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**SCOUTING AS AN IT APPLICATION IN VOLLEYBALL**

**Case of Mestaruusliiga and Kokkolan Tiikerit**

**Thesis**

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**ABSTRACT**

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<p>In modern times, many different aspects are required for a team to be in the top level of its sport. These aspects differentiate the amateurs from professionals. One of those aspects is scouting.</p> <p>The aim of this thesis is to showcase how scouting and IT in general elevates the sport of volleyball and how the use of it is crucial if a team wants to be at the top. The advantages of scouting will be discussed, as well as why it is compulsory to use it in the top league.</p> <p>Theory lists and explains every instance of IT use during a professional volleyball game and goes into detail about the DataVolley program. Video, scouting codes, user interface, and statistics use are explained more closely. Use of cloud between all the teams in Mestaruusliiga is listed.</p> <p>Last chapter discusses, in more depth, the effects of modern technology in the realm of volleyball.</p>		

<p><b>Key words</b> Data analysis, Data Volley, IT, professional sports, scouting, statistics, volleyball.</p>
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**ABSTRACT  
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## 1 INTRODUCTION

This thesis aims to showcase an application of IT unknown to many – sports. Some of the most common and well-known jobs in IT are software engineer, web developer or generally IT specialist. However, IT is a very versatile field. Practically everywhere where there are computers, there will be IT jobs and someone that must do them. This thesis will explore the job of a volleyball statistician, or a scout, and the use of IT in that specific field. The principle and programs used in volleyball are often only known to professionals working in the field, and not much is being written about it. As a professional volleyball scout for Kokkolan Tiikerit and the Finnish National Junior Team, the author aims to shed some light on the topic of use of IT, data and statistics in volleyball.

Professional volleyball is in many ways a game of strategy. Knowing a team's opponents can be just as important as the team's physical skills. At the top level of the sport, the physical readiness and professionalism of the players and teams overall are quite equal, so teams are always looking for ways to gain an advantage against their opponents. Analysing a team's performance over time helps predict their play and create a proper strategy against them. Said analysis is made possible by scouting.

This thesis will focus on scouting. Scouting is a term used to describe thorough analysis of every part of a volleyball game. Everything that happens from the moment the game starts until the last point is over must be carefully written down. It is more than just noting what happens during points though, as important things, like timeouts and substitutions, happen between points, and they must be noted as well. However, scouting is not only what happens during a game. A substantial part of it is the work scouts do with coaches and their team before and after the game as well. Before every game, a thorough analysis of the opponent team is performed. The statistics from the team's several past games are analysed to excruciating detail, so that a proper strategy against them can be formed. Chapter 2 will introduce the reader to some of the background needed to properly understand this thesis.

The program used for scouting is called Data Volley. The chapter 3 of this thesis will focus on, and thoroughly analyse the professional version of Data Volley 4. Many of the program's ca-

pabilities will be discussed, some more thoroughly than others. The user interface will be depicted, analysed and compared to the best practices of graphical user interface design. The scouting codes used for scouting will be explained with as much depth as reasonable. The chapter will also go over other notable parts of the Data Volley program, as remapping the scouting keyboard, using the web client and the function of video. Chapter 4 will solely focus on the data analysis and the reports used in Kokkolan Tiikerit. Chapters 5 and 6 will describe what happens before and after a volleyball match, while chapter 7 will try to capture the main point and the aim of the thesis and explore the differences in the volleyball world since modern technology became wide-spread.

Apart from describing an unfamiliar use of IT and the profession in the field, the main question this thesis aims to answer is how scouting and the advancement and wider use of technology in general has elevated professional volleyball. The impact the wide use of, for example, laptops made was monumental to people's daily lives, as well as to various professions. Through many interviews conducted with several volleyball professionals holding different positions, the author aims to gather their knowledge and explore how substantial of a difference the use of IT in people's daily lives has affected the world of volleyball.

## **2 BACKGROUND**

Since this thesis relies on the readers' understanding of several basic concepts, they first should be explained so as the readers possess all information necessary to understand the core of the thesis. This chapter will introduce to the readers essential concepts for the thorough and complete understanding of this thesis.

### **2.1 Volleyball**

Volleyball as a sport was invented in a small city named Holyoke in Massachusetts in 1895, just a few years after basketball. The inventor of the sport was a Young Men's Christian Association's physical education director William G. Morgan. The main idea was to create a less physically intense version of basketball. It grew quickly across the world, and finally made its Olympic debut in 1964. (Olympics, 2018.) Nowadays, volleyball's international federation FIVB is the largest international sports federation in the world judging by the number of federations, with 220 affiliated national federations belonging to it. (FIVB, 2011.)

According to the newest official rules of FIVB, last updated in 2016, volleyball is a game played by two teams of six players each, separated by a net. Although the complete rules are too extensive for the scope of this thesis, the basics will still be explained. The concept of the game is that the teams play up to five sets of 25 points, the fifth a tie-break in a situation of 2-2, being played only to 15 points. A rally consists of a serve, reception, and then consecutive attacks, blocks and digs, until the ball falls to the floor. The teams are allowed three touches per turn, with block touches not counting. There are five different positions players hold: opposite, outside hitter, middle-blocker, setter and libero. (FIVB, 2016.)

### **2.2 Data Analysis in Sports**

To start with, data analysis is, by definition, taking raw data then cleansing, modelling and converting it into meaningful information that will be used in making certain decisions. Sources of data and methods used to collect it often differ, but they are always followed by trying to make sense of what has been collected through careful analysis. Main points considered while

performing data analysis are summary, finding and understanding the relationships between characteristics and subsequently grouping, identifying most important trends and patterns, and finally building regression and classification models. (Myatt & Johnson 2014, 2-10.)

This thesis focuses on one of many applications of data analysis – sports. When discussing sport analytics, it is hard not to mention “Moneyball”, the book, and subsequently a movie about the baseball team Oakland Athletics. The book describes how a general manager helped lead his team to the play-offs by using statistics to find underrated (and cheaper) players. However, sports analysis has come a long way since then, and volleyball is a different story. (Lewis 2003.)

Each sport is unique and hence each sport has different methods on performing analysis. One fact true to every sport, though, is that more data will lead to better and more precise results. Analytics provide insight into the game development in real-time. Since sports are so different, most often the important game parameters will be vastly different too, so most sports use different programs and analysis methods. (Sundar 2018.)

### 3 DATA VOLLEY

Data Volley is the program most commonly used for scouting, and it is used specifically for volleyball. Among sport professionals, it is believed that it is one of the best developed scouting programs for any sport. It is the default program in Mestaruusliiga, and every team is required to have the professional version. As of season 18/19, the old version of the program, Data Volley 2007 became obsolete, and all the teams must now have the same new version, Data Volley 4. This facilitates work between teams and sharing statistics and documents.

According to their website, Data Volley and accompanying programs, like e-Scoresheet, are currently used by over 80% of the leading volleyball leagues and federations worldwide. Notable examples are the Italian league Serie A, Polish Plus Liga and the European Volleyball Confederation, or CEV. (Data Project 2017.)

#### 3.1 User Interface

User interface is a branch of a study named human-computer interaction. It is a study devoted to designing the computers to fit the needs of people using them as comfortably, naturally and effectively as possible. Research shows that people are more productive and make fewer errors when working on a program with good interface design, and companies save substantial amount of money on operational costs. Considering scouts need to have near stellar speed and low error rate, the program they use, understandably, needs a good user interface. This section will compare the user interface of Data Volley to the 14 steps of interface design. (Galiz 2007.)

Step 1 is knowing one's client. This step is all about knowing and understanding the person using the program, the system user. To create a successful user interface, and therefore a successful program, the designer must understand the needs of the system user thoroughly. Data Volley is, in its basis, a simple program. There is one main screen from which every important element is accessed. The scouts can modify many components based on their own preference, which is important. The people that use the program need it to be simple and clear, which enables them to be fast and efficient. (Galitz 2007, pp. 71-102.)



Step 2 is understand the business function. This step is straightforward. It is about determining how and for what the program will be used. Data Volley has a very specific, narrow use, as its only purpose is scouting volleyball matches. (Galitz 2007, pp. 103-126.)

Step 3 is about understanding the principles of good interface and screen design. This is a wide subject and this thesis will not focus on it, but simply observe the main point. A well-designed program needs to fulfil many functions, like reflecting the needs and capabilities of its users, considering the hardware for which it is developed, effectively use the software's capabilities and achieving the intended system's business objectives. To achieve these functions, a designer must understand the principles of good design and follow a wide-ranging set of guidelines, including, but not limited to, organising screen elements, screen flow and navigation and visually pleasing composition. Comparing Data Volley to these guidelines reflects the success of the program. Even though the screen design is clear and concise, it is still made to be highly customizable to fit the needs of different people. The aesthetics of the program are pleasing to the eye and it is not tiring to work on it for hours on end, something scouts must go through during their day at the office. (Galitz 2007, pp. 127-306.)

Step 4 is about developing system menus and navigation schemes. No matter what the program is used for, it must have a way to tell the human using it what it has accomplished and the information it has processed. The designer must provide means for the program to communicate this to its human, and that is most commonly accomplished by menus. Data Volley menus will be discussed at several points during this thesis, as well as what they offer. The first instance of it is the main bar, labelled 1 later in this chapter. (Galitz 2007, pp. 307-383.)

Step 5 discusses selecting the proper kind of windows. There are numerous different kinds of windows, all with their own characteristics. A designer needs to know what kind of windows to use in different situations. The difference of the Data Volley main screen windows are analysed later in this chapter. They have different purposes and, with that, different appearance. Customization is possible as needed. (Galitz 2007, pp. 385-422.)

Step 6 is about selecting the proper interaction devices. The human needs to communicate with the program they are using, and the program needs to be able to respond. Hence, there are two types of interaction devices – input and output mechanisms. Both are equally important.

The most important input mechanism in Data Volley is the scout bar, used to input data live during a point. The codes list window is also used as an input mechanism. The data is input via a usually remapped keyboard, discussed in chapter 3.3. The output of the program is essentially the data and statistics. They are printed and distributed to the press and the coaches. (Galitz 2007, pp. 423-441.)

Step 7 discusses choosing the proper screen-based controls. Another name for screen-based controls is widgets, and they make up the body of a screen. They are constituted of buttons, text boxes, various types of selection controls and alike. A good control looks the way it works and works the way it looks. Data Volley has many of them. They look simple and are straight forward. Some are featured in Figure 1 and discussed later in this chapter. (Galitz 2007, pp. 443-561.)

Step 8 dictates one should write clear text and messages. This step is about making the text featured in the program clear and understandable. While Data Volley does not feature much text, in some cases it is crucial. One example of that is the error messages that show up during code verification, in case of a problem in code. Some of them can be difficult to comprehend at first, because the scout needs to recognise what error it is pointing to, but that is something that gets easier with practise. Another case is the labels. They are always clear and translate their meaning well. Step 9 (provide effective feedback and guidance and assistance) and step 10 (provide effective internationalisation and accessibility) will be skipped, as it is not feasible to apply them to Data Volley program. (Galitz 2007.)

Step 11 is about creating meaningful graphics, icons and images. This is quite an important step concerning Data Volley. Since the world of scouting is so fast-paced, the program most often relies on icons to translate meaning instead of text. The icons are styled well and tastefully. They are simple and very easy to understand. Step 12 dictates the Choose proper use of colours. The colours of Data Volley 4 uses a palette of crimson, black and gray which is aesthetically pleasing and easy on the eyes. (Galitz 2007.)

Step 13 is about organising layout windows and pages. Like it was mentioned many times before, the scouts have the freedom to customize their own main screen. The scouting window can be merged with the scout bar, for example. The window sizes, appearance and position on the screen can be easily changed based on preference. (Galitz 2007.)

Finally, last step, step 14 says one should test, test, and retest. A program is never completely finished. After being released, it must be constantly updated. Data Volley releases updates every few months. As with many programs, updates are not as straightforward as they sound. Many times, while trying to improve one aspect of the program, another worsens. One game last season for example, the program was showing the result of a game that had not yet begun. In that case, Data Project's Italian office is contacted by the designated person in Mestaruusliiga to search for the solution. (Galitz 2007.)

Now that the 14 steps have been discussed in reference to the Data Volley program, it is time to take a look at the program itself. Figure 1 shows the main screen during one of the home games of season 18/19. Main parts are labelled and explained separately.

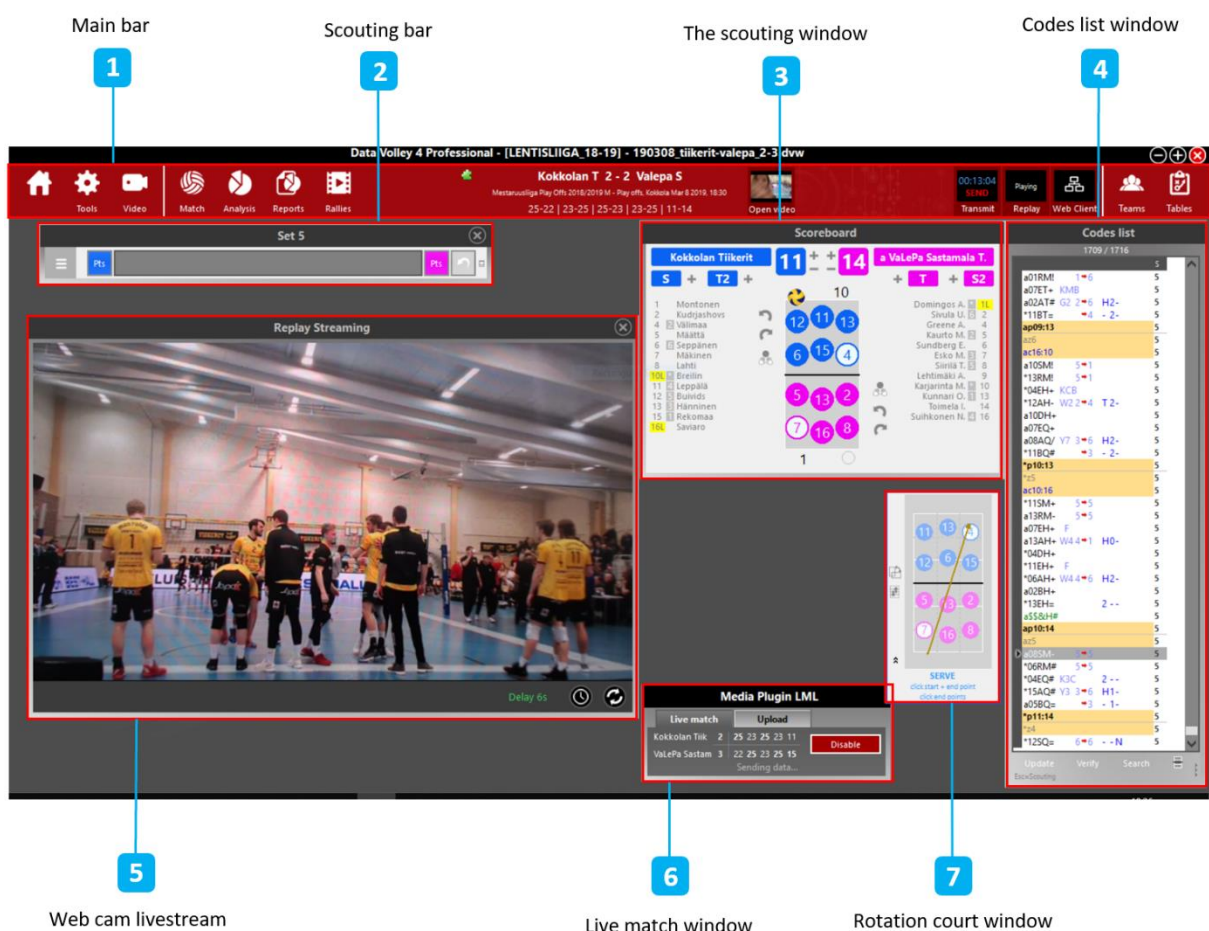


Figure 1. Data Volley 4 Graphic User Interface (GUI)

Main bar (labelled 1) is the bar at the top of the window. It includes the toolbar, which will be discussed separately in chapters containing information related to it. Scouting bar (labelled 2) is the window used for inserting evaluation codes during a game. It contains two buttons on either side of the bar used to assign points to the teams. This can also be (and most often is) performed by using the keys on the keyboard previously assigned (see chapter 2.3 Keyboard remapping) with End of Rally right and End of Rally left. It also contains button to undo last entry and a button with a drop-down menu with shortcuts, where the scout can choose to open match notes, players list, and starting line-up windows, print the match report, copy or save the scout file and change or rotate the court.

Scouting window (labelled 3) mirrors the main information concerning the match. Before every set, this is the place to enter the team's line-ups, which then appear in the window as a court animation. It showcases the correct rotation and players on the court at any given time of the match. It also notes the designated libero, setter and serving team. It contains buttons to change rotation and select setters. On the opposite sides of the court animation are the teams. Home team is always on the left, while the visiting team is on the right. Under each team name are buttons to add substitutions and timeouts, as well as the full player list. Next to each player's name there is a number signifying their position in the starting line-up, or a \* symbol, meaning they have been substituted in the current set. Next to team's names, there is the score, with the possibility to manually add or remove points, if needed.

Codes list window (labelled 4) is the window where the codes typed in the scouting bar are displayed after assigning a point to a team. Before showing up in this window, the codes are 'translated' to a series of standard strings, and sequentially verified. If there is a logical error in the code that line will appear red. It is possible to manually add or correct the codes in this window, which is most often done during the correcting phase after the match. (Chapter 5.3) The codes window contains buttons to update and verify the codes, as well as search for specific codes. The codes will be discussed further and in more detail in Chapter 3.2.

Web cam livestream (labelled 5) is the window used to display the delayed live-stream. There are so many events that happen during a point, and it is useful for a scout to have a replay of it, seconds after it happens. Whether to check information or to add something, scouts rarely

submit a point before watching the replay. This window is used for the delayed live stream from the web cam connected to the laptop. The length of the delay can be chosen manually.

Live match window (labelled 6) is the window of a plugin used to update the online livestream during the match and to send official results and statistics after it. Rotation court window (labelled 7) is a window that shows up after a specific line of code is clicked. It shows the specific of a skill, like the direction, position or type. It is manually editable, to show more accurate analysis.

## **3.2 Codes**

The Data Volley program has a specific set of codes used to transpose and translate everything that happens during a point into a language the program can understand. The same codes look different when written by the scout in the scouting bar and in the codes list window, as they will then be translated into a series of standardised strings. Both cases will be analysed in this chapter.

### **3.2.1 Scout bar**

As mentioned in chapter 2.1, scout bar is used to scout points live. Since points in volleyball happen so fast, understandably there will not always be time to write every hit separately. That is why there are many facilitators and compound codes that make it faster and easier to scout live. The line of code in the scout bar is shorter and overall different than it will appear after being put into codes list window. One facilitating aspect is keyboard remapping, which will be discussed in the next chapter.

In the scout bar, a short point could look like this: 11SM57.12=. This signifies an ace for the home team. A longer point could look like this: a16SQ66A.10! 13W42T.2- a6DH+ a7PP3# KC  
At first glance, this might seem like gibberish, but to a trained eye of the scout, it gives all the information on how the point went. Codes can vary from simple to advanced, depending on the skills of the scout, but there are some aspects every code needs to include.

The full code syntax consists of three parts: main code, advanced code, and extended code. Main code (depicted with blue text in Figure 2) is what every line of code must include. It includes primary and fundamental information about each shot and consists of 5 to 6 characters. 1<sup>st</sup> character signifies which team is performing the hit. ‘\*’ is for the home team and ‘a’ is for away team, although the home team is often omitted by the scout, as it is the default option and the program adds it manually. 2<sup>nd</sup> and 3<sup>rd</sup> characters are numbers signifying the number of the player performing the hit. If the player belongs to away team, the signifier ‘a’ must precede the numbers. 4<sup>th</sup> character is for skill. Possible skills are serve (S) which is always paired with reception (R), attack (A) which sometimes pairs with block (B), dig (D), set (E) and free ball (F). 5<sup>th</sup> character designates type of hit. Most commonly used are high (H), medium (M), quick (Q), tense (T) and other (O). 6<sup>th</sup> character is used for skill evaluation. Possible characters, from best to worst, are # for perfect, + for positive, ! for medium, / for overpass on reception, blocked attack or net touch on block, and = for error. Not all skills have all evaluations and sometimes different evaluation means different things for different skills, like /. In many cases, there is not a clear rule to tell the evaluation of a skill, and a scout must rely on their knowledge, experience and agreement with coach to evaluate a skill on the spot.

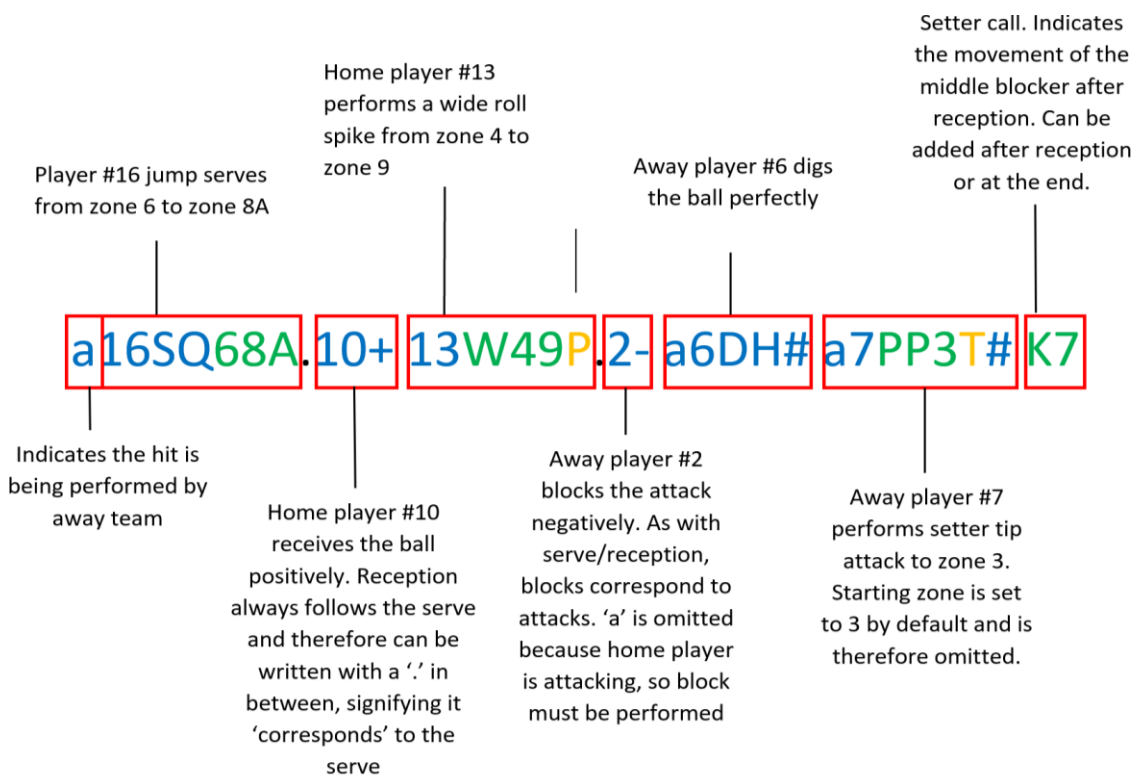


Figure 2: example of a point in code

Advanced code (depicted with green text in figure 2) is used for adding more specific additional information, which are essential for analysis. It consists of combinations and hit zones. Attack combinations are specific codes that describe different types of attacks. Not all leagues use the same attack combinations. In Mestaruusliiga, attack combinations consist of two characters. First character can be G, designating a fast set, W for a wide set or Y, meaning the middle blocker attacks. Second character is a number, designating the zone of the attack in case of wing attacks or the position of the middle blocker related to the setter. Hit zones are the starting and landing zones of skills, and they help determine direction of the hit. The court can be divided into various zones, depending on scout's level. The basic zones are 1-6, intermediate are 1-9 and advanced divide each of those zones into 4 smaller zones, marked with letters A,B,C,and D.

Extended code (depicted with yellow text in figure 2) represents specific characters for each hit. Many of them are not used in Mestaruusliiga. Used code is, for example, type of attack (hard, tip or roll), number of blockers or type of error. Figure 2 shows an example of what a line of code written in the scout bar could look like. The colours correspond to the three parts of the syntax and smaller snippets of the codes are explained individually.

### **3.2.2 Codes list window**

As previously discussed in this chapter, the codes from the scout bar get normalised and translated into a series of standard strings before being put into the codes list. This occurs after a point gets assigned to a team. From here, codes can be modified, fixed and added, but more on that will be discussed in chapter 2.7. The figure below (Figure 3) depicts the codes list window, after the game had been corrected.

This is an automatic code that appears after the line-up has been entered. It designates setters and their starting zones.

This is what an actual point looks like in the codes list window. In the scout bar it would appear as:

15SM51.13# a8Y55.15D+ 6E+ 13W42T.7- 11D+ 13G47# K7

Some codes are inputted into the codes list by default, like sets set by the setter, starting zone of middle blockers' attacks and many hit types. They do not need to be written in the scout bar.

Automatic code that designates the score. It appears after every point, prefaced with 'a' or '\*', signifying which team won the last point.

Automatic code signifying home and away team setter position (zone). Thanks to this code, the program can recognise and update team rotation.

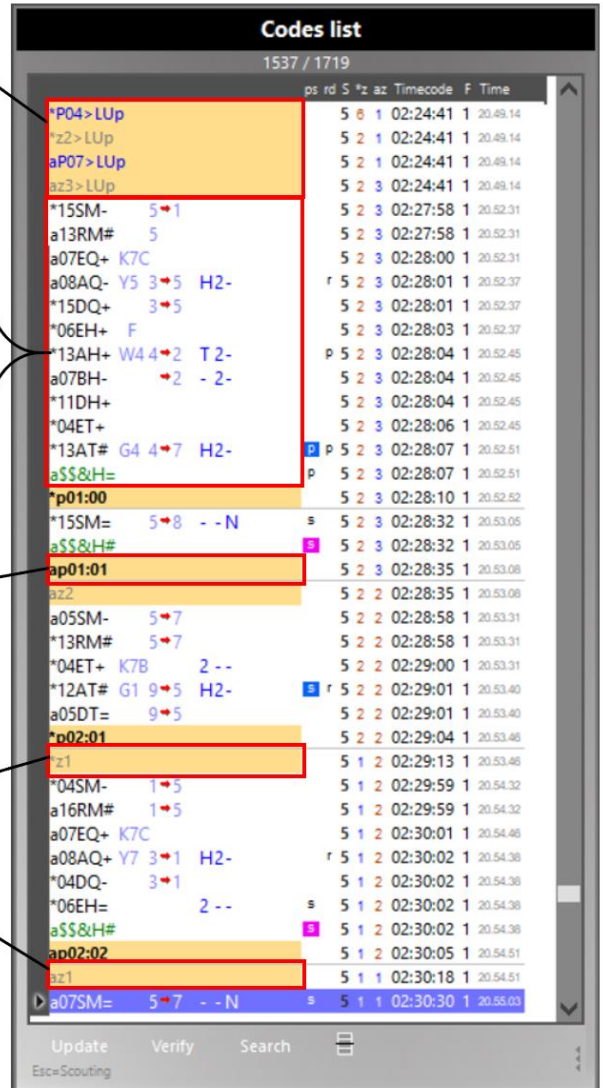


Figure 3: Codes List Window

### 3.3 Keyboard remapping

Volleyball is a fast sport, and everything important happens in less than a minute, unless it is a very long rally. Scouts need to be able to keep up with it. Not only do they need to notice and evaluate every detail that happens during that minute, but they also need to write it down. Usually as it is happening. Because of the fast and challenging nature of this task, Data Volley offers many facilitators. One type of said facilitators are compound codes that have been discussed previously. They allow the scout to write less, and faster, while still retaining the amount of information intended to input.



Another facilitator is keyboard remapping. The essence of keyboard remapping is allowing a scout to personalise their keyboard. This is done by creating shortcut keys that correspond to certain commands, allowing faster speed and smoother scouting process. Figure 4 shows what the physical keyboard of Kokkolan Tiikerit looks like, while Figure 5 shows the options set up to achieve the remapping. Most common commands that require shortcut keys are attack combinations, like G4 or Y1, as they are always comprised of two characters, skill evaluation symbols, like # and !, because the symbols are difficult to locate on keyboards and would most often require a SHIFT click, and keys to assign points to left or right team, so the scout does not have to use a mouse to assign points.

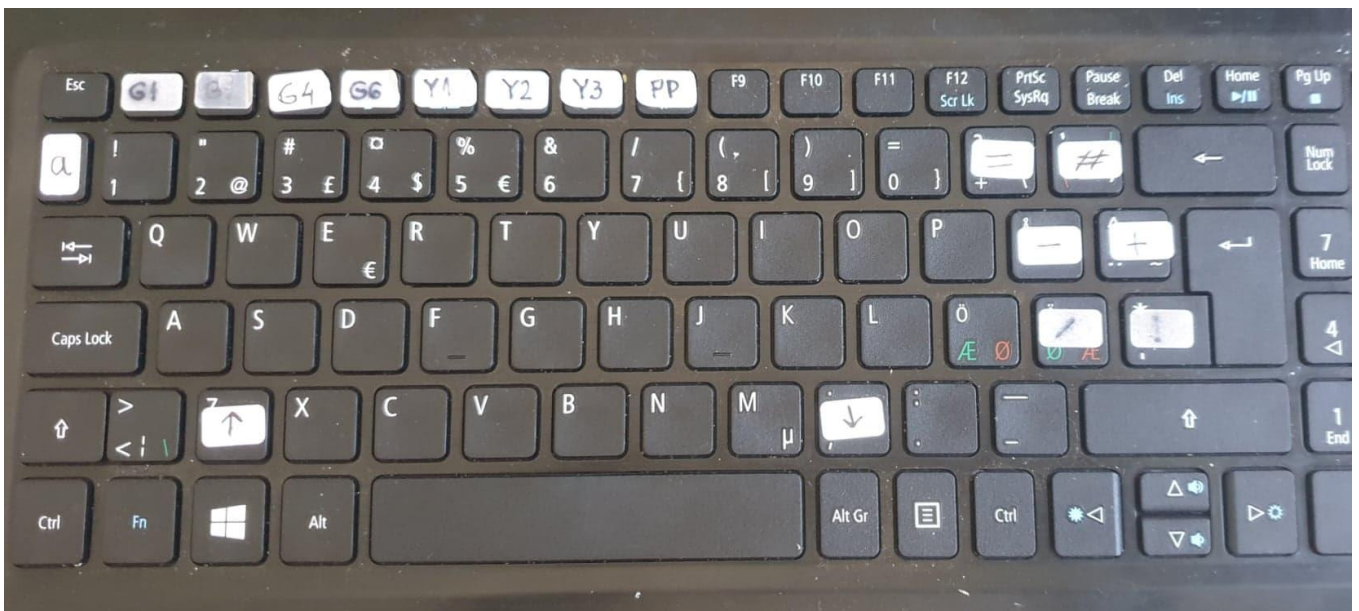


Figure 4: Remapped keyboard

Although the keyboard can be done by own preference, there are best practices adopted most of the teams in Mestaruusliiga. The remapped keys should never be ones that are used often and/or during scouting. The attacking combinations are almost always placed instead of function keys, the skill evaluation keys are usually on the right side and the assign point left/right are most often on the left and right of the SHIFT keys.

The remapped keys on the keyboard are usually marked with a sticker or a piece of tape with a shortcut written on them. In Figure 4, the keyboard of Kokkolan Tiikerit laptop is shown. Some of the stickers had to be changed prior to taking this picture as they were so worn out, the symbols on them were illegible. The keyboard can be remapped by clicking the 'Tools' button from the main bar. From there, the window from Figure 5 is prompted and changes can be made.

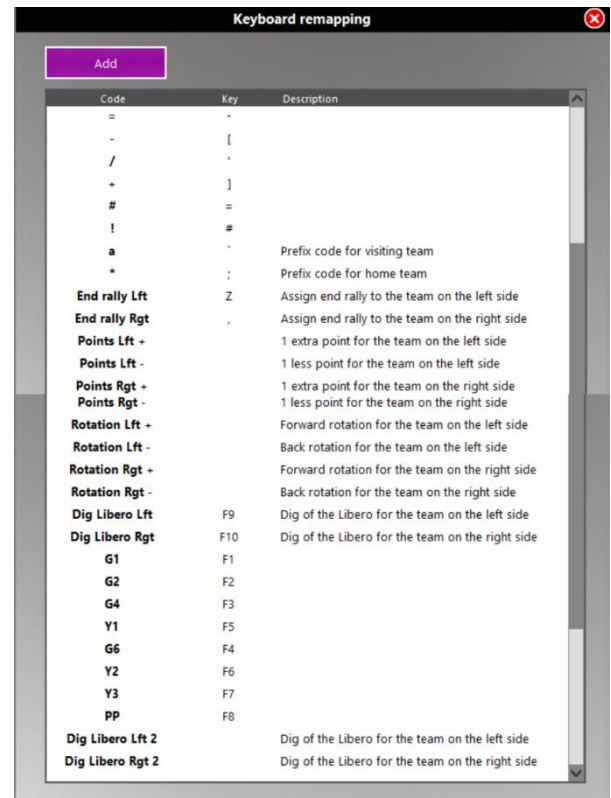


Figure 5: Options for keyboard remapping

### 3.4 Web Client

Web Client is a web interface of Data Volley that allows the scout to send various scouting components to the bench or other devices in the venue. This is depicted in Figures 6 and 7.

The live stream replay is not only useful to scouts but can also be useful to the coaches. Some coaches like to have a device, be that a laptop, a tablet or a phone, to replay the delayed stream of the game. Moreover, apart from streaming the delayed video, web client can also share various kinds of analysis in real time, share the scoreboard displaying the timeouts, substitutions and rotations throughout the match, show last hits and allow chatting between devices.



Figure 6: Window for setting up the web client

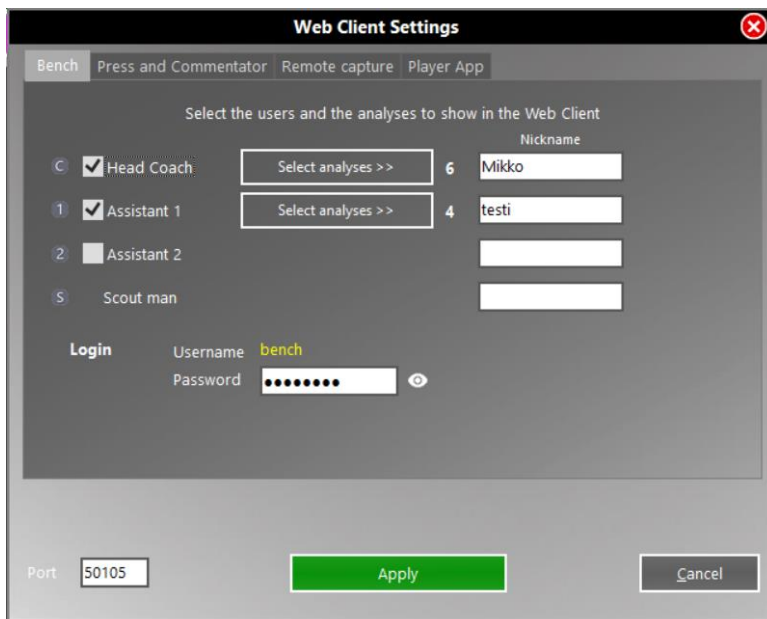


Figure 7: Web client settings

The web client window gives an IP address that is to be copied into a browser so that remote client can be accessed. In the web access window, there are also buttons for chat and settings. The settings window is depicted in Figure 6. It shows the people allowed to access the web client, a button to select which analysis either of them get, and a type box for their nickname. It is useful for the coaches to be able to pick different analysis to get to the bench at any point of the game. The window also allows the scout to set the login credentials manually to allow security. The remote web client can be accessed through an application, or simply by inputting the IP address in the browser. The user will be prompted to the login screen, where they will have to input the credentials from the scout's settings window. After they log in, they will be able to see the live video and previously selected analysis and reports.

### 3.5 Video

One of the most crucial aspects of volleyball today is documenting the games on video, so they can be watched, re-watched and thoroughly analysed. In every game the scout must position the camera in a place that is behind the court and in an elevated position, so as to provide the best angle for analysis. The video should include the whole court from a right angle and have extra space beneath the serve line and above the antennae. The camera should also be in a

position where it is protected from incoming balls. It should either be inside of a closed box with a window for filming, or somewhere where the scout is able to protect it. It should always be plugged in and charging, and the memory card should be empty, as the length of the game can be unpredictable. Moreover, the scout should check every so often that the camera is still on and filming and the video is even.

It is recommended to have a camera that is able to simultaneously create two separate files, one in HD and the other in mp4. This is because the Data Volley has a limit on how big the video can be and will have to compress the video before uploading. Another difficulty is that, if a camera makes several files of the same game, the video will first have to be converted. This is time-consuming and can be avoided by getting a camera with the right specifications. However, many teams do not own a camera with optimal specifications, hence Data Volley's options to convert and compress the video, which will be discussed more in chapter 5.

The video is not only used by the team that films it. In Mestaruusliiga, every team must share their home game videos in the cloud. This way all the teams have access to it. This is important when it comes to match preparation, which will be discussed in its own chapter 6. In short, to properly prepare for a game, teams analyse how their opponents have been performing lately and devise a strategy against them. This is possible because they can find all their previous game videos (and scout codes) on the cloud.

The ability to watch the video of any game of the season is one of the most important and prominent examples of the role modern technology plays in volleyball. In the words of the coach of Kokkolan Tiikerit Mikko Keskisipilä, before game video was available for wide use, most of the things and preconceptions were based on beliefs, not facts. This will be discussed more widely in Chapter 7. (Keskisipilä 2019.)

## 4 DATA ANALYSIS

Data analysis is one of the most important aspects of the Data Volley program, as well as the core of scouting itself. The program analyses all the data put in it during the scouting process and outputs many different forms of data, the most important one being the match report. Match report, shown in Figure 8, is a paper that shows the most important statistics of the game, like how a team won their points in each set, teams' attacking efficiency, receiving quality, errors and more. It can consist of all the sets combined, or it can be a set report, which shows all the details of one set.

During the game, both set and match reports are printed for the coaches after every set. This is so they can see the overall statistics of the game so far and some skills of particular players. Then they can devise a strategy for the rest of the game. A partial match report is printed for the TV announcers after every set so they can comment on player's and teams' skills and performance. After the game, five or six match reports are printed for the press conference, as well as set reports for each set for the journalist writing about the game. This chapter will discuss the analysis used by Kokkolan Tiikerit during a match.

### 4.1 Match Report

The match report is arguably the most important output of Data Volley. It is a summary of the match, in numbers. It is very difficult to read and understand it for a person that does not know what they are looking at. That is why it is important for every volleyball professional to know how to read it. In this chapter, all the different segments of the match report will be analysed and explained, and the match report itself is shown in Figure 7.

Match notes section (labelled 1) is where most important match notes are shown, like place and time of the game, game and spectator numbers and net and main referees. Partial score is labelled 2. The final score does not say much about what happened between the first and the last point of a set. That is why there is a partial score window. It shows the score at different parts of the set.

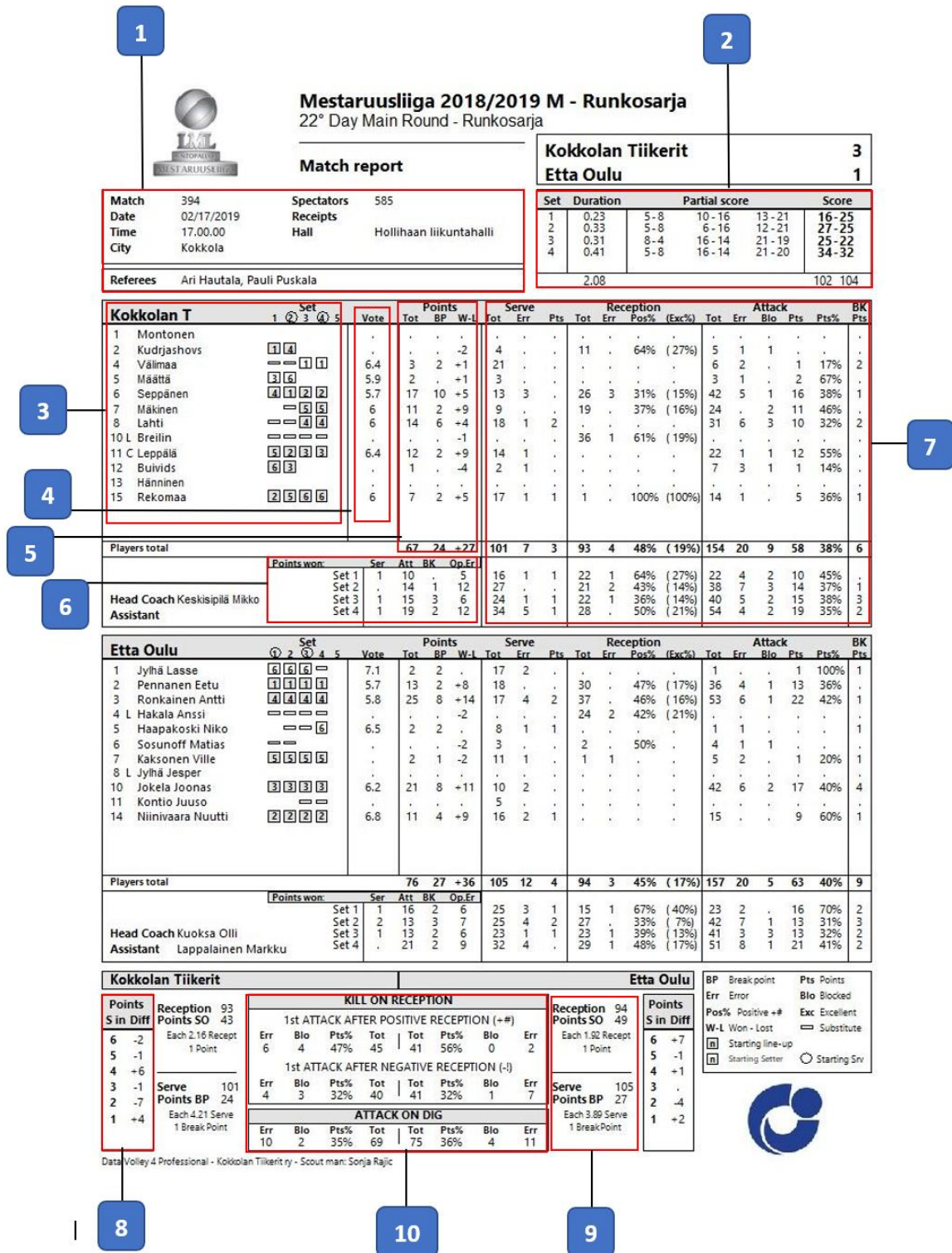


Figure 8: Final match report from a match

In this game, the partial score shows a very exciting second set, where the home team was losing with the score of 12-21 (the away team later had 11 set points at 14-24, which is not shown in the report), but managed to turn the set around and ultimately win it.



Apart from the partial score, this window also shows the duration of each set and total points won by both teams.

Player list is labelled 3. In this window, team is shown with all its players. Players' rotation details are shown, meaning the number of their starting zone is written next to their name, or a bar if they entered the set as someone's substitute. The circles around the set numbers indicate that the team was serving. Vote (labelled 4) is a number indicating how a player has performed during a game. All the skills are evaluated and have a specific weight assigned to them. It is acquired by plugging in the weight of skills into an elaborate formula, which compares an average of different weights of different quality of skills divided by the total number of hits.

Points are marked with label 5. This is a very important part of the match report. These are the numbers one can hear TV commentators read out after each said when discussing player performance. It is most importantly comprised of how many points a player has made and the win-lose difference between their points and errors. An example from Figure 5 could be 'Leppälä 12 +9' meaning he made 12 points and his win-lose difference is +9, so he made 3 errors. Listed in this window are also break points, which is when a team wins a point on their serve, but they are not as important. Points won are marked with label 6. This is the section one might see if they were watching a professional game on tv (although Mestaruusliiga does not yet have that option). It describes how each team won their points. It is made out of serve points, or aces, attacking points, block points and opponent errors. These are shown for each set.

Skill efficiency is marked with label 7. In this section of the match report, both the skills of each player and the overall team's skills are analysed. The section is divided into four parts, each part analysing a different skill. The skills analysed are the serve, reception, attack and block, whereas the block is not analysed as a skill separately, but only the block points are listed. Serve analysis is comprised of the total amount of serves, errors and points or aces. Here, the efficiency is not looked at.

Reception is a skill that only happens after the opposite team's serve. Not all players receive serves. The designated receivers are the outside hitters and the libero. It is uncommon but not impossible for the other players to receive. It could happen, for example, after a let serve, when the ball hits the net, but ends still ends up on the opposite side of the court. Analysed are the

total amount of receptions per player and per team, the number of errors, the positive percentage of reception and out of that, the excellent percentage. In the simplest terms, positive reception means the setter does not have to move downwards and away from the net and can set almost all combinations with minimal risk, and perfect means the setter does not move from the perfect reception 'window' between zone 2 and zone 3, can set first tempo all other combinations with no risk, and the ball parabola is regular (not too low or too sharp). The number of reception errors must always match the number of serve points of the opposite team.

Attack efficiency explains how the players have attacked. It notes how many attacks in total a player made, how many of those were errors, how many were blocked by the other team, how many made a point and the attacking efficiency, or point percentage. Attacking efficiency is calculated because not every attack will make a point or be an error. It signifies how many hits from the total number made a point. The libero is the only player in the team not allowed to make points. The last section is for block points. As previously mentioned, it only notes the points made by blocks, and does not analyse blocking efficiency or errors. This is because block outs are not considered as errors in the statistics. The combined number of errors of each skill must match the number of opponent errors in the 'points won' section of the opposite team. Underneath the skills of each player, the skills of the team overall will be listed, and underneath that, the same is listed for each set separately.

Label 8 stands for 'Points S in Diff'. This analyses the point difference (errors subtracted from points won) by rotations, meaning by which zone the setter is in. The more challenging rotations are when the setter is in the back of the court, with the most challenging one being P1, when the setter is in zone 1 (when he is serving). This is so challenging because the player positions are essentially reversed. The opposite, or right-wing player, attacks from the left side, and the right side of the court is covered by an outside hitter, or left wing. Many teams do not perform well in this, or another rotation, which is why this section of the match report is important.

Label 9 reception per side-out and break point per serve. This is, arguably, the least important part of the match report. Essentially, it notes the total number of reception and the total number of points made on a side-out (meaning the opposite team has the serve in that point), then divides the two numbers to output statistic stating 'one point was made each 1.92 serves.'



Same is done with the total number of serves and the total number of break points (when the team wins a point on their serve).

Finally, label 10 signifies the kill on reception and attack on dig. This is another important part of the match report. In volleyball, errors (or blocked attacks) should never happen after a perfect reception. This is because perfect reception gives a possibility for the perfect case scenario and should always be followed by a perfect set and a kill (attack that makes a point). Any error in this case is unforced. Teams always strive to have a very high percentage of kill after perfect or positive reception, meaning the players are not making unforced (and honestly stupid) errors. In this case, most coaches consider a blocked attack to be an error. Kill after negative reception is difficult, mostly because setters will set wide balls, giving the opposite team time to prepare, sets to the middle-blocker are extremely risky or impossible, and attacking carries more risk. High percentage of kill on negative reception means a team is performing well in difficult situations. Dig is a skill that comes after the opposite team's attack, if the team saves the ball. Therefore, attack on dig is an attack after successful defence.

Match report summarises the whole game (or all the combined sets so far if it is printed before the game is finished), but during a game it can be important to see how teams have been performing in each set separately. That is why Data Volley can output set reports, which look the same as the match report, but only analyse a specific set.

#### **4.2 Direction Chart: Attack Directions by the Away Team After Perfect or Positive Reception (#,+) by Rotations**

This analysis is printed out for the coach of Kokkolan Tiikerit after each set and depicted in Figure 9. It is useful because it gives insight in how the opposite team performs when they have all attacking options available. It helps predict the starting and ending zones of opposite team's attacks, and therefore helps plan own team's block and defence. It also analyses different attacking patterns in different rotations.

On the top of the paper, underneath the analysis title, the match information is written. It includes the teams, the score for each set and the most important match notes, like the day and the place of the game. There are six courts shown on the paper, one for each rotation.

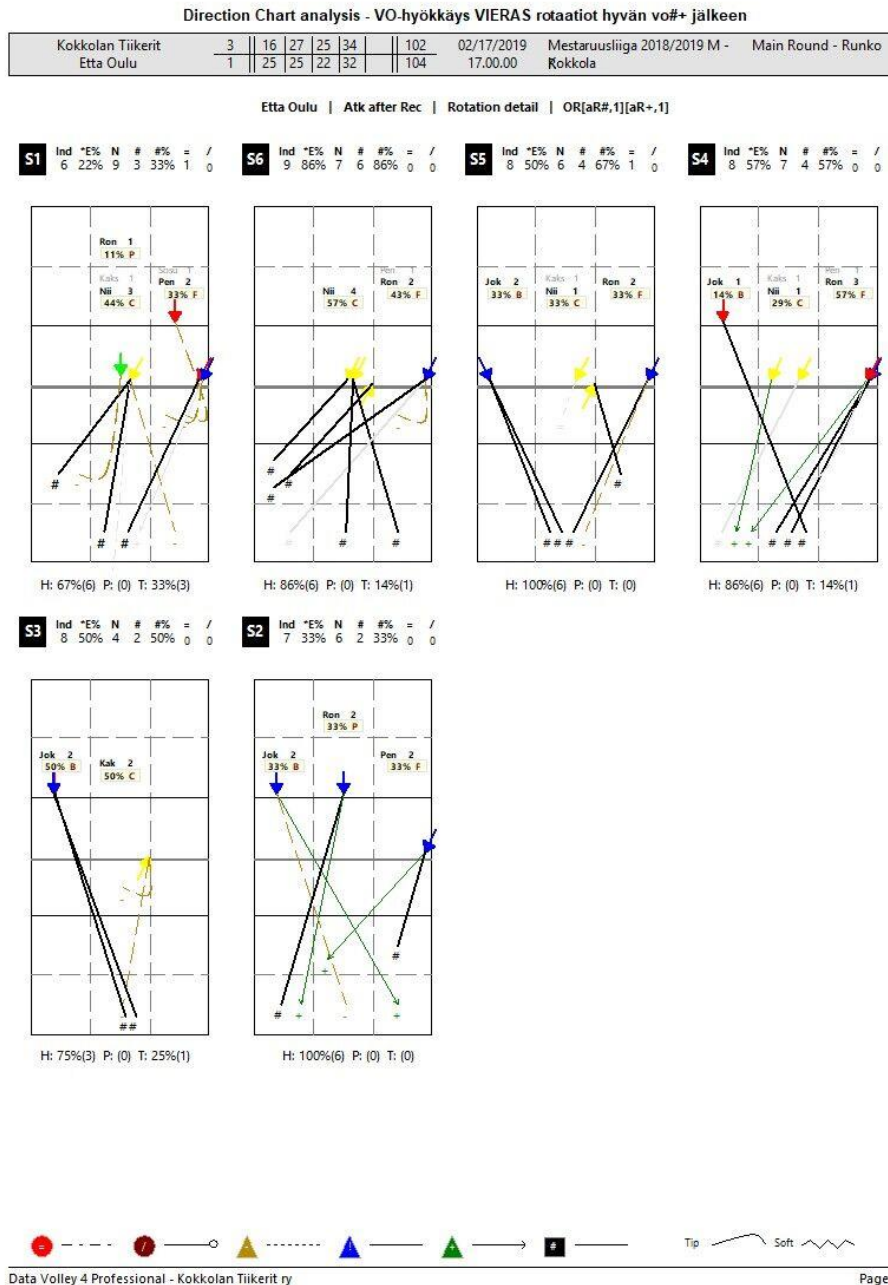


Figure 9: Direction chart analysis from a Tiikerit match

They are labelled with S1-6, indication the zone the setter is positioned in. Next to the rotation label, the statistics for that rotation are shown. They include the evaluation index value (ind), the efficiency (E%), the total number of hits (N), the total number of kills (#), the percentage of kills (#%), total number of blocked hits (/) and the total number of errors (=). There are lines scattered on the court. They represent the direction of attacks. The colour of the arrow indicated the type of the set (quick, tense, wide...) and the colour of the lines themselves represents the efficiency of the attack, which is explained in the legend on the bottom of the Figure 10.

One more thing worth noting is the type of the line. It can be straight, arched or wavy (not shown in Figure n). That indicates the type of spike – hard, tip or soft (roll).

### 4.3 Analysis by Player – Home and Away

Following are two analysis that are also printed out after every set. They are analysis by player by both home and away teams, shown in Figure 10.

Analysis by Players - Pelaajakohtaiset suoritukset KOTI																										
Kokkolan Tiikerit		3	16	27	25	34	102	02/17/2019		Mestaruusliiga 2018/2019 M -		Main Round - Runko														
Etta Oulu		1	25	25	22	32	104	17.00.00		Kokkola																
Kokkolan T   Player detail   Skill detail																										
Player	Skill	Type	S	Set	Ind	*E%	Tot	=	%	BP	pS	/	%	BP	pS	-	%	!	%	+	%	#	%	BP	pS	
Team	Serve		4	28%	101	7	7%	7	6	6%		42	42%	17	17%	26	26%	3	3%	3						
	Reception		4	41%	93	4	4%	4	3	3%		22	24%	19	20%	27	29%	18	19%							
	Attack		6	19%	154	20	13%	15	9	6%	8	1	27	18%		40	26%	58	38%	16	42					
	Atk after Rec		6	20%	85	10	12%	10	7	8%	7		14	16%		20	24%	34	40%	34						
	Transition		6	17%	69	10	14%	5	2	3%	1	1	13	19%		20	29%	24	35%	16	8					
	Block		1	-11%	75	33	44%	6	27	1	1%	1	15	20%		20	27%	6	8%	5	1					
	Dig			29%	83	17	20%			12	14%		13	16%		41	49%									
	Free ball			93%	14								1	7%		13	93%									
	Set		7	88%	147	1	1%	1	1	1%			13	9%		111	76%	21	14%							
2 Kudrjashov	Serve		6	50%	4				1	25%		2	50%		1	25%										
	Reception		5	64%	11							1	9%	3	27%	4	36%	3	27%							
	Attack		3	-40%	5	1	20%	1	1	20%	1		1	20%		2	40%									
	Atk after Rec		5		2										1	50%										
	Transition		2	-67%	3	1	33%	1	1	33%	1					1	33%									
	Dig			100%	1											1	100%									
4 Välimaa	Serve		5	48%	21				1	5%		8	38%	3	14%	9	43%									
	Attack		4	-17%	6	2	33%	1	1			2	33%		1	17%	1	17%	1	17%	1					
	Atk after Rec			-100%	1	1	100%	1																		
	Transition		5		5	1	20%	1				2	40%		1	20%	1	20%	1	20%	1					
	Block		2	10%	10	3	30%	1	2			3	30%		2	20%	2	20%	2	20%	2					
	Dig			40%	15	2	13%		2	13%		3	20%		8	53%										
	Free ball			100%	1										1	100%										
	Set		7	91%	100	1	1%	1	1	1%		5	5%		75	75%	18	18%								
5 Määttä	Serve		4		3							3	100%													
	Attack		7	33%	3	1	33%	1																		
	Atk after Rec		7	33%	3	1	33%	1																		
	Block			-100%	2	2	100%	2																		
	Dig			100%	1											1	100%									
	Set		6	88%	25							3	12%		20	80%	2	8%								
6 Seppänen	Serve		4	15%	13	3	23%	3				5	38%		5	38%										
	Reception		2	12%	26	3	12%	3	2	8%		4	15%	9	35%	4	15%	4	15%							
	Attack		6	24%	42	5	12%	3	2	1	2%	1	8	19%		12	29%	16	38%	9	7					
	Atk after Rec		6	13%	15	2	13%	2	1	7%	1	3	20%		4	27%	5	33%	5							
	Transition		6	30%	27	3	11%	1	2			5	19%		8	30%	11	41%	9	2						
	Block		1	-20%	10	5	50%	2	3			2	20%		2	20%	1	10%	1							
	Dig			28%	18	4	22%		1	6%		4	22%		9	50%										
	Free ball				1							1	100%													
	Set		7	100%	1										1	100%										
7 Mäkinen	Serve		4	11%	9				1	11%		7	78%	1	11%											
	Reception		3	37%	19							7	37%	5	26%	4	21%	3	16%							
	Attack		7	38%	24				2	8%	1	1	3	12%		8	33%	11	46%	2	9					
	Atk after Rec		7	33%	12				1	8%	1	2	17%		4	33%	5	42%	5							
	Transition		7	42%	12				1	8%	1	1	8%		4	33%	6	50%	2	4						
	Block			-29%	7	4	57%	4				1	14%		2	29%										
	Dig				7	2	29%		2	29%		1	14%		2	29%										
	Free ball			100%	2										2	100%										
	Set		4	50%	2							1	50%		1	50%										
8 Lahti	Serve		4	33%	18	1	6%	1	1	6%		6	33%	4	22%	4	22%	2	11%	2						
	Attack		5	3%	31	6	19%	5	1	3	10%	3	6	19%		6	19%	10	32%	3	7					
	Atk after Rec		5	6%	18	3	17%	3	3	17%	3	4	22%		1	6%	7	39%	7							
	Transition		5		13	3	23%	2	1			2	15%		5	38%	3	23%	3							
	Block		2	8%	13	6	46%	1	5						5	38%	2	15%	1	1						
	Dig			38%	13	2	15%		2	15%		2	15%		7	54%										
	Free ball			100%	6										6	100%										
	Set		7	100%	2										2	100%										
10 Breilin	Reception		4	56%	36	1	3%	1	1	3%		10	28%	2	6%	15	42%	7	19%							
	Dig			22%	18	4	22%		4	22%		2	11%		8	44%										
	Free ball			100%	2										2	100%										

Figure 10: Players skill analysis

However, the attached Figure only shows the first part of the home team analysis, as there is enough information on it to explain everything appropriately.

During the match, it is important to see how every one of the players are performing in each segment of the game. That is what a player skill analysis is for. The report, like all the others, has match notes at the top. Below, it is separated into parts for every player, as well as for the team overall at the top. Every skill the player can perform (so no serves and attacks for libero, for example) is analysed. It is separated into sections by skill evaluation and the percentages are calculated. Bolded and on the right side of the player's and skill's name can be found index, total efficiency of a skill and a total number of hits. A skill is then broken down to different evaluations and analysed separately. Every evaluation section has the amount of hits with that evaluation and a percentage of total, with some also have listed how many hits of that evaluation happened on a break point or side-out. This table is helpful with comparison of each player in each skill.

#### **4.4 Direction Chart: Away Team Serving Direction by Rotations**

This is the last paper printed after every set. It portrays the serving direction of the opposite team, shown in Figure 11. It has the same elements as the direction chart from chapter 4.2, but instead of attacking, it has serve directions. Line colours mean the same as in all charts of this type and are explained on the bottom of the page. This analysis is very important so the coach can plan how to position their receivers when different players of the opposite teams are serving and hence improve reception.

Direction Chart analysis - Syöttö VIERAS rotaatioittain

Kokkolan Tiikerit	3	16	27	25	34	102	02/17/2019	Mestaruusliiga 2018/2019 M -	Main Round - Runko
Etta Oulu	1	25	25	22	32	104	17.00.00	Rokkola	

Etta Oulu | Serve | Rotation detail

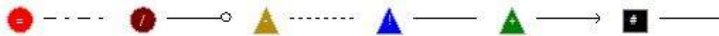
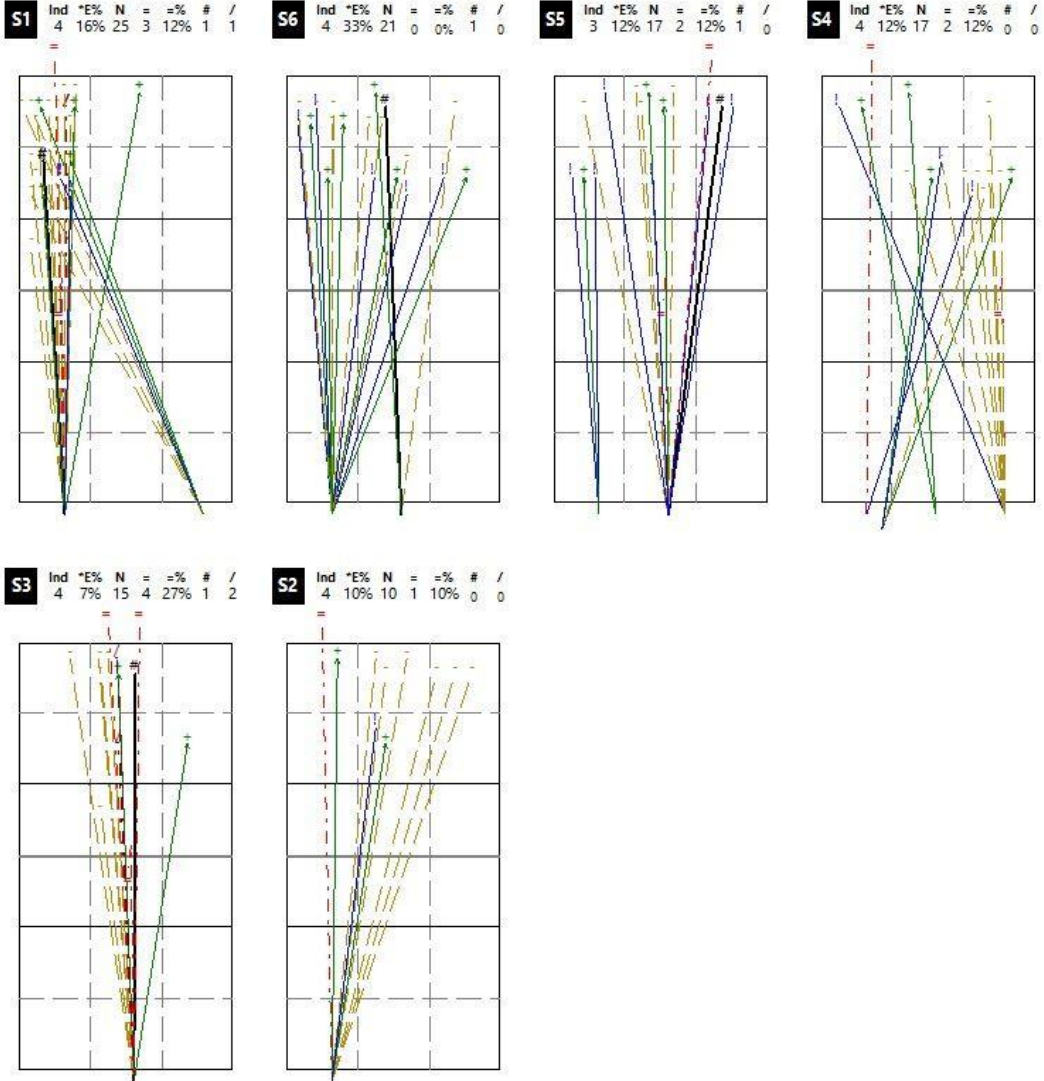


Figure 11: Serve direction analysis

## 5 AFTER THE MATCH

Scout's job is not over when the match finishes, it is just beginning. A big part of scout's workload is correcting and perfecting the codes they wrote during the match. Logically, the better code they write live, the less they will have to do afterwards, but the job is still long and excruciating.

### 5.1 Getting Everything at the Same Place

To begin, the video must first be uploaded from the camera to the computer. There is a designated folder for the game videos. There is a generally accepted format of naming folders, videos and scout files, which is `yymmdd_hometeam-awayteam_score`. An example would be `190310_tiikerit-valepa_3-1`. This helps with clarity, sorting and sharing of the files. The scout file should be saved in its designated folder and named by the same standards. If the video is too large or comprised of separate files, it first has to be compressed and converted in Data Volley. The converted video is then to be added to the appropriate match in Data Volley.

### 5.2 Synchronising

After the video has been converted, scout file saved and both added to their match in Data Volley, the scout has both the codes and the video at the same place, but they are still separate entities. To connect them, the codes must be synched to the video. This is made possible because the time stamps are created when codes are processed and inserted to the codes list window. However, only the first code in a point is stamped, which is always the serve. That is why it is important for the scouts to always write the serve code at the same time as the player serves, or when he throws the ball in the air. When synching the codes, the scout must find the first serve of the game and click the sync button in the program. After that, the program will synchronise all the serve codes of the match to the appropriate place in the video.

However, serve is not the only skill that should be synched to the video. It is heavily advised that every attack is properly synchronised as well, if not every skill on its own. This can be done

in two ways. Either a scout can go manually through the codes and clash the F12 button every time they want a line of code connected to the video, or they can check the option in the program that allows the skills to be synched several seconds after the set. While the other option can be useful and seem like efficient use of time, it is not advised for scouts to rely solely on that, as it does not sync every attack perfectly. Best practice is to utilize that option but manually sync important events, nonetheless.

### **5.3 Adding and Correcting**

When the syncing has been done, the scout can start going through the codes one by one to correct mistakes and add events that were missed during live scouting of the match. Some errors and missed point parts happen to all scouts. Misjudging reception for perfect when it was positive, writing a block touch to the wrong player or missing a dig are not crucial and will not affect the quality of the statistics during the match. However, mistakes like giving a point to the wrong player, or accidentally assigning a point to the wrong team (very easy to happen, very hard to fix), should be avoided at all costs and fixed immediately, if possible. The match reports printed at the games should be an accurate statistical representation of the game, and therefore must at least have the accurate point distribution.

Whatever mistakes have been made must be fixed at this phase. Moreover, all other codes should be checked, and every ball touch should be accounted for, so skills should also be added. During the game, it is simply not possible to write every ball touch with all the correct extended codes. That is why Data Volley allows for quick and easy adding of codes, line by line or as compound, after the match. The existing codes can also be easily fixed in the code wizard window. One more useful thing the program allows is to put the video in slow-motion. This is very helpful in case of an ambiguous event, for example when deciding which player was blocking a ball.

### **5.4 Verifying**

After all the codes have been properly synchronised, checked and added, the scout must verify there is no errors. The easy way would be to just verify the file in Data Volley. However, there are some errors the program does not recognise and report. In this case, there is a useful web

page that allows for more precise verification of the codes. The errors this website reports and Data Volley does not are incorrect rotations, incorrect starting zones, like when a back-row player attacks from the front row and more. (Volleyball data file validator, 2019.)

## **5.5 Uploading to the Cloud**

The last step is to upload the video and the synced and corrected codes to the cloud, so that every team in the league can access and download them. In Mestaruusliiga, the program used for this is ownCloud, which is a cloud collaboration platform. There is one designated folder on the laptop in which all the game folders including the video and the codes are copied. This folder is linked to ownCloud, and everything in it is automatically uploaded to the private cloud. The cloud is a collection of each team's folders. Every team has access to two accounts. One is team specific and allows the user to modify their own folder and another is universal to the whole league and gives access to each team's folders but allows no modifications. (ownCloud, 2019.)



## 6 BEFORE THE MATCH

One of the most notable changes scouting has brought to volleyball is the possibility of thorough analysis of the opponent's last matches. Nowadays, the staff does not need to attend matches to be able to see how an opponent team is performing, it is enough to download them from the cloud. Moreover, with match videos, codes can be downloaded as well. This is precious because Data Volley gives the possibility of code search and subsequent video montage. This means a scout, or a coach can select a specific skill from a specific player (and even add more filters, like sets and directions), view every one of the desired events in sequence, and create a video montage, possibly to share with the whole team in a video meeting.

In Kokkolan Tiikerit usually the last three or four opponent matches are analysed before every game, primarily by the coach, Mikko Keskisipilä. He would focus on opponent attack and block in different rotations, serve, best receivers and overall team performance after positive or negative reception. The main point of this is to analyse why the team plays in a certain way. Then, he selects the most important points and events and discusses it with the whole team in a video meeting, while being careful to keep the information short and concise, so as to allow the players to focus on the game itself. (Keskisipilä 2019.)

The match preparation stage of the analysis and scout's and coach's workload is crucial because it allows for more thorough understanding of the team's opponents and their style of play and therefore allows the staff and the team to develop a proper and personalised tactic of play. Analysing as many of the opponents' events, like serves and attacks, allows for at least a statistical advantage, since the team should be able to recognise different recurring situations and be able to prepare a good answer for them.

## 7 HOW IT HAS CHANGED VOLLEYBALL

This chapter is meant to capture and summarise the point of this thesis. The sources for it have been taken from interviews the author had previously conducted with many volleyball professionals, most notably Mikko Keskipilä, current coach of Kokkolan Tiikerit and Tuomas Mikkola, a long-time scout for different Finnish National Teams, scouting instructor and possibly the most experienced scout in Finland.

According to Tuomas Mikkola, scouting before modern technology as we know it was challenging. Filming the games has been practiced for as long as it was possible but using that film for more than just simply re-watching was an excruciating process. Nowadays, it is easy to make a montage of specific events from a video, for example a specific player's attacks in different rotations. This is practiced often and mostly used in the match preparation stage for opponent analysis, for example. Today, a desired video can be ready in the matter of minutes. However, this used to be a painstaking process, involving two cameras and/or a video recorder, and many hours of effort. And according to Keskipilä, one of the most important things that modern video brought to volleyball is that things are not based on educated guesses anymore. In his words, many things used to be based mainly on beliefs, which were often wrong. Today, it is easily possible to check any event from the video or the statistics, so there can be an objective truth. (Keskipilä 2019; Mikkola 2019.)

The video is not the only thing that has gone through substantial change with the modern technology and programs, though. The other most notable part is the game analysis and statistics itself. Before the era of commercial laptop use, most of the statistics were done with pen and paper, coaches writing some basic events, like attack directions on the paper on the side of the court. This offered limited, but nevertheless useful insight into the team performance. Then, after the use of computers had gained momentum, some statistical analysis were done in Excel. This system allowed basic set and match analysis of skill quality. However, Mikkola managed to produce an Excel file that allowed for a more detailed rotation analysis. The Finnish Volleyball association acquired their first licence to Data Volley in 2001. However that version was still relatively basic compared to what it is today, and extracting analysis still required many hours of work. (Mikkola 2019)

The way the things work today in the league would have been unthinkable in the past. 24 hours after any game, every team across the league has access to its video and codes. This system saves many hours of work and personal effort from the scout. Nothing needs to be based on personal opinion anymore, and human error is greatly reduced, because there is video evidence for everything nowadays. This has helped achieve a universal truth. Of course, statistics do not win games, but they contribute. A team firstly needs to have a good coach and good players. But a crucial part of a team's success happens in practices, and scouting can help improve practice quality significantly. Coaches rely on statistics, apart from their experience and instinct, to create tactics and improve their team before, during and after the games. This is why Tuomas Mikkola believes a scout is, next to the coach, the most important staff member in a team. (Keskipilä 2019; Mikkola 2019.)

In the wise words of Tuomas Mikkola, in the past coaching was reactive, but scouting has made it more proactive. Meaning, a substantial part of work is analysing the opponents and developing a strategy against them before entering the court. Rather than responding to what is happening in a short period of time during the game, players are now armed and prepared with knowledge before. (Mikkola 2019.)

## 8 CONCLUSION

Nowadays, the difference between professional volleyball teams is small. All the players are on their physical peak, all the coaches are competent. Only the slightest factors decide which team wins and which team loses. One of those factors is scouting. How well a team produces and analyses the game statistics and how much weight a coach puts in it often influences the team's readiness for specific matches. To be at the top, a team needs to utilise every single strength that can give them an upper-hand. That is where scouts come in play.

Although not the most important factor in a game, scouting is certainly a pillar of success with modern teams. Using the information scouting can give, a team not only gains an advantage by understanding and analysing their opponents to better prepare for playing against them, but also allows for better understanding of own team's strengths and weaknesses. This allows for more efficient trainings and preparations. It has also made volleyball more proactive, when it used to be reactive.

The aim of this thesis was to introduce the reader to one of the lesser known areas of IT use, which is volleyball scouting. It introduced the reader to what scouting is and what it takes to be a successful professional scout. Finally, it analysed how modern technology and the use of IT influenced the world of volleyball and the ways it changed, improved and elevated it.

Possible further research is finding a way to upgrade and improve the Data Volley program and automatise things now done manually. The program is not finished. It is alive, and should continue to change, grow, and improve. This can be done by using the knowledge and experience of coaches, scouts and other volleyball professionals.

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