A digital platform in professional road cycling


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Team Sunweb is searching for marginal gains compared to its sporting competitors. We as KPMG are part of their expert team. We provide them with insights from data analysis, help them with transforming their organisation to be more data-driven and build a platform which the team uses to manage and plan their season and races. In this article we describe several projects and tools which we have created with Team Sunweb. We will dive into what is the optimal sprint, team time trial, real-time data analysis and digital performance platform.

INTRODUCTION

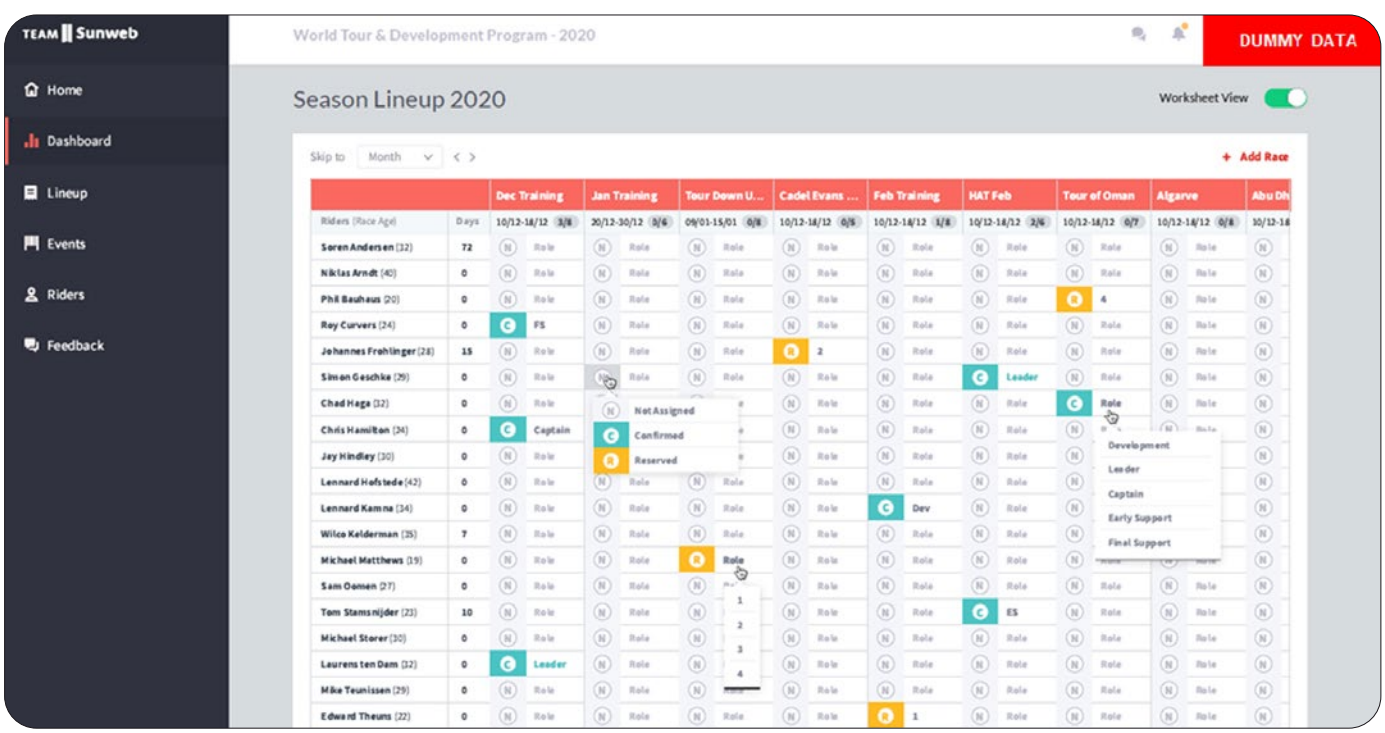
Professional sports is one of the toughest businesses on earth. The competition is exhausting and in most cases there can only be one winner. In top sports the whole company is built around a single person. Its sole business is to make that person excel and even exceed his or her own limits to be the best in his or her kind of sports. A professional sports company is one big team which works for this person. We are part of such an amazing team: Team Sunweb. Team Sunweb is a professional cycling team which performs on the world's highest stage.

KPMG has developed a digital platform for the professional cycling team Team Sunweb. The digital platform supports the performance organisation, the business of professional cycling. The digital performance platform consists of data analysis functionality and apps which support the riders, coaches, experts and management throughout the season. The performance app supports the development of the season line-up, race plans and individual year plans, allowing the different experts in the team to provide their input following a structured process. The performance data analyses provide strategic and tactical insights (see Figure 1). For instance, analyses of historical race results provide input to optimise the season line-up, and analysis of power data of young talented riders provides input to decide on development trajectories towards the men's elite team. In this article we share insights on the analysis of the sprint train and the team time trial (TTT). The former is used by coaches to optimise race tactics specifically when it comes to reaching top speed during the final sprint. The latter provides real-time insights to coaches during TTT practice to make constant adjustments to achieve the smoothest ride.

SPRINT ANALYSIS: TOWARDS TOP SPEED

The goal of Team Sunweb is to have an even minor competitive edge over the other teams. Winning in cycling is one of the toughest goals one can have. A rider is competing against 150 to 200 other top athletes and only one can win. Increasing the chance of winning even by a small margin is huge in cycling. Having that competitive advantage over the other teams is needed to excel. In the partnership with Team Sunweb we focus on this goal. Team Sunweb is provided with insights in optimal positioning and optimising the amount of supporting riders in the team (a.k.a. domestiques) by our data analysis. For example, it was found that the thought of "the more helpers the better" doesn't apply. Too many helpers will make your sprint train inflexible, the optimum can be found between three and six helpers in the final kilometres. The analysis is performed on the basis of video and power data analysis.

Figure 1. Performance app.



The sprint analysis focusses on optimising the performance in the bunch sprint[1] of a race. There are three key factors for success, namely positioning, helpers and insight. Insight is one of the most difficult aspects to measure but is partially correlated with the positioning and helpers. In the research of the sprint we have investigated the positioning of the rider and the number of helpers related to the success of a race.

Optimal positioning of a professional sprinter for a bunch sprint

From the research we have determined what a sprinter's optimal positioning is for the last 10 kilometres of the race. There is a narrow bandwidth of positioning where one has the highest chance of success compared to other positions. This can be seen as the optimal positioning for the last 10 kilometres and has been presented to the performance team of Team Sunweb in a scorecard format to provide guidelines to the coaches before and even real-time during the race based on the composition of the leading breakaway group.

Gathering the data

We have analysed video data of several hundred races to determine the position and the number of helpers for a top sprinter. We have selected only bunch sprint races and top sprinters. The top sprinters are selected according to a certain metric called the rider strength. The rider strength was calculated in a previous project together with Team Sunweb (The Grand Tour Analysis). This metric tells you how strong a rider is compared to the other riders in a certain aspect of cycling, for example sprinting, climbing or general classification. To make sure that a failure sprint is really a failure and a successful one really a success, the ten best sprinters according to the rider strength of each year are selected. This selection process is important for the validity of the analysis.[2]

Determining the best team size

After investigating the positioning, we have investigated team size. Team size is an important aspect in two ways. First of all, the more helpers, the less the key sprinter has to do to maintain a good position. Secondly, if a fast finishing sprinter has too many helpers around him, you as a team might lose flexibility and might be left behind

or be restricted in tactics. The optimal number of helpers is determined using the same type of statistical analysis. This is calculated for various distances till the finish line, starting from the last 10 kilometres.

TEAM TIME TRIAL: A SMOOTH RIDE

The plan for an optimal team time trial (TTT) is essentially very simple. The point is that all riders reach the finish exactly by the time they run out of energy. Having energy left, means you could have gone faster, running out of energy before the finish, means that your helpers will have to continue without you. The plan can be better executed with coaching based on insights from real-time data and can then yield up to 20 seconds on a TTT of around 30 kilometres. This is why it is very valuable to get insights from data. Additionally, in a TTT you have more control over the course of the race than in regular race

> If you can generate better insights with data analysis, you can also make better decisions about the race plan

1 A bunch sprint is a sprint where a large group of riders is close to each other; generally, this is a group that is bigger than 30 riders.

2 When a mediocre rider is sprinting and finishes fourth or fifth, this can sometimes be seen as a success when compared to the rest of the field. Hence, we have left out these riders to obtain and analyse a "cleaner" dataset.

stages. There are many possibilities to gain more insights. For example, in wind tunnels you can simulate real-live racing to identify the optimal positioning for attaining the least resistance and therefore the lowest energy consumption for the specific course you are driving.

Real-time sensor data analysis

We use sensors on bicycles and riders that measure three things: heart rate, speed and the power transmitted to the pedals. During training, since the use of live performance data is not allowed in competition, the data from those sensors can be sent in real time to the cloud and back to be presented on a dashboard in the team leader's car. Using this type of technology only makes sense if you can properly model an optimal execution of a TTT. We developed this system in an innovation project together with the Technical University Delft (TU Delft) and Team Sunweb. This includes optimising the time intervals for the lead riders. If you take the lead too explosively as a rider, it will take too much power. Taking the lead too gradually is also suboptimal. TU Delft has developed the ideal plan for a stage with mathematical modeling. Our system compares the actual performance to this ideal plan in real time. An important factor for feeding that model is that you properly measure how long a rider rides in front (see Figure 2). Because that strongly determines how quickly his figurative battery drains, and needless to say, the goal is to use those batteries optimally. Our model measures the lead turns (how long a rider rides in front) based on, among other things, the data on speed and power, and it determines the lead position with a 93% reliability. In addition, the system can only be used if the data arrive within a few seconds.

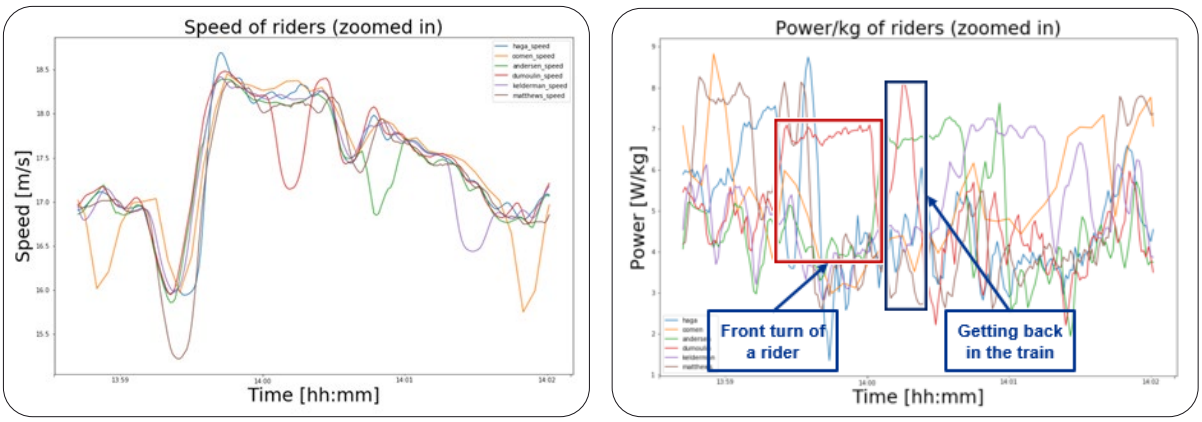


Figure 2. Team time trial analysis.

However, the definition of "real-time" differs between the commonly used BI tools and they take up to 10 seconds to refresh. That was not fast enough, so we built a solution ourselves to generate real-time insights for the support vehicle with a latency of less than 1.8 seconds.

The TTT system can be used during training and is used to prepare and evaluate the last training before a race on the actual race course. This makes it possible to train every exact moment and place at which the lead position changes during a TTT race. The data analysis that is used for this is automated and is part of the digital platform. The platform is the technical foundation which enables us to develop valuable use cases like this one for the TTT.

A DATA PLATFORM AS A FOUNDATION TO ACCELERATE

In order to perform the above analyses properly, it is important to have access to advanced methods and techniques. An important first step is to replace the many separate applications (e.g. in Excel) with a solid data platform on which data scientists can build and run their analyses, giving the user the right insights. The data analysis platform makes it possible to link different data sources and it offers all the necessary (scalable) computing power to be able to perform complex analyses quickly. The staff of Team Sunweb processes data into insights more efficiently working with our platform. We can analyse the expected performance and FTP values (Functional Threshold Power) of a few thousand riders in combination with countless races and the insights can be realised in a matter of minutes. The platform is gradually being further developed with ever new functionalities, and enriched with a growing number of data sources and algorithms that have been developed by the data scientists of KPMG together with the Sunweb cycling team. Conceptually, this platform is well thought-out – with clear basic principles about, for example, the architecture and security that facilitate the growth model in terms of functionalities. The prioritisation of the applications to be added is agreed on in close consultation with the experts of the performance organisation and aligns with the team's race philosophy.

THE PHILOSOPHY: AN OPTIMISED PLAN IS A PREREQUISITE FOR OPTIMISED PERFORMANCE

In essence, it is very simple: if you can generate better insights with data analysis, you can also make better decisions about the race plan before, during and after the race. That is only possible if you have a clear plan. Strongly simplified: a rider applying 400 watts of force to the pedals for an hour, doesn't mean anything; it only becomes valuable information when compared to the plan which states that the goal is to transfer 420 watts for that period.

About the authors

Paul Adriani MSc is a senior manager at KPMG and has a background in artificial intelligence. He founded the Sports Analytics department of KPMG and started the partnership with Team Sunweb.

Bram Schermer MSc is a senior consultant at KPMG and has a background in particle physics. He has been working at KPMG for three years as a data scientist. Besides data science, he has a passion for cycling, which is the reason for his involvement in this partnership.

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