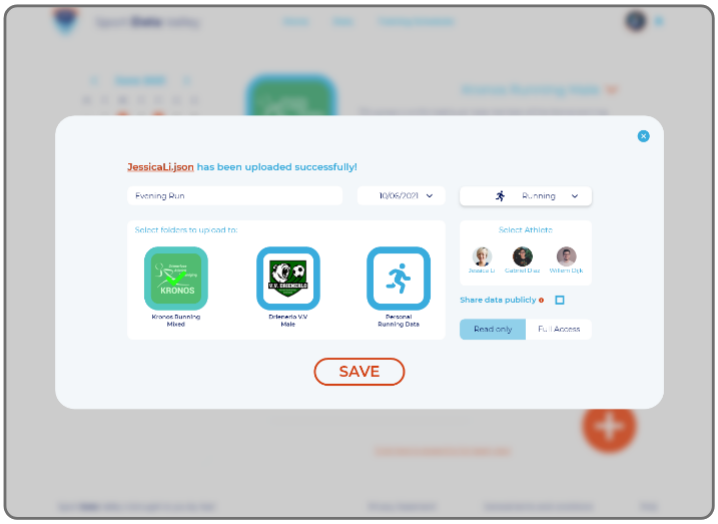


2. Uploading dataset to shared folder

With the shared folder successfully created, the next task that will show whether or not all the design changes have improved usability is uploading a dataset directly into a shared folder. During this task, users will have the first chance to interact and use the brand new add button. These series of interactions will be key during the testing phase to test details like positioning, colour, etc.

Unlike the previous interaction (adding a new folder), there are not many new challenges, except for the designing of the upload menu. Currently, SDV allows to upload data by either connecting to an external platform (e.g.: Garmin or Polar) or by uploading a local file; this will be kept the same. Moreover, upon successfully uploading a local file, a menu similar to the one implemented in the folder creation will open up (figure 6.20), where the following details about the dataset can be filled in: dataset name, date (if it has not been automatically detected), sport type, what folder to upload to, athlete (useful if a coach uploads data that belongs to one of his/her athletes), share publicly, and permissions (read only or full access). Again, reducing the amount of necessary steps to perform a single action (in this case, enabling users to upload and share data in one go).

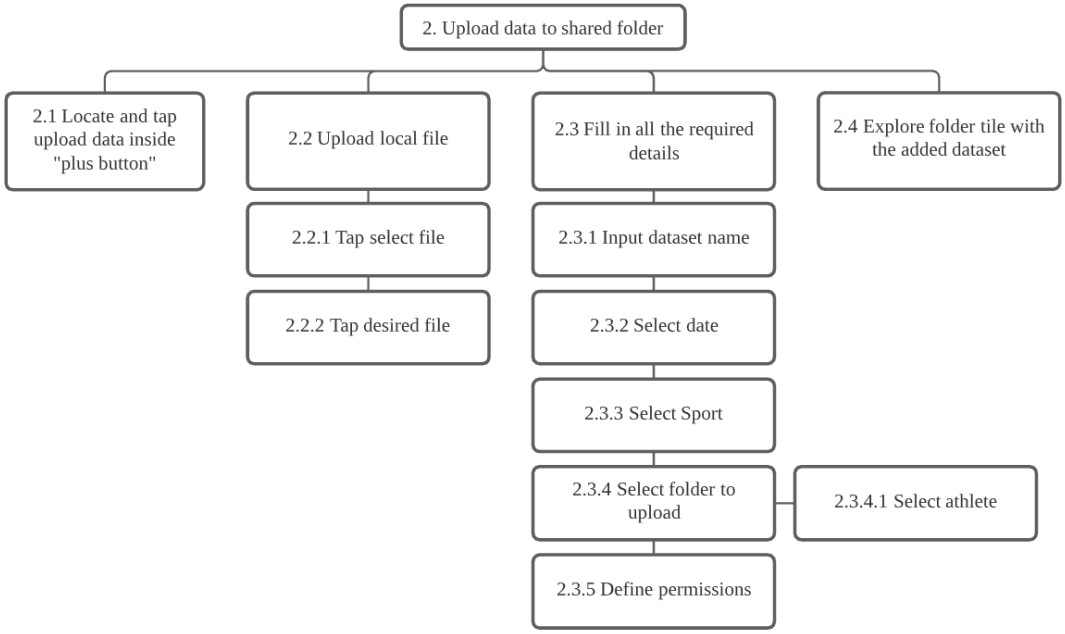
Figure 6.20: "Upload Data" menu layout



Hierarchical interaction breakdown

In this small section, all the interactions that have been implemented are shown in hierarchical order (order of actions is enumerated. If an action is not enumerated, it means that action can be performed at any moment)

Figure 6.21: Hierarchical task analysis of uploading dataset to a folder



3. Removing datasets from the public pool

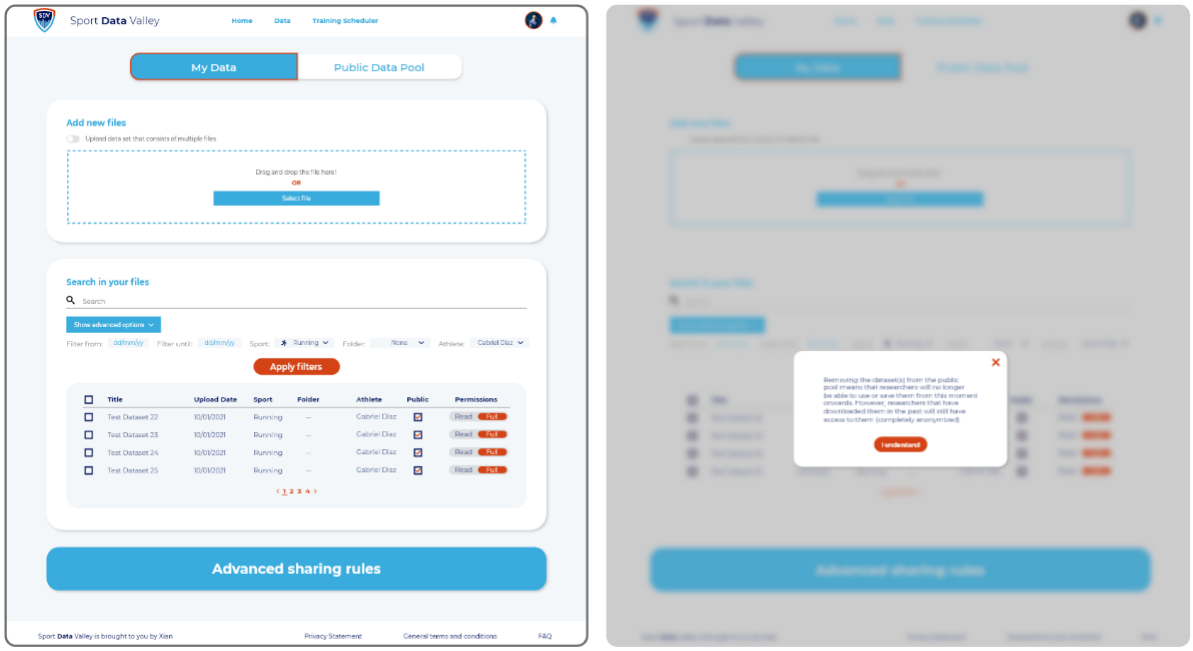
The third and last interaction to be designed involves working with data that is already uploaded into SDV (i.e.: datasets that were uploaded in the past) and removing them from the anonymised public data pool. The goal with this

interaction is to get users acquainted with the possible new data architecture of the platform. Ideally, this task along with the previous one (uploading dataset to shared folder) will unconsciously introduce the new concepts of anonymous public data to the users and will hopefully result in insightful outcomes during the testing sessions.

The whole removing process will not happen in the homepage, but instead, in the data page. The data page was actually the only one that was relatively easy and intuitive to use during the usability testing, so much so that it actually became the nodal point where users would go to in case of feeling lost (instead of going to the homepage). The layout of this page was kept pretty much the same, although some minor design changes were made to ensure consistency across all pages (mainly using tiles to create the different modules in the page). The only notable thing that was taken out is the division between "My data" and "My network" (depending on which one is selected, the user will see a list of the files uploaded by him or, on the contrary, the files shared with him by his network), these lists were merged together and can now simply be filtered based on, amongst others, who has uploaded the file, sport type, date, etc.

After finding the datasets that want to be removed from the public pool and unchecking the "public" box, the user will then receive a pop-up message stating the following: *"Removing the dataset(s) from the public pool means that researchers will no longer be able to use or save them from this moment onwards. However, researchers that have downloaded them in the past will still have access to them (completely anonymized)"*. Which will hopefully make sure users understand the functioning and purpose of the public datasets.

Figure 6.22: New "Data" page design



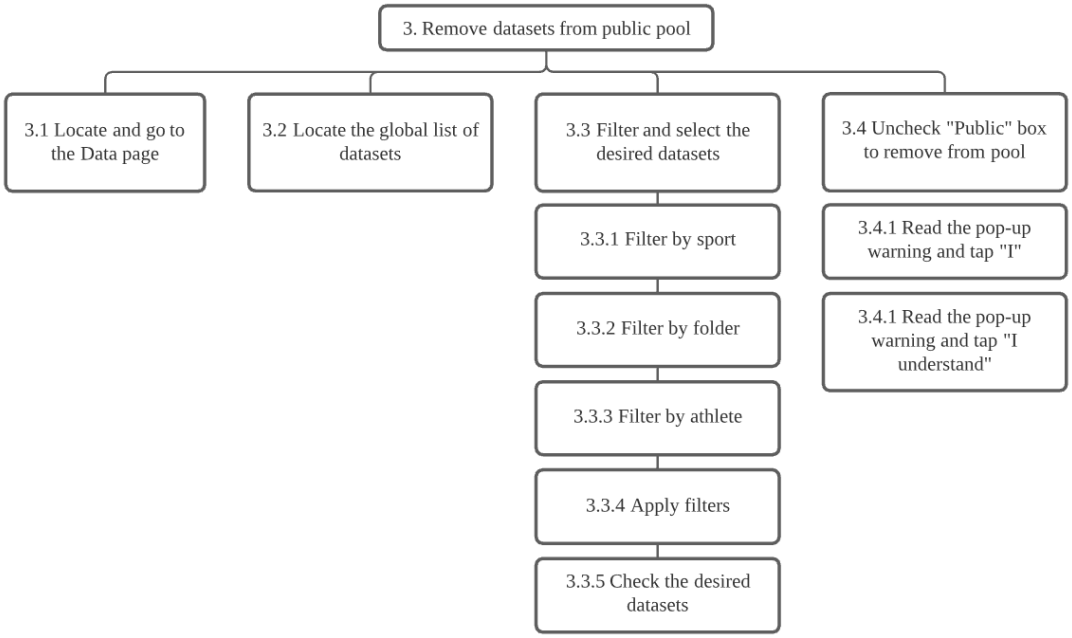
a) New data page with filtered data

b) Pop-up message before removing data from public pool

Hierarchical interaction breakdown

In this small section, all the interactions that have been implemented are shown in hierarchical order (order of actions is enumerated. If an action is not enumerated, it means that action can be performed at any moment)

Figure 6.23: Hierarchical task analysis of removing datasets from the public pool



Chapter 7

Evaluation

Now that the final prototype has been designed and developed, it is now turn to put it to the test. Throughout this chapter, a look will be taken at the final usability lab sessions, how were they conducted and the results obtained from them. Furthermore, the new conceptual framework developed for Sport Data Valley will also be evaluated by at least one of the members of the development team. Lastly, a requirements evaluation will also be done in order to assess how well the final product meets the design requirements created in chapter 5 of this paper.

7.1 Final round of usability labs

7.1.1 Goal

Unlike in the first round of usability labs, the focus of this testing session will be much narrower. During the first usability tests conducted in section 3.4, the goal was to try and find as many issues as possible inside of the platform. This evaluation session to be carried in this section, however, is completely the opposite and will focus solely in testing out the final mock-up of the new redesigned platform against two different criteria: adoption of the new elements (folder system, new interface, etc.) and the level of understanding that users have of the platform.

The ultimate goal of this evaluation round is to obtain sufficient results to respond to the evaluation research question of this project: *Has the redesigned user interface or the implementation of a novel feature made a positive impact on the UX and usability of the Sport Data Valley platform?*

7.1.2 Methodology

Unfortunately, the COVID-19 pandemic was still present at the time of the evaluation phase. Thus, all the testing was again carried out remotely. This did not affect the usability tests since the wireframe mock-up will be uploaded as a website and will thereafter be easily accessible by all users with a computer or laptop and a stable internet connection.

Similar to the first round of usability labs, the evaluation session has been divided into two different components. First, a usability test was carried out

on which the participants run through a series of predefined tasks. These tasks were chosen and designed in chapter 6 and are all related to the topics of working with the new folder system, sharing data, and withdrawing datasets from the public (refer to Appendix E to see the full script of the test and the tasks). As mentioned, not all the platform interactivity was implemented into the final prototype. Tasks like analysing data, sending questionnaires, or editing a dataset were not looked at in depth. They were evaluated though, by the means of a verbal walk through. After the main tasks have been completed, a series of questions were asked regarding the aforementioned topics. The users then had to make use of the interface and express out loud their thoughts as to were they expected to be able to perform the requested tasks (more on these tasks in the results section).

For the second part of the usability lab, the initial plan was to ask users to try and sketch out the conceptual map depicted in figure 6.5, in order to test their understanding on how the platform works. This method was tested beforehand with a single participant, and due to the negative feedback obtained (the question was hard to understand, sketching a framework requires a certain level of technical skill, and the task was extremely time consuming) it was decided to not pursue this approach. Instead, a much simpler route was taken that consisted in conducting a short interview/discussion session after the usability test, where the users were asked the following questions:

1. *Do you understand what public data is and why is it necessary in the platform?*

2. *How would you describe Sport Data Valley? And do you know what Sport Data Valley Stands for?*

Question 1 will be asked, if this one is not answered properly, then question 2 will follow. The goal of this being to try and discover whether or not users actually understand the purpose of the platform, or if they just see it as another sports analysis application.

7.1.3 Participants

A total of five participants were recruited for this evaluation session. One of the recruiting requirements was to have as many repeating participants as possible (by repeating it is meant that they were the same people that did the first usability test session). The reason behind this requirement was so the majority of testers would be able to compare and contrast their experience between the old and the new interfaces. From the five users recruited, Sport Data Valley managed to provide three repeating testers (this number was initially four, but one participant did not show up to the evaluation session). The remaining two participants were self-recruited amateur athletes, so they were still representative of at least one of the target user groups of the platform. Researchers were still kept out of this usability test, mainly because of the incapability of recruiting one with such short notice.

Demographics such as gender, race, nationality, etc. Were not used during the recruiting process since the platform does not aim to cater the needs of a specific demographic. Only age was kept in mind when recruiting users, solely

to simplify the process of obtaining consent (all participants were older than 18 years of age)

7.1.4 Usability test results

Overall, the results obtained in this second round of usability testing were far better compared to the first test. Participants were actually able to complete all tasks in record time and with very little external input needed (no need for moderators to intervene and help). The only minor issues that were encountered were caused by the natural limitations of wireframe mock-ups (e.g.: not all elements in the prototype are interactable with, which got some of the participants confused when they tried to click on something and got no output from the platform). For the sake of clarity and structure, the results of the usability tests have been divided into four different categories:

Creating a group/shared folder

Four out of the five testers faced no issues when creating a folder. The participant who had trouble with this task explained that the only troublesome part was that he could not easily find the place or button to create the new folder. After having to give it away to him, he then proceeded to complete the task with no further issues. This participant also happened to be the first subject of the evaluation session, so his feedback was used to quickly iterate on the issue. The rest of the participants had no trouble with the task, they were able to easily find where to create the folder and basically followed the hierarchical order shown in figure 6.19 to the letter.

Uploading and sharing data in one go

One of the purposes of this task was to assess the positioning and understanding of the plus button, which is why the only way to upload data in the prototype is via the use of this button. This limitation caused confusion amongst two participants, due to the fact that they attempted to upload a file from the data page. Technically speaking there was nothing wrong with how they tried to complete the task (uploading from the data page will indeed be possible in the final platform). However, it was then necessary to ask them to try and upload the dataset directly from the homepage. After this clarification, one of them proceeded to complete the task with no further issues, while the other one still struggled to find the button in the homepage.

The remaining participants were able to perform the task from beginning to end without any issues.

Withdrawing data from public pool

This task was successfully accomplished by all of the participants. All the subjects followed almost identically the hierarchical order shown in figure 6.23. Again, minor confusion amongst a few of the participants caused by the limitations of using a wireframe mock-up (e.g.: some users tried to unpublish datasets

one-by-one, which should of course be possible in the final version, but not currently available in the mock-up, where users had to first select all the desired datasets).

Verbal walkthrough

As explained in the methodology section, a series of questions were asked to the participants right after the completion of the previous tasks. These questions will be shown below, and the responses were used to see if the new interface is in the right path to improve the usability of the platforms in terms of analysing data, coach specific tools, etc. And not only uploading and sharing data.

- *If you want to create a new sports questionnaire, where would you do it from?*

  All users except one navigated back from the data page to the homepage and proceeded to use the plus button in order to access the shortcut of "New Questionnaire". The last participant voiced that he would likely click on the "Questionnaire" tab, inside of the team folder tile, where he would expect to be able to send and manage already existing questionnaires. Both approaches are valid.

- *How would you add a new team member to a shared folder?*

  Every user gave the same answer. Using the plus button with the desired team folder selected and tapping the "Add new member" button. This answer is valid and showed that users were quick to grasp the functionalities offered by the new plus button.

- *How would you analyse the dataset that you have just uploaded?*

  The answer to this question varied depending on the user. Two of them mentioned that they would either use the analyse button found under the most recent dataset in the team tile or go to the analysis tab inside of the tile, one of them said that she would simply go the analysis tab (but did not mention the analysis button under the recent data) and the last two said they would go to the data page and select the file to be analysed from the list. All of these being perfectly valid approaches.

7.1.5 Interview results

The results obtained from the interview sessions were far less positive than the usability tests. Out of all five participants, only one of them was able to reply to the question of *Do you understand what public data is and why is it necessary in the platform?*. The participant that got this question correctly also happened to be an intern at Sport Data Valley, meaning that he should already be very familiar with the platform and thus had a knowledge advantage over the rest of the subjects. The rest of the participants did not only fail to answer that first question, but also the second question about what Sport Data Valley as a platform strived for.

All participants were able to explain the role of athletes and coaches, and they all saw the analytical potential that the platform brings. However, none

of them were able to identify the third pillar of the platform: the researchers. When this was brought up to them, they explained that they thought researchers referred to in-team sports scientists (i.e.: they thought researchers were part of the trusted data requestors and were completely unaware of the existence of external data requestors in the platform).

7.2 Feedback on the new conceptual framework

Though the redesigned interface uses the new conceptual framework as the bed layer and builds on top of it, it was considered that assessing it individually (just the framework without the interface) and getting feedback from Sport Data Valley themselves would also be beneficial and bring out insights that might have otherwise been missed. The conceptual map was pitched to the team during one of the biweekly demo sessions and the response from the members was positive. The project owner was taking part on demo session, and he was pleasantly surprised with the fact that an actual framework was designed. He also mentioned that the team was currently working on coming up with a new architecture themselves, because they had become self-aware of the fact that they indeed were leaving researchers too much aside during the development of the platform.

As far as feedback goes, they brought up a few critical questions to bear in mind during the discussion chapter. First of all, they commented on the technical challenge that it would be to create an algorithm that is able to anonymise files of many different formats. Beyond that, they were also worried about the feasibility of the anonymous data pool since a lot of the datasets contain GPS data, and they are not aware of the anonymisation regulations regarding such data. Apart from that, they really appreciated the fact that researchers now have a clear and simple way to work with the platform inside of this framework, and they expressed that this could be a solid head start if was shared with the team taking care of the new architecture of the platform.

7.3 Requirements Evaluation

This section will look into the design requirements that were set during chapter 5 and will evaluate whether or not these requirements have been met. The requirements that are deemed to be successfully met are highlighted in green, requirements that were partly met are highlighted in orange and requirements that were not met at all are highlighted in red. If any of the requirements have not been fully met, these will be discussed in the next chapter.

Table 7.1: Requirements Evaluation table

Requirement	**Must**	**Should**	**Could**	**Won't**
Use the same margins as current platform (10% margin on each side until 1332px wide)	X			
Use the same design language as the current version	X			
Avoid getting rid of any feature currently available in the platform		X		
Translatable (current platform offers Dutch and English language)	X			
Use the same interface for all target user groups	X			
Improve the intuitiveness of the platform		X		
Allow users to understand how their data is being treated	X			
Take into account and accommodate parallel developments that the team might be doing		X		
At least mimic the interaction with the most important new elements	X			
Make it easier for researchers to access and utilize public data	X			
Make it easier for users to upload and categorize/share data	X			
Simplify the information architecture of the platform	X			
Testable before implementing it into the final platform	X			
Transferable and editable at the end of this project		X		
Technically feasible to implement in case SDV decides to		X		
Treat other areas of less importance (minor UX/UI fixes)			X	
Responsive (design can be adapted to mobile devices, tables, or computer screens)				X

Chapter 8

Discussion

Throughout this discussion chapter, the findings from the evaluation session will be interpreted and discussed in order to provide a final answer to the evaluation research question. Moreover, the limitations of this project will also be listed, as well as some recommendations and future work that Sport Data Valley can do in order to keep on improving the platform.

8.1 Findings

8.1.1 Usability of the new interface and tools

The performance and results obtained from the usability test results show that the new interface and tools have been positively welcomed by all the participants of this study. Although test completion time was never a factor to be taken into account, it was impossible not to notice the massive time difference between the first round of usability tests and the last round. The first test took around 50-60 minutes to complete (4-5 minutes per task), while on the last session participants were done with all of the tasks in in just 15-20 minutes (2-3 minutes per task).

The concept of folders and using shared folders to replace the group function seemed to be easily grasped by everyone. There were no comments or questions about the folder sharing system at the end of the tests either, which further proves this initial statement. Apart from the carousel explaining what folders are, it is believed that users had no trouble understanding the new feature because they are likely already familiar with platforms such as Google Drive or Dropbox, which use a similar sharing system. Results also supported the current choice and distribution of elements that can be found inside of the folder tile. Not all elements were interactable/functional (analyse button, analyse tab, questionnaire tab, etc.), but thanks to the verbal walkthrough it was easy to see observe that in most cases, users would have made use of the tools offered inside of this tile.

The only issue found inside of the tile, was the positioning and/or look of the plus button, and this only occurred with one of the participants. An interesting observation was made: the participant that struggled with finding the plus button during the uploading data task was the oldest of all testers. The button was placed in that location following the F-scan pattern theory discussed in the realisation chapter, as well as looking into the future implementation in mobile

devices. Nowadays, there are many smartphone applications that make use of similar collapsible menu buttons and similar placement in the bottom right side of the screen for easier reach. Perhaps this is why the younger participants had no trouble identifying this button, since they are likely already familiar or have seen it in some smartphone apps, while the older audience could have a tougher time identifying this button.

8.1.2 New conceptual framework

The conceptual framework is the first building stone of the new redesign. Thereafter, the positive results discussed in the previous subsection already hint that the new conceptual framework has indeed somewhat improved the situation of the platform, filling in a lot of the gaps that the current platform has. For example, the new architecture gets rid of the need for a consent form to use public data. This goes against one of the design requirements of not getting rid of any existing features of the platform (hence its orange colour in the requirements evaluation). However, the consent form feature as it currently stands is broken and easily bypassed, meaning that keeping it in the platform could actually cause more harm than good (e.g.: researchers can download any public dataset directly from a user's profile completely unnoticed and without the need of sending out a consent form, putting the privacy of SDV users at stake). In addition to this, there were also some concerns raised by the Sport Data Valley team themselves surrounding the feasibility of having a public anonymised data pool.

Anonymising data is no easy task, and it has to be done properly to successfully comply with the GDPR. Creating an algorithm that will be able to anonymise files of many different formats (e.g.: Strava, CSV, JSON, etc.) will be highly challenging. Still with this in mind, it is believed that it is the best approach that the platform can take towards making their platform privacy and researcher friendly. An alternative would be to develop a dynamic e-consent form, but more on this will follow in the future work section. Lastly, the company was also doubtful about the possibility of retaining location information after anonymising a dataset (a lot of the datasets include GPS coordinates to calculate ran distance, show the specific route, etc.), because losing such data would make some of the files unusable. Nonetheless, according to documentation from the GDPR [26], anonymising data while still keeping location information is perfectly possible and is actually already in use in plenty of other platforms. The "only" thing that needs to be ensured is that the data is indeed non-traceable to the original source (further discussion in the recommendations section).

8.1.3 User Unawareness

Probably the most important finding from all of the evaluation sessions was the discovery of the unawareness that users have of what Sport Data Valley as a tool is. Participants were completely unaware of the role of external researchers, which could very well explain why the company is having issues with their users not comprehending the platform. How are clients supposed to make appropriate use of Sport Data Valley and all the tools it offers, if they are not even aware of

the full potential that this one brings to them? This is a clear example of how achieving a good user experience is not solely a matter of having a beautiful graphical interface or an intuitive site navigation. But also making sure that people know and understand your product and its true purpose before they even begin to use it.

8.2 Limitations

In this section, all the limitations faced in this project will be listed and explained. These limitations shall be taken into account if anyone wishes to recreate or carry on with this project in the future.

8.2.1 Incomplete interface

Because of time constraints, it would have been impossible to make a redesign of the entirety of the platform. The final prototype developed in this graduation project has shown great improvements in the area of usability, more specifically towards the topic of data sharing. Analysis and the new look and feel of the analysis page are yet to be implemented into the mock-up, meaning that the main function of the platform has not been designed and tested with the new UI. The new interface has been designed with that in mind, so it should not require another complete redesign to accommodate the missing items.

8.2.2 Mock-up

Directly correlated with the previous limitation, using wire-framing to produce a high-fidelity prototype also has its shortcomings. Adobe XD allows to create high-fidelity visual and interactive prototypes of websites, apps, etc. However, these wire-frames are essentially "hardcoded", meaning that if a participant accidentally miss clicks and jumps from one frame to another, he/she will need to restart the whole task from the beginning. Very basic actions found in websites can become huge design challenges in a wireframe mock-up. A clear example of this is the fact that testers were not able to input their own text fields. Whenever there was a text input box, the user simply had to tap on it and it would automatically get filled in. The best way to surpass these limitations is to either create an even more complex wire-frame or to create a separate functional prototype in the form of an actual website (only functional and aesthetically not polished, otherwise it would require too much time and resources). Due to time limitations these could not be developed.

8.2.3 User Testing

Mentioned in section 3.4 "SDV through the users' lens", theory explains that five representative testers will be enough to expose over 80% of the problems that are in your product. In the case of SDV, this number is probably not correct. As it has been repeatedly stated throughout this entire paper, Sport Data Valley happens to be a platform that aims to equally target three user groups: athletes, coaches, and researchers. These three groups will make use of

the platform in completely different ways and for completely different purposes. Therefore, testing should have been carried out with at least a member of each target group. This was not the case in any of the testing sessions, for participants were only coaches or athletes.

The results from user testing also happen to all be qualitative, meaning that they have an ample degree of interpretation, this can cause biases in the end results. Using a tool such as the system usability scale (SUS), in addition to the already used methods would have likely strengthen the reliability of the results.

8.3 Answering evaluation research question

Now that all the results have been discussed, it now not time to determine whether or not the initial evaluation research question can be successfully answered. The question read as follows:

"Has the redesigned user interface or the implementation of a novel feature made a positive impact on the UX and usability of the Sport Data Valley platform?"

The short answer to this question is "Yes". The combination of the new interface, framework, and novel features (folder system and anonymous data pool) have proven to improve the overall usability and user experience of the platform, though it is still far from being perfect. Such a straightforward answer can be drawn, amongst other reasons, thanks to the fact that most of the test subjects used in the second evaluation round were repeating subjects, so they could compare the old and new interfaces from first-hand.

Improvements can always be made, as seen in the limitations section. But this prototype has been able to show, backed by results, that it takes a step into the right direction towards creating a platform that is easy, intuitive, and pleasant to use by everyone.

8.4 Future work and recommendations

8.4.1 Invest into spreading SDV's message

Investing resources into making sure all users are aware of what Sport Data Valley really stands for. People need to be fully aware of what makes Sport Data Valley unique, and why it is different to any other competing platform. Ways to do this might involve launching a better marketing campaign or giving a platform tour every time a user signs up to SDV.

8.4.2 Bringing researchers on board

Researchers need to be involved in the testing and development of the platform, and this should take place immediately. Just like athletes and coaches are constantly being tested on and asked for feedback, researchers must also be highly involved in order to make sure the platform is easy to use by all target user groups.

8.4.3 Anonymisation of data

Developing a program that will anonymise datasets before passing them onto the public data pool is perhaps the most crucial step to take in the future. Briefly mentioned earlier in this chapter, the GDPR allows for ways to successfully anonymise datasets while still retaining location and GPS information. Nonetheless, anonymity is not the only thing that should be looked after, sensitivity is also an issue that needs to be resolved. For example, a running workout that exposes information related to gender, age and specific route taken might be anonymous and non-traceable, but it is still exposing sensitive data that can be exploited for malicious intent.

A recommendation would be to dedicate an entire team to truly look into this issue and find the best solution possible. Some suggestions include, but are not limited to, ensuring users know what giving consent means (even if that means the potential exposure of sensitive data), implementing an end-user license agreement that all researchers must sign in which they commit to not share any of the data used publicly, only the results from their studies can be shared, etc.

8.4.4 Expanding prototype & wire-frame testing

This project should have shown the importance of rapid prototyping, testing, and iterating during the product development cycle. Mentioned in the limitations section, the final mock-up of this project is far from being complete. This prototype will be handed over to Sport Data Valley at the end of this project so the team can continue to test it further. In addition to this, it is also recommended that SDV dedicates more time into rapid prototyping by expanding on the current mock-up. One of the benefits that wire-framing brings to the table is the low amount of resources that it requires. There is no need to spend precious time in coding and programming a feature without being sure that it will be accepted by the users of the platform. Thus, it is best to expand, test and iterate on the current prototype.

Chapter 9

Conclusion

The initial goal at the start of this graduation project was to fix the user experience that Sport Data Valley delivers. According to the company, they suspected that the issues were closely linked with the user interface of the platform (i.e.: by fixing the interface, users will be able to better use the site). In order to break this problem down into tangible sections, a series of research questions (refer to section 1.3) were systematically formulated and answered throughout the span of these ten weeks in the different sections of this paper. Nonetheless, there is one question yet to be answered, the global research question of the project, which will be addressed in this chapter.

How can the user experience and overall usability of the Sport Data Valley platform be improved by changing the front end of the application such that users are able to better access and comprehend the functionalities that this one offers?

The experience a user receives when using a product (in this case Sport Data Valley) is affected by a number of different elements. The literature reviewed and researched in chapter 2 of this thesis and the usability tests carried in chapter 3 proved this; where it was made clear that things such as choosing appropriate data visualisations or following basic web design rules can be helpful towards delivering a pleasant and successful UX. It can then be deducted that the initial research question was actually flawed, because it takes usability of the platform as the only affecting factor of UX. Exactly because of this, it was then decided to dig deeper into the problem to find out whether or not designing a better UI was the best solution for this project.

Layer after layer, one got to the point where it was clear that indeed, a better UI was not going to be sufficient to improve the experience of the platform in the long-term. This is why the final solution and product developed involved three new elements: A new underlying conceptual framework that covers the gaps of the current framework, a new sharing system (shared folders) to try and improve the understandability of the data-sharing paradigm *and* a new user interface. These were then tested and evaluated.

The evaluation of the new platform with representative users (coaches and athletes), showed a visible improvement in usability and understanding of data sharing. Furthermore, the company also recognised the potential value that the new conceptual framework has, especially towards balancing and looking after

the needs that researchers have. However, the evaluation also brought up a completely new issue that could very well be the main obstacle stopping users from fully understanding the platform and consequently, using the platform effectively: users lack understanding of what the goal and purpose of Sport Data Valley is (discussed in depth in the previous chapter).

To conclude it can be said that this project has shown that improving a user experience is not a matter of simply making a better interface, but often, there are bigger underlying problems that need to be tackled in order to achieve a long-term solution. Understanding your own platform, working with users, and paying equal attention to all target user groups in the realisation stages are some of the biggest takeaways of this project. The biggest takeaway though, is the discovery of how important it is for your users to understand the purpose and goal of your product and brand. Discovered at a late stage of the project, it is possible that addressing this issue alone would be enough to massively improve the understandability and consequently the usability of the platform. If SDV goes forward with this project and pays attention to the given recommendations, the positive results can be dramatically increased, especially with the discovery of the issue regarding the lack of understanding of the platform.

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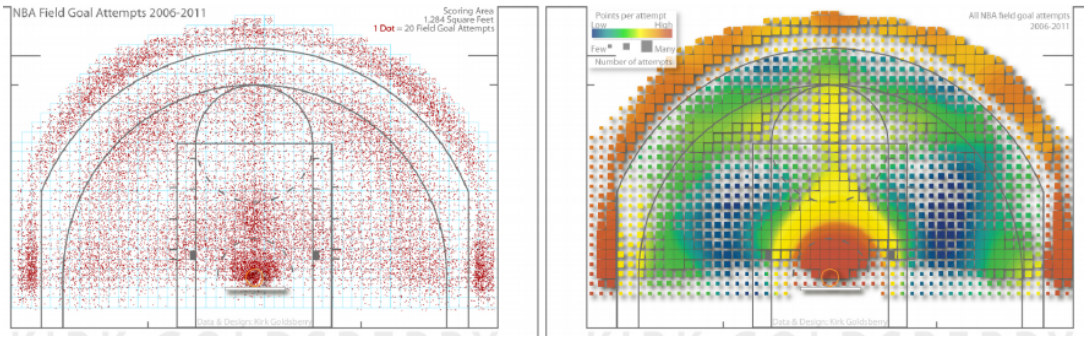
Appendix A

Event density maps

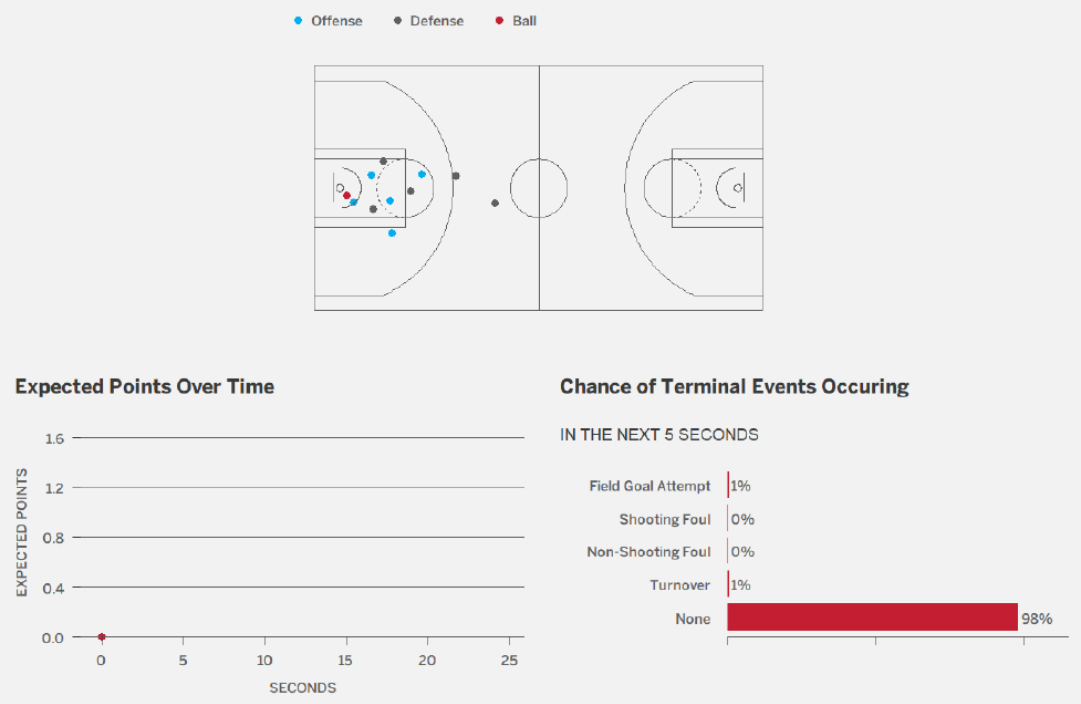
Below, a figure used in the paper "*State of the Art of Sports Data Visualization*" by Perin et al. [5]. Where a pair of density maps derived from tracking data can be observed. On the left, a dot spray map can be observed while on the right a density heat map can be seen.



Appendix B

Visualisation of expected points prediction model

Below, a small dashboard can be seen where the results of an action/point prediction model are visualised.



Appendix C

Script / Progress sheet of first UX Lab

Progress Sheet (Coach) - Usability Labs

Task list that the user should follow during the lab.

Instructions

For the purpose of this Usability Lab, we will pretend the following:

- You are a running coach.
- You coach a team with 2 athletes (Linneke and José).
- You have 2 files. Both of them are running workouts done by your athletes, which you recorded using sensors. One of the workouts was done by Linneke and the other by José.

The participant should try to complete the following tasks in the order they are given (from top to bottom) without the least intervention possible from the monitor:

Tasks	***Remarks***
Create your account	
1. Go to sportdatavalley.nl and create an account	
2. Open the sportdatavalley platform and fill in your personal information, so that other users know it's you.	
3. Add two of your athletes to your list of Connections. The names of the athletes are: - Linneke Telleman - José Carlos Coutinho	After finishing this step, you should wait for the monitor to take action.
Make a group for your team	
4. Create a group for your team (You can choose the name and the description)	
5. Add your athletes (Linneke and José) to the group.	After finishing this step, you should wait for the monitor to take action.
Share data with the team	
6. Upload the 2 running workout files to SDV	

7. Share the running workouts with the group	
Ask the team to fill in questionnaires	
8. Upgrade your account to Premium Coach	
9. Start a protocol that will send a daily (dagelijkse) questionnaire to the athletes of the team	After finishing this step, you should wait for the monitor to take action.
Analyse data	
10. Add 2 athletes as Premium connections (Linneke and Jose)	(this should be given for free)
11. Open a dashboard that allows you to analyse the Daily questionnaire data you collected from your athletes.	
12. Open a dashboard that allows you to analyse one of the running workouts	
13. Compare the two running workouts	
14. Analyse your running workouts of the past weeks	
Cleanup - **Delete the group** - **Delete the connections** - **Delete the example data**	

Appendix D

Introduction form and consent form

My name is Xian Bodelon Ruibal and I am currently doing my thesis internship at Sport Data Valley. My main role within the SDV team will be to improve the experience the users have while using the platform/tool.

In order to do this properly and ensure I put you (the user) at the core of the design process, I am seeking understanding on your experiences with the platform. To this end I take part in the SDV usability labs. If you agree to this, I will be present during your session at the usability lab, and I might sometimes ask you a question to elaborate on what you are doing or what you think about the experience. Participation in my research is completely voluntary, and you are free to end your participation at any moment that you wish.

If you have any further questions, please feel free to ask me, or contact my supervisor Dennis Reidsma at d.reidsma@utwente.nl

Consent form for study on User Experience

Thank you for participating in this usability lab.

During this session I will be observing and taking notes regarding the effectiveness of the new user interface designed for the Sport Data Valley platform.

Please be aware that you are allowed to leave this usability lab at any moment if that is what you wish. Accordingly, all the data collected will be discarded.

All the data collected during the session will be completely anonymous (i.e.: non personal) and it will not be retraceable to you.

The data will be shared solely with the SDV team and will be used for academic purposes and to help further improve and evaluate the user experience of the platform.

Contact details:

Researcher: x.bodelonruibal@student.utwente.nl

I have read and understood the information above and thereafter consent the presence of **Xian Bodelon Ruibal** during my usability testing. (circle the applicable statement):

Yes / No

Signatures:

Name of participant	Signature	Date
Name of researcher	Signature	Date

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-bms@utwente.nl

Appendix E

Script / Progress sheet of last UX Lab

Usability Test Progress Sheet

This is the task list that you will follow during the usability test

https://xd.adobe.com/view/a8333c2b-46a4-459d-b1e9-260ce84f4f7b-fd60/?fullscreen&hints=off

Instructions

During this usability test, the subject (you) will assume the following role:

- Coach for the running team "Kronos"
- Your team members are Jessica Li, Gabriel Diaz and Willem Dijk

Tasks to complete

Tasks	*Remarks*
Creating group and sharing	
1. Spend some time taking a look at the new home screen	
2. Create your first folder and input the following parameters: a. Avatar b. Name group (just by tapping) c. Select "Running" as category d. Invite all the group members shown	
3. Again, take some time to visualize the new elements in the homepage before proceeding to the next step	
4. Upload the dataset of Jessica Lee to the platform and make sure that: a. Dataset name is filled in b. Type of sport is selected (Running) c. Dataset is shared with the appropriate group d. The data is shared publicly	
Dealing with already uploaded data You have just learnt how to upload and share data in one go. Now we will see how it is to work with data that is already uploaded in the platform	
4. Find the place in the site where you can see all the datasets that you have uploaded to the platform.	
5. Explore and familiarize yourself with this new Data page	
6. You realize you want to remove a group of datasets from being publicly accessible. Find these datasets and remove them from the public pool. Use the following filters: a. Sport: Running b. Folder: None c. Athlete: Gabriel Diaz	