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WINS GOLD AT RIO 2016

Team GB returned from Rio 2016 with 27 golds, 23 silvers and 17 bronzes to finish second in the overall medal table. From athletics to equestrian, from gymnastics to hockey, from diving to shooting, it was an unforgettable Games but, as Ged Henderson reports, the big difference was technology.



■ Medal winners: Mo Farah, the women's hockey team, Victoria Thornley and Katherine Grainger, and Jessica Ennis-Hill.



It had been a close call. British cycling legend Jason Kenny stood on the Olympic podium to have a sixth gold medal placed around his neck with the strains of the national anthem ringing out. But it could have been so different.

Kenny's record-equalling gold – his third of the Rio Games – came in the keirin event. But if it had not been for two members of Team GB's backroom technical staff he might well have been disqualified.

It appeared Kenny and another rider had come close to illegally overtaking the pace motorbike before it had left the

track. The race was stopped, the nation held its breath.

That's when two data performance analysts from British Cycling – Will Forbes and Dr Debs Sides – entered the picture.

From their vantage point in the gallery at the Olympic velodrome they sent GB's head coach Iain Dyer video footage of the incident. Beamed through the team's own internal WiFi system it was available less than a minute after the gun was fired to stop the race.

Tension

As the tension mounted and millions of TV viewers waited anxiously, Dyer was able to show the race officials – who did not have their own on side-on camera

to prove that the riders were over when the pacemaker left the track - Team GB's footage.

Dyer said later: "I offered our footage, not really knowing how it looked. It was a big call in hindsight, but we didn't have anything to lose."

Fortunately for Kenny the officials were willing to accept the help Dyer offered. The video showed it was too close to call, no-one was disqualified and the race was re-run with all six riders.

Frustratingly that second attempt was also aborted and Team GB's video evidence again came to the judges' aid, preventing the eviction of a German rider. Finally, on the third attempt, the race was completed, Kenny powered his way



to victory – and the rest is now Olympic history.

The efforts of Forbes and Sides that evening may have been the most high-profile example of technology helping bring Brazilian gold back to Britain but it is by no means the only one.

Olympic powerhouse

In sports from rowing to taekwondo, a host of highly skilled and dedicated backroom staff – “the team behind the team” – have harnessed the latest technology to help Britain’s athletes deliver and to give them and their coaches that competitive edge.

And how they delivered! Team GB returned from Rio with 27 golds in total – a haul of 67 medals altogether – the most Great Britain has won at an Olympics since 1908 and putting us ahead of China in the final medals table.

It’s all a far cry from 20 years ago when the team returned from Atlanta with just one gold medal between them.

The journey from Olympic no-hoper to powerhouse began shortly afterwards. It has been fuelled by hundreds of millions of pounds of National Lottery cash. And investment in technology has played a major part.

Established in May 2002, The English Institute of Sport (EIS) is a grant-funded organisation that provides sport science and medical support services to elite athletes.

EIS experts help coaches and performance directors to improve the performance of their athletes by delivering services which enable them to optimise training programmes, maximise performance in competition and boost their health and wellbeing.

Glenn Hunter is EIS research and innovation manager and has seen first-hand the work that has moved Team GB up the medals table.

He says: “When I joined we were 36th in the table, now we are second. Part of that is UK Sport creating a culture where you are expected to go out and win.

“We’re here to support and help the athletes on their performance journey. There is quite a machine behind the scenes to help people win.

“The athletes and their coaches are the important people, they do it all. We provide the support. It’s also about continual forward planning and trying to get better.”

Hunter says: “The only really true competitive advantage you have is to learn faster than the opposition. We have a whole range of projects based around that idea.”

He has been involved in the development of the Performance Data Management System (PDMS), which played an important role in the run-up to Rio.

PDMS is available to all athletes, coaches and EIS sport scientists. It brings together data from a variety of sources.

This information-led approach allows athletes and coaches to better manage and understand health and fitness and reduce the incidence and impact of illness.

Data-driven

The intelligence gathered allows coaches to monitor and adapt training programmes and manage recovery in a way that optimises their athletes’ availability to train and compete with maximum effort – giving them the

“We’re here to support and help the athletes on their performance journey. There is quite a machine behind the scenes to help people win.” Glenn Hunter

best possible chance of achieving their performance targets.

It includes monitoring and input from the athletes themselves, insights and reports based on medical records and the use of the data to look at potential future injury issues, their causes and the probability of occurrence.

The PDMS app is also used to communicate directly with athletes and deliver advice and tips on a wide range of recovery techniques.

Advice is sport specific and tailored to reflect the individual circumstances of a sport or athlete and covers a range of subjects – everything from meal planning and nutritional advice, to tips for minimising the impact of jet lag, or even the best way to create a home ice bath.

PDMS has been used by competitors in a range

of Olympic sports from cycling and gymnastics

to women’s rugby, canoeing and hockey.

British

Cycling was one of the first sports to use the PDMS

app to support its athletes in their recovery

strategies and provide them

with specific, best practice information to suit their individual requirements.

GB Hockey, whose women won gold in Rio, also used the PDMS app as part of its athlete monitoring.

EIS strength and conditioning coach, Andy Hudson, head of physical preparation for GB and England Hockey, says: “PDMS has a user friendly interface so it makes it easier to capture information and then present it back quickly in graphical reports that provide a snapshot of athlete availability for training and, longer term, enable us to track and analyse the volume and intensity of their work.



"Having all of the information available and up-to-date in a single place makes it much easier for the sport science team to support the athletes as they are all working from the same data.

"It means the strength and conditioning coaches can use it to inform their work as can the physiotherapists, physiologists, doctors and other practitioners that are also part of the multi-disciplinary team."

Steve Ludlow is principal analyst at analytics, business intelligence and data management experts SAS UK, which has worked closely with Britain's successful Olympic rowers.

He says: "Sport generally is making more and more use of data and analytics. We only got involved with British Rowing and the GB Rowing Team in May 2014, so rowing has already come a long way.

"All sports, including rowing, are continually looking for different ways they can make those small marginal gains.

"We are looking at new areas, such as biomechanics – all the forces and angles of those forces that are operating on the boat – to see how we can make each of the strokes, by rowers and the crew as a whole, more efficient."

He adds: "Data is never going to be the complete answer, but making use of the available data to extract insights can only help the various experts within the sport to make smarter decisions."

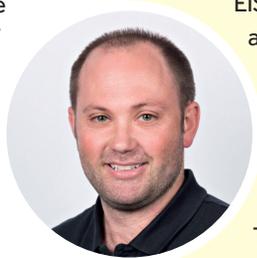
The crowds may only just have stopped cheering the efforts of Team GB's Rio triumph but attention has already turned to the Tokyo Games in four years' time.

Creating "what it takes to win" models will continue to play an important part in those preparations.

Hunter at EIS says: "We are already looking at the Tokyo timeline, asking what are the key things that might go wrong and how do we mitigate against them.

"It's about gathering intelligence to help us make decisions, putting it all together for the bigger picture.

"It's a bit like working for MI6, gathering intelligence, putting it on the table and asking, 'What does this mean? And, if it means this, what should we do about it?'"



EIS head of performance analysis Chris White (pictured left) was based at the British School, just eight kilometres from the Olympic Village and Athletes' Village in Barra de Tijuca.

As well as the technology that allowed the performance analysis team to link with Manchester, it boasted top training facilities, medical, physio and operational areas.

White says: "Team GB in Rio was the most supported that has ever competed at an overseas Games, and the performance analysts in Manchester played a vital role in this as the team behind the team."

Cutting edge technology was used to deliver targeted video analysis to teams in the time frame they needed to make

PUTTING TEAM GB IN THE PICTURE

Some 6,000 miles from the sandy stretches of Copacabana beach or the Olympic stadium, a special sporting team in Manchester played a key role in helping Team GB athletes to golden glory.

The EIS performance analysis hub, set up in the state-of-the-art Manchester Institute of Health and Performance (MIHP), was linked directly with the British School in Rio.

Experts based at both sites recorded and reviewed hundreds of hours of footage of the Olympic sporting events as they took place.

The work of the central performance analysis team was sent immediately through to the embedded analysts, coaches and athletes in more than 17 Team GB sports using the online video analysis platform dartfish.tv.

It provided crucial information on the performance of British competitors and their opposition – helping make the difference between winning Olympic gold and missing out on the podium altogether.



■ Performance analysis is crucial.



a difference. The time difference meant some late nights for those back in Manchester.

One of the main roles for the team back in North

West England was to review Team GB's opposition – looking to identify all their strengths and weaknesses.

White says: "High performance sport within the UK has advanced significantly since the London 2012 Olympic Games in its delivery of technical expertise to sport and the performance analysis team based in Manchester are at the forefront of this."

He adds: "The job of the analysts embedded within the teams at Rio and working at pitch side or in the arena was to provide simple, targeted and effective video and digital feedback to coaches.

"Research shows coaches only recall 30 per cent of the action and incidents played out on a pitch. We fill in the other 70 per cent. Why would you guess when you can know?"

White, who spent a decade working with British Cycling and Team Sky, says: "It's an exciting job, every day is different. You are on the frontline, working with coaches and athletes, genuinely having an impact and adding value to their success.

"The athlete's performance is what is important. You are the team behind the team, looking to support them in the best possible way.

"It never stops, and that is our challenge. You need to stay on the front foot with the technology."

VISUALISING SUCCESS

BAE Systems delivers some of the world's most advanced, technology-led defence, aerospace and security programmes. If there were medals for innovation and engineering excellence it would be in the running for gold.

While its high-flying Typhoon and Lightning fighter plane programmes make all the headlines, the company had a crucial role as part of Team GB's Rio success.

BAE Systems is UK Sport's official research and innovation partner. The eight-year partnership has seen it apply technology usually reserved for the defence and security sector to help the nation's athletes improve their performance.

This partnership approach has helped more than 30 different sports and 250 Olympic and Paralympic athletes since 2008.

Recent projects include an advanced cycling ergometer used to measure the power output of Britain's all-conquering Rio cyclists.

Its visualisation experts have also been helping British athletes train by providing 360° and 3D simulations of course layouts ahead of major competitions.

Digital headset technologies are being used to integrate 3D video in new ways, aimed at providing a real benefit to a wide variety of sports including sailing, canoeing and triathlon – all Rio gold medal winning sports.

The technology provides a playback of 3D recorded material collated ahead of competition, giving athletes a fully immersive experience.

It allows them to feel familiar in the environments they'll be competing in as well as understanding the undulations, twists and turns of a course layout. Again it is all about giving Britain's elite sporting performers an edge.

Simon Timson, director of performance at UK Sport, says: "Familiarity and practice in the competition environment, whether real or virtual, breeds confidence in athletes.

"The advantages of virtual training should not be underestimated in the pursuit of excellence. This adaptation of new technology allows us to digitally bottle that experience for elite athletes and help them perform at their best."

Brendan Purcell, performance director for British Triathlon, adds: "Having the support of a major technology business such as BAE Systems is exciting and opens up new opportunities for us.

"We worked with them on this 3D video imaging project as part of our intelligent racing strategy, using content gathered at the Rio Test Event last summer."

Another team of engineering experts at BAE Systems worked closely with the British cycling team to develop the state-of-the-art advanced cycling ergometer to measure the immense power output of its elite performers.



"Virtual training should not be underestimated in the pursuit of excellence. It allows us to digitally bottle that experience for elite athletes." Simon Timson

It measures the work-rate and energy expended by cyclists and according to the BAE Systems experts is capable of replicating the inertial forces of a velodrome more accurately than any other testing tool.

The important data collected includes gas and blood analysis and enables testing at high speeds to analyse the technique of the cyclist.

In another of its sporting projects BAE Systems applied some of the techniques and principles used to develop fighter jets and military tanks to help give the GB Taekwondo team an edge.

Its team of engineers and scientists helped the team to evaluate the electronic scoring vest which is used in major international competitions.

As a result the GB Taekwondo team adjusted its training style to maximise the methods needed to score.

The company has also worked on a training simulator to enable GB's Taekwondo competitors to develop new skills while significantly reducing the risk of injury through repetitive impact.

Henry White, BAE Systems' UK Sport Technology Partnership lead, says: "We apply the same problem-solving principles and ingenuity to challenges in sport as we do to tackling complex defence and security programmes."



Virtual training in action.



A MASTER STROKE

At 6ft 8ins Olympic rower Paul Bennett (pictured above) was the tallest member of Team GB's victorious men's eight crew in Rio.

In an immense performance in the final Team GB led from start to finish to beat their great rivals Germany.

The 27-year-old Oxford Blue, who has a Masters in computer science, has seen first-hand how performance analytics and the information it delivers can help elite athletes in their pursuit of success.

Earlier this year London-born Bennett, who is also a double world rowing champion, was appointed as a part-time intern at SAS (pictured right, below), the analytics partner for British Rowing and the GB Rowing Team.

He says: "Currently the main use of data we have is through a system referred to as 'telemetry'. Essentially this is a sensor system which we can fix to boats to gather data about the rowing stroke and the boat speed.

"From this we draw conclusions about how each of us is rowing, and whether we are rowing together. It is essentially a form of coaching by data.

"It has in the past been shown to be useful for identifying areas in which we can improve so we can be better prepared for racing."

He adds: "The key pieces of information I use are predominantly my ergo scores. If I am pumping out personal bests all year then I think I am on to be winning medals come the summer.

"When we are in crews we have fixed goals for boat speed during training pieces. These speeds are based on the fastest speeds that boats have ever done. We aim to be beating those speeds when we are practising at or close to maximum intensity."

There is also a psychological edge to performance analytics. Bennett says: "Knowing that you are going fast in training and knowing that you are physically at your fittest can do a lot to calm your nerves before racing."

He also sees performance analytics continuing to develop in his and other sports. "Currently it all feels very rudimentary. There is a huge amount we can do with the data we have."

Britain's rowers returned from Rio with three gold medals – it's a sport where success is now demanded and expected.

With top British rowers training multiple times a day, the amount of data that a single athlete can produce can be extensive. On top of that there is the combined crew information to sift through.

SAS has worked with British Rowing to provide the tools to examine and interpret all this information more quickly and in-depth.

Mark Homer, GB Rowing Team's senior sports scientist, says: "Bringing together that array of data, combined with data from competition, we have a huge resource to inform our training and help to enhance athlete performance. But the data is nothing without the tools to analyse it."

Data analytics is used to spot initial signs of injury so training regimes can be tailored accordingly, enabling rowers to miss fewer sessions. Data modelling also provides the knowledge that allows more informed coaches and managers to make better decisions.

Steve Ludlow, SAS UK and Ireland's principal analyst, says: "The GB Rowing Team collects lots of different data on each of the rowers – strength and conditioning data, on the water data, physiological data such as blood lactate levels, biomechanical data – as well as other data types such as weather data.

"We analyse their data to find insights that aid decision-making. We can spot anomalies in the data and look into why they might exist, and we can look into correlations between one set of data and another.

"As well as better understanding of what the data is telling us, it can help uncover things we may have not previously known about – the hidden gems or needles in the haystack.

"All this ultimately helps the coaches make better decisions so the boats go faster. If we can find a few marginal gains here and there, that can make a significant difference.

"At the Olympics in Rio, you will have noticed that some of the races were extremely close including one, not involving the GB Rowing Team, close to a dead heat."

He adds: "A key element is the in-built analytical capability – it's predictive,

meaning it can be used to generate insights into various future scenarios, making it a key aid to better decision-making.

"For example, it could reveal information about a particular rower that is indicative of a slight muscle strain that could lead to a full-blown injury unless their training schedule is adapted accordingly."



SAT-NAV PUTS HOCKEY STARS ON RIGHT ROAD

The mass celebration after Great Britain's women won a first Olympic hockey gold medal was one of the most enduring images of Rio 2016.

The final against defending champions Netherlands finished 3-3 and Team GB won a dramatic penalty shoot-out, with Britain's keeper Maddie Hinch – who keeps a database of information on opposition players – making a string of remarkable saves.

The team was put on the road to Olympic success by everyday technology used in car

sat-nav systems.

With eight games in just 13 days, high fitness levels were of critical importance, but coaches were also keen to focus on the technical and tactical aspects of the sport in training – and also keep an eye on how hard individual players performed at certain times.

GPS tracking technology was introduced in 2009-10 to monitor the training routines of both male and female players.

If the data shows that a player hasn't covered enough ground, or completed enough high intensity drills, these can be incorporated into later sessions.

A coach might make a drill physically harder by increasing the physical space used, reducing recovery time or increasing the number of reps.

The development of more individualised programmes also recognises physiological differences between players and whether

they are – or aren't – responding to training.

Andy Hudson, head of physical preparation for GB and England Hockey, says the trackers are incorporated in vests worn by players in training and matches.



"It works in the same way as the sat-nav in your car, only the units are much more sensitive. It can place someone within a few centimetres," he says.

"We use it to analyse performance, thought processes and positional play.

"We use the data to answer questions around the work done by individuals and the collective.

"We look at individual player performance and understand what their training and playing footprint is.

"It's also important for monitoring and maintaining the levels of fitness players need to carry into the next game."



■ Andy Hudson delivers conditioning training.



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