The changing technological face of the Tour de France

July 2 2014, by Bryce Dyer

Gearing up takes brains, brawn and tech. Credit: EPA/Nicolas Bouvy

The Tour de France is one of the most iconic and physically demanding sporting events in the world. Held annually since 1903, it has evolved from a simple test of endurance and speed to a festival of technology and innovation as teams fight to find the egde that will take them over mountains, high speed straights and cobbled roads ahead of their rivals.

The basic premise of the tour has generally remained the same since

1913 – the rider who covers the route in the least accumulated time across all of the stages wins. But the route is changed by the organisers every year, which means that unique demands are placed on the riders, the teams and their resources.

This year's tour is divided into 21 stages covering a total of 3,656km. There are nine flat stages, five hilly stages, six mountain stages, one 54km time trial and two rest days. As a result of all these different conditions, an awful lot of specialised equipment is needed. In early tours, the same bike was used for the whole race but these days, a different one is chosen based on the different demands of the stage, its gearing and wheels tailored to the terrain.

Cobble horror

Perhaps the most intriguing test for the teams this year will come on stage five when the riders face some perilous sections of cobbled roads. The tour riders, who generally weigh between 60kg and 80kg, will be subjected to massive levels of impact and vibrations as they pass over these surfaces.

To add to their misery, these cobbled roads have been in place for decades so they are not flat. Wear, breakage and subsidence makes them uneven, to put it mildly. To maximise speed and control, the best riders often ride in the middle or "crown" of these sections. With space at a premium though, experienced riders might also choose to ride in the dirt gutter between the cobbles and the grass banks at the sides of the road which has often been worn smooth.

This decision becomes critical in wet weather in particular, when riding on even the slightest camber can be extremely dangerous at these speeds. Punctures, loss of control and crashes are common and injuries can be severe.

Many of the riders looking to do well in a race like the tour will not typically ride on these kind of surfaces in other events because they are suited to heavier, stronger riders rather than those built for mountainous terrain. There are a small number of early season races in the spring that do feature these kind of surfaces such as the notorious Paris-Roubaix – known as the "Hell of the North" – which give a flavour of what riders can expect.

To ride these cobbled stages, bicycle frames may use a different geometry when compared to those used on tarmac or asphalt. These bikes may be longer in length to help smooth the ride. Riders will also often use extra padded bar tape and wider tyres to absorb the vibrations and sometimes extra brake levers are added to help them stop quickly in the peloton.

Higher ground

During the hilly and mountain stages, when the race passes through both the Alps and the Pyrenees, the teams will send their riders out on the lightest bikes possible. The lighter a bike is, the faster it will go uphill. A professional rider may be able to generate and sustain 6.4 watts of power per kilogram on a typical alpine climb whereas a recreational rider may only be able to achieve half of that ratio. As a result, the bike's weight will be as close to the regulation minimum of 6.8kg as possible and lightweight wheels will be used to minimise the impact of rotating mass which could slow a bike's acceleration when a rider wishes to attack others when on a climb.

Time trial tech

Stage 20 this year will showcase the real importance of cycling aerodynamics. This relatively flat individual time trial will see the riders

trying to generate maximum power while minimising aerodynamic drag. Put simply, the more aerodynamic you are, the faster you will go (or the more energy you can save) for the same power.

The bicycles used for this are highly specialised, with filled-in disc rear wheels and low drag frames. The riders themselves will assume a riding style that makes them look a lot like a downhill skier with their arms angled directly in front of their chest and torso to minimise their frontal area. They'll use aerobars and wear a teardrop shaped helmet to reach speeds that can average 50km an hour.

Staying in touch on level ground

One of the more controversial new technologies in professional cycling has been the use of team radios to relay orders and information during the race. The organisers have even experimented with removing the riders' earpieces in an effort to add more drama to the racing.

It is true that radio technology is often used to influence the result. Flat terrain typically results in a mass sprint but sometimes a small group of riders will break away at an early point in a stage and try to hold onto the lead until its end. However, these early escapes are rarely successful because the team cars and the riders following the breakaway can calculate the distance between the breakaway group and the "peloton" and then use radio transmitters to determine how fast they need to move to control or close the gap. It's very hard for the breakaway group, typically containing just a few cyclists, to overcome the horsepower of 200 chasing riders armed with precise knowledge of the wherabouts of their quarry.

Do it yourself

Technology is a major part of the tour these days but that has not always been the case. In the early editions of the event over a hundred years ago, the riders were very much expected to compete alone and be self-sufficient.

Bradley Wiggins on a time trial. Credit: Waterboyzoo, CC BY-NC

When the forks of Eugène Christophe's bike snapped mid-race in 1913, he had to visit a local blacksmith and then re-weld them himself. It was later discovered that Christophe had enlisted the help of a local boy to pump the bellows for the forge and as a result, he was later penalised for receiving outside assistance.

The use of new developments in cycling technology was frowned upon too. The tour's organisers didn't even allow the use of mechanical gear

changing systems until 1913. Before this, a rider would have to stop, unbolt their rear wheel and flip it over so they could switch to a single cog mounted on the other side of the hub. In the event of a puncture, they rode with spare tyres looped around their torsos.

Battling bodies and brains

Technology is now, of course, a fundamental part of riding the tour. And it stretches far beyond the bicycles themselves. Preparations for the race will have begun long before the start and the clothing riders wear, the bicycles they ride and the nutrition they take are finely honed products that can take months or even years to develop.

Eugène Christophe

When they're not actually riding, recovery technology is used to prepare them for the next stage. Riders will have massages, wear compression clothing and take ice baths to help reduce muscle soreness and inflammation. The key principle here is that winners are not always the strongest but those who possibly tire the least over the three weeks.

Each team of riders is supported by doctors, mechanics, physiologists, coaches and operational management. There are multiple team cars and buses which house their equipment and spares. They become, in effect, a

mobile business and garage for the duration of the race.

Professional bike racing has been referred to as "chess on wheels" as the smartest rider and team, not the strongest, often win. We'll find out if this is the case this year from July 5.

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