

Coaching Support by Collecting and Analyzing Data (CoCoAnDa)

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Abstract. Team handball is a popular, traditional team sport in Europe. However, it is just at the beginning of the digital transformation. The project CoCoAnDa focuses on the discovery of IT-based methods to support team handball coaches in four major areas: automated and manual collection of player and team information, automated detection of group tactics and game events, development of a player and a team performance index, and the long-term prediction of player's potential.

CoCoAnDa has decided to use team handball as the focus area for its research. However, the concepts and findings can be applied in other team sport areas as well. Overall, CoCoAnDa investigates how digital technology and data science can be used to improve the performance in sports.

Keywords: Digitalization · Prediction · Data collection · Data analytics
Sports

1 Introduction

1.1 Team Handball

Team handball [1] is an Olympic sport and has a long tradition in Europe. It is the second most popular sport, after football, in countries like France, Spain and Germany. However, the budget of teams is significantly less than the budget in football. For instance, the aggregated budget of all teams of the Team Handball Bundesliga (DKB HBL) adds up to approximately 80 million Euros in the season of 2018.

The game itself has been derived from football. Originally called “field handball”, it was introduced as an alternative to football for women and it was played outdoors on football fields with 11 players in each team. The modern and Olympic version is now played in-doors on a smaller field with 7 players per team. The basic idea of the game is the same as in football. There are two goals and the players try to score a goal with a ball. The difference is that is not allowed to touch the ball with the feet and it is prohibited for the field players to enter the penalty areas in front of the goals. Furthermore, players can be substituted at any time during the game without an interruption of the game and without a previous announcement.

Team handball is a fast, physical, full contact game. A general rule prohibits equipment that might cause injuries of players or equipment that can be used to reach any kind of advantage (e.g. can be used as a handle). That is the reason why personal sensors are not used so far in team handball.

1.2 Current Status of Digitalization in Team Handball

Team handball is just at the beginning of the digital transformation. Match information is only collected regularly in the men's major leagues and on the national team level. If at all, then coaches only have access to the information during the match if the collection is done based on paper. Digital information is mostly collected manually after the matches based on videos.

Sensors for automated collection of information are not used at all during matches, due to the regulations. Some teams are using sensors during training but there is almost no combined analysis of both the training and the match data. Lower leagues, as well as youth teams, do not use information collection and analysis at all. Women's leagues usually follow a very rudimentary approach based on pen and a blank piece of paper.

2 CoCoAnDa

2.1 Project Context

CoCoAnDa is a project of the *Center of the Intelligent Use of Information Technology* (ZINI) located at the *Cooperative State University of Baden-Wuerttemberg Stuttgart*. CoCoAnDa has been created as a result of a conversation of representatives of the *Team Handball Federation of Baden-Wuerttemberg* (HVW) and Prof. Dr. Friedemann Schwenkreis who is the director of the ZINI. The first real steps were made in 2016 together with Eckard Nothdurft, the assistant coach of the team of HBW Balingen-Weilstetten (a first league team handball team), at that point in time.

2.2 Objectives

Coaches need to make frequent decisions while managing teams, to improve the performance of teams and players in general, as well as during matches in particular. Currently, the decisions of coaches are mainly based on their experience and intuition. The objective of CoCoAnDa is to collect, analyze and present data such that coaches can take most recent and objective data into account when making decisions. Furthermore, the raw data is pre-processed such that the decision-making process is accelerated by enhancing current data with analytical results using historical data. Additionally, CoCoAnDa develops user interfaces in close collaboration with coaches, such that the graphical presentation of the information can be quickly understood, which in turn helps to further accelerate the decision-making process.

2.3 Focus Fields

As being said, currently, not much digital information is collected and available in team handball. This is due to two major reasons: Affordable solutions do not have the needed quality and solutions having the necessary accuracy are too expensive for most of the teams. Most of the available digital information that is available today has been generated manually either directly during matches or based on videos after the matches. Unfortunately, the in-match collected information is often error-prone due to the speed of the game and the absence of quality assuring concepts and fault-tolerance in the collecting tools. Thus,

- CoCoAnDa develops mechanisms to collect high quality digital match information of team handball matches by following a two-track policy: A tablet based mobile app is provided that allows to directly collect digital information during a match. At the same time sensor technology is investigated to enhance the manually collected information and to incrementally replace the manual data collection with an automated collection.
- CoCoAnDa provides coaches with digitalized information during matches as well as during the preparation of matches, while managing the team, and during training sessions. Thus, CoCoAnDa develops mobile apps that can access and visualize historical data as well as data that has been recently collected (e.g. data of the currently ongoing match). Additionally, CoCoAnDa defines an infrastructure that allows to directly present information to coaches regardless whether the information has been collected manually or by sensors, and regardless whether teams are playing at their home location or remote.
- CoCoAnDa develops an evaluation model that allows to evaluate the actions of players and teams as the foundation of the evaluated presentation of gathered information. Currently, there are only very basic evaluation models of team handball. CoCoAnDa strives to develop a comprehensive model that in particular allows to evaluate both defensive and offensive actions in a balanced way.
- CoCoAnDa investigates data analysis methods for their applicability in the context of team handball. There are two major areas which are of special interest to the project: Prediction of the potential of players including the influence of injuries and the automated recognition of team tactics with an estimation of their success.

2.4 Project Setup

CoCoAnDa is a research project which is integrated with education provided by the Cooperative State University of Baden-Wuerttemberg Stuttgart (DHBW Stuttgart). While the continuous context of the project is provided by Prof. Dr. Friedemann Schwenkreis, specific topics are looked at by business management students on behalf of their studies.

Thus, students can use team handball to look at “classical” digitalization questions like how can a field benefit from digitalization and what needs to be done to actually perform the digital transformation. The challenges range from the development of

apps to the application of deep learning technology and mechanisms to find and recognize patterns.

The application field is represented by team handball coaches as for instance Eckard Nothdurft who is coach by himself but also a professional trainer of sport coaches. Recently the set of experts has been extended by coaches from other fields, because the Olympic Training Center in Stuttgart has realized, that the ideas of CoCoAnDa can be applied to other areas beyond team handball as well.

CoCoAnDa cooperates with Prof. Dr. Ulrich Rückert from the University of Bielefeld in the area of sensors and the intelligent analysis of sensor data. However, the project is constantly seeking for industrial partners (like sensor manufacturers) to be able to focus on most recent developments.

3 Current Work Packages

3.1 Team and Player Performance Index

Whenever CoCoAnDa components present data of teams of players to coaches, the data shall be pre-evaluated in terms of the performance of a team or a player. Therefore, a performance evaluation model is needed. A so-called player impact index [3] is developed which allows to measure the contribution of a single player as well as of a whole team. While current approaches over-emphasize the offensive actions of players, CoCoAnDa aims at a balanced index which also takes defensive actions into account.

Basically, we assume that players at a certain position on the field have a certain scoring probability, if they possess the ball. This simple observation allows to evaluate any player activity on the field. Increasing the scoring probability of the own team is assumed to be a positive contribution and decreasing the scoring probability of the opponent team is a positive contribution as well (and vice versa).

How the scoring probability of each player is aggregated to the scoring probability of the team is a research question. The same holds for the value of a certain activity at a certain point in time of a game.

3.2 Mobile Apps

CoCoAnDa develops a whole infrastructure of mobile apps that allows to collect data and use data for decision making [3]

Backend Infrastructure for Mobile Apps. CoCoAnDa's mobile apps do not have a built-in data management. It is rather a separate (mobile) component based on a set of simple concepts:

- The backend needs to be co-locatable with the mobile apps
For the fully mobile case, the backend needs to run on the very same mobile device as the apps that collect information as well as apps that analyze and visualize information. Particularly, the backend must not require any Internet connection.

- The backend infrastructure shall use a standard SQL database that supports state of the art analysis tools.
- Any kind of information collecting component shall be connectable to the backend, regardless whether it is a mobile app supporting the manual information collection, or an automated sensor-based component.
- The backend shall offer different kind of views on the data (including analytical views) that can be used by visualizing apps.
- The backend shall support the export of the data in Microsoft Excel format, such that the data can be further processed using Microsoft Excel.

Scouting App. CoCoAnDa has developed a mobile app for collecting information during matches or based on watching a video of a match. The following requirements have mainly influenced the development so far:

- The scouting app needs to allow the manual collection of game information using a 10” Android® tablet.
- The number of manual steps to collect the different events of a game shall be minimal
- Given the speed and complexity of events, the scouting app focuses on one team only. Thus, it is an asymmetric approach. To get the full symmetric information, two scouts are needed.
- Errors during information collection cannot be fully avoided. The scouting app must support the correction of any type of error.
- The data collected with the scouting app is sent as event data to the backend.
- The set of events that need to be collectable with the scouting app is constantly revisited with team handball coaches.
- Consistency ensuring mechanisms are built into the scouting app to avoid inconsistent data.

Coaching App. The coaching app of CoCoAnDa presents the collected event data to team handball coaches. Again, there is a set of major requirements driving the development of this component:

- The coaching app must support a 10” Android® tablet.
- The coaching app shall be able to depict the current event information of a match while the information is collected.
- The information shall be graphically displayed as a dashboard for the coach.
- Which and how information is displayed is constantly revisited with domain experts.
- There needs to be a team-focused view and a single player-focused view.
- The coaching app shall be either co-located on the tablet of the scouting app or running on a separate tablet.

3.3 Data Science for Team Handball

CoCoAnDa also investigates how methods of data science can be applied in case of team handball. We have identified multiple potential areas which are investigated in particular:

- Pattern discovery based on data of the leagues. Particularly, patterns that explain the success / failure of teams in matches and during a whole season.
- Discovery of major “influencers” of a match performance and automated suggestions during the match.
- Prediction of the potential of a player’s performance and identification of potentials for the national team (or other elite teams).
- Prediction of the impact of certain injuries on the mid-/long-term player’s performance.
- Automated tactics recognition [2] and prediction of the success rate of a certain tactic.

4 Conclusions

CoCoAnDa is an ambitious project which introduces information technology and methods to a very traditional, and currently mostly analog field. The project tries to help with the digital transformation, clearly identifying areas where the digital transformation introduces a direct benefit to the application field.

Team handball is used just an example. The methods and concepts used in the project can also be applied to other areas of sports and beyond. For instance, it is a very typical situation that the potential benefit of the use of analytics is obvious, but there is no or not enough digital data available to be able to use the modern methods of digital analytics. Thus, it is a very common thing in traditional areas, to introduce digitalization in the area of data collection first. Then this is followed by a collecting phase which in turn lays the ground for analytics. However, the analytical concepts can be worked out while data is collected or even before.

References

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