

Technology in Sports

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Introduction

Recall the night Sri-Lanka won the Cricket World Cup in 1996, by beating the Australians, an experience that would be celebrated many times over, as a nation united in one accord to find a new confidence and strength and a sense of patriotism like never before, (Figure 1). Such was the power of a sporting moment to infuse courage and inspire hope for a nation for many years to come.

It's been twenty years since that iconic win and Sri-Lanka has not been able to repeat the same heroics although the inborn talent and passion may have remained the same. Sport and the game of cricket have progressed much since and the role of technology has become a key deciding factor in the performance of a cricketer and the success of the game as a whole. It is regularly stated that the difference between a good performer and the best performer in sports is based on the use of technology to harness talent, rather than on the individual skill level of an athlete. Simply having talent and

skill is not sufficient in professional sport anymore – a little insight, a more directed push, and consistent monitoring and a well-planned development process are required for the talent to convert into results. That is what technology now provides in the area of sports development.

Role of Technology in Sport

Sports of all type have changed greatly from the start of modern Olympics in 1896 to the present day. There is a stark contrast in how players are selected, trained to

perform better with improved times and reach overall higher standards. For instance, in 1936, Jesse Owens won the 100m sprint in 10.2 seconds. In 2013, Usain Bolt finished the event in 9.77 seconds – a highly significant difference for sprinting events (Figure 2). This improved performance was aided by the track that Bolt ran on, a special fabric carpet, and he propelled himself from the starting block. By contrast Owens ran on cinders (ash from burnt wood), and propelled himself from garden shears that were dug into the cinders.

Swimming is another sport that has shown significant improvement in



Fig 1 : Sri Lanka wins Cricket World Cup in 1996



Fig 2: Jesse Owens (1936) and Usain Bolt (2013)

performance times over the years. These improvements overlap with changes in how the sport was essentially performed. Tumbleturns were introduced to reduce the time that elapsed between laps, gutters were introduced into the pools to carry away splashed water that could otherwise cause turbulence in the water, traditional swimwear were replaced by full body synthetic material swimsuits which streamlined the body during swimming.

These changes in how sports were performed, changed the level of performance that athletes could reach. These changes were not made on a whim. Rather, they were the calculated result of empirical findings from science. Sports science refers to the combination of understandings from a number of disciplines such as physics, physiology, psychology etc. that help to understand how athletes perform. Sports science draws heavily from biomechanics – which is the study of human motion, that helps to understand which conditions help and prevent humans from

performing to their maximum. The learnings and findings from sports science have been critically applied in the field of sports engineering – where technological advancements in

sports are made to

help improve the conditions of the sport to enhance performance. These changes are not simply at face value. In 2009, Professor Stephen Haake, while assessing the effects of technology in sport, found significant performance improvement indices for the Olympic events, the 100m sprint, pole vault, javelin throw, and cycling. For track based events such as sprinting, 4% of the performance improvement index was attributed to better and more aerodynamic clothing. Technological developments in the

sporting equipment were accounted to improve athletic performance by 20%.

Given these encouraging statistics, sports engineering which can be understood as the applications of technology in sports science, has scope in a number of areas. Performance analysis is an area where sportsmen's performance is measured and evaluated using a number of measures to better understand the nature of their performance. The information from performance analysis is used to inform performance improvement strategies, where coaches use empirical data to guide specific coaching regimes. The information from performance analysis is also used to advise injury prevention in athletes where the understanding of a sportsman's level of capacity and endurance are used to ensure that overexertion does not occur. Sports engineering has also informed changes in the sporting equipment and clothing, and has also helped to make

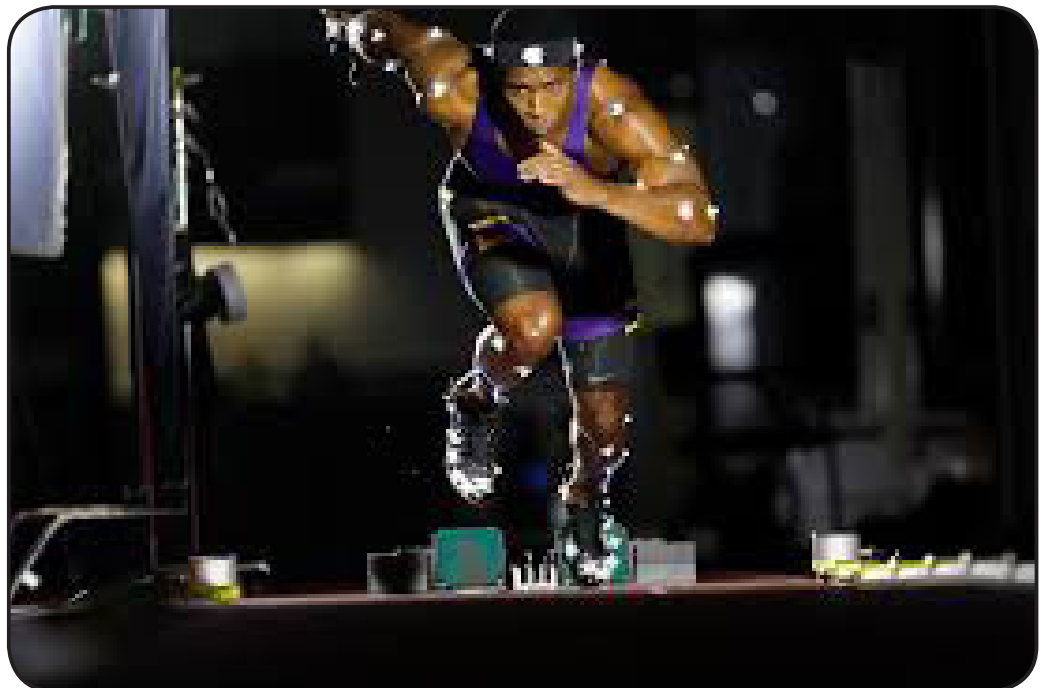


Fig 3: Motion Analysis using Markers

advancements in the promotion of para athletics.

Performance analysis

Technology from the field of biomechanics has much scope in the area of performance analysis. Of most significance is motion capturing technology.

Motion capturing relies on capturing signals from

the body during motion, often done in a biomechanics laboratory and interpreting them through software. Markers are placed on the body at specific anatomical locations, and the 3D motion in the body is configured to a high level of accuracy using a system of cameras (Figure 3). While this method of motion capturing provides high quality and accurate representations, the costs are very high and hence unaffordable to many in the developing world. In 2010, Microsoft released Kinect which is a 3D depth sensing camera that has revolutionized the gaming experience. A set of infrared pattern of dots that bounce off an object or person are picked up by an infrared camera and configured through algorithms to give 3D positional information. Although the output from such technology can be at a lower level of accuracy, the significant lower cost makes such technology a more affordable alternative for motion capturing for sport .



Fig 4: Monitoring health levels of athletes

Besides capturing the trajectories and patterns of movement, motion capturing techniques also help understand the characteristics of the motion. Accelerometers are equipment that help measure the accelerations of human dynamic motion. The reaction forces involved in walking, balance, starts, takeoffs, lands, swings, etc. can be measured using force plates. The resulting data pool gives rich information on movement patterns, forces and accelerations which when analyzed helps decode the true nature of movement in a

person.

Performance Improvement

Technology plays a crucial role in performance improvement. Simply capturing and analyzing a player's movements cannot immediately produce results. Rather, it is how these analyses are used to inform strategy and coaching that has an effect

on performance. As UK Sport Technical Scott Drawer says, "it is in the hands of the coach." If coaches were given access to high quality analyses derived from technology based measurement, and trained on how to use such data to inform coaching strategy, this will vastly improve the quality of advice given by them and the overall performance management of the player throughout their career from younger age to mature level.

Sport engineering contributes



Fig 5: Monitoring health levels of athletes

to designing equipment and clothing in a way that enhances and promotes human body functions for peak efficiency. Sports equipment is built to be lighter, yet stronger, and outfits are more streamlined to reduce frictional drag, so as to improve the overall performance. Results from motion capturing performance analyses help understand the very nature of an athlete's performance styles. This provides coaches with valuable information on how to design targeted training regimes to specifically focus on key areas for the sportsmen. Proof of this is clear and apparent in the Olympics. The English Olympic teams for rowing and cycling have been working tirelessly since 2000 to perfect their game. Using analytic tools and maintaining a game focus on improvement and development,

the teams are seeing results now winning at London in 2012 and at Rio in 2016. Targeted training can help athletes focus their attention on their Achilles heels – eliminating

peak. For example, a modern day professional cricketer is at greater risk of injury through wear and tear due to the increased number of games played in a year. Technology can manage this by constantly monitoring and evaluating the conditions of muscles and evaluating injury proneness therein (Figure 4). This is achieved by using measures such as electromyography, which helps understand the tensile strength in muscles.

Other scientific measures can look into other health parameters regarding physical

and psychological health (Figure 5). A holistic understanding of the current status and situation of a sportsman can enable coaches, trainers, physiotherapists and others to make training and lifestyle recommendations based on actual facts – ranging from diets to exercise routines to mental stamina improvements.

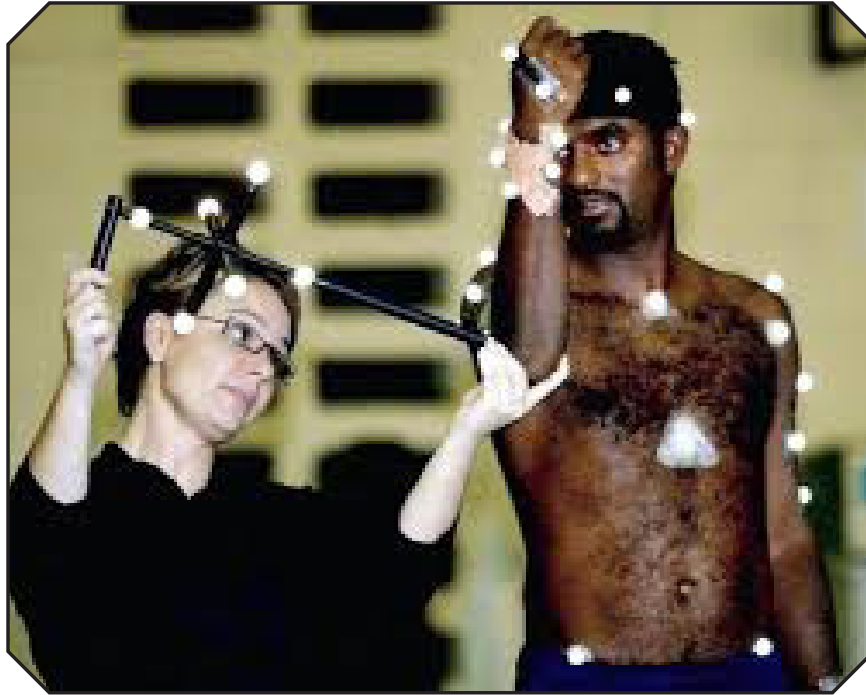


Fig 6: Assessments for fair play following Muralitharan controversy

obstacles that hinder them from performing at their best.

Injury Prevention

Injury prevention too can be achieved using data related to muscle activity to give insight into when an athlete should play and when an athlete is/will be at their



The current Minister of Sports expressed his concern at the loss of sporting talent in Sri-Lanka from school level to national level. According to him, many star sportsmen and women leave the game too early due to injuries sustained at school level without proper rehabilitation and player management. This is largely due to the absence of correct coaching and advice on managing these injuries that prevents them from persevering in the sport. The current Sri-Lanka Cricket's performance manager shares the view that younger bowlers need to be managed well without over exertion while their bodies are developing, so that they can have lengthier careers.

Monitoring all aspects of an athlete's fitness from earlier on in the development trajectory using technology based measurement analyses, can help coaches guide trainings in such a way that injury and illness does not occur due to overexertion and wrong technique.

Improvements in Equipment and Clothing

Understanding human motion, and the factors that promote and inhibit efficient motion, has allowed science to contribute towards various modifications and adjustments to

the designs of sports equipment and clothing. From the type and style of fabrics that are used for athlete outfits, to the architectural design of the sports equipment,



Fig 7: Wearable sensors for analyzing bowling in cricket

science has enabled to create supporting material for sportsmen that enhance, rather than inhibit the effort that is put into their techniques.

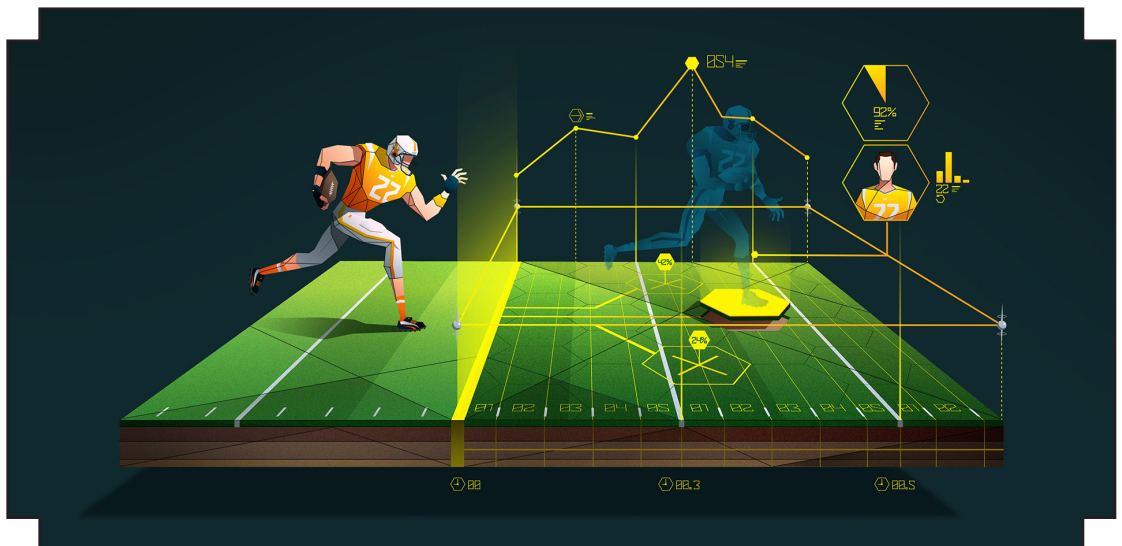
Sporting suits are built of synthetic polymer fabric which is light, and also has a streamlining effect on the body, tucking it in neatly to reduce drag. The track surfaces too are built using special fabric carpets which help an athlete to run at their fastest.

Fair-play and Equality

Technology has been introduced to a number of games to improve the decision making when human judgement proves to be erroneous or subjective. In situations where human judgment is insufficient to reach a final verdict, a technological intervention can help make the better decision. The use of a simple camera is so vastly helpful. This happens live, in real-time, on the field. In cricket and tennis, when the field

umpires are unable to come to a verdict, a "third umpire" has access to a technology called 'hawk eye' that can give a better picture of an otherwise ambiguous situation

Technology has also contributed





in assessing sportsmen who are accused of having incorrect technique, or using illegal movements in the game such as chucking. Thanks to technology, it was possible to clear Muttiah Muralitharan, when he was called for ‘chucking’, a controversy that polarized the cricketing world at the time (Figure 6).

Promoting Equality

One of the most inspiring applications of technology in sports is its application in supporting the sports performances of people living with disability. Advancements in the build of prosthesis has helped to design a prosthetic leg that helped Marlon Shirley of the US to break the 11 second barrier for finishing a 100m race. Advancements in motion capturing technology has enabled to measure the motion and analyze performance in wheelchair bound athletes – ensuring that even para-athletes can benefit from the applications of technology in sports, and enjoy the benefits of targeted training.

Trends in Sports Technology Advancements

The traditional motion capturing techniques, typically administered within the confinements of a laboratory, is being replaced with the developments in wearable technology to provide performance related data. By using an arm band/attachment to clothing, measurements can be received real time (typically on a mobile phone), when sportsmen are working in their natural environments.

The National Football League (NFL) uses motion sensing tags embedded into the players’ outfits to track player movement and performance. These tags record data on player acceleration, speed, routes, and total running distance. This information can be used to analyze the individual and collective patterns of a team’s game. Currently in Sri-Lanka, 3D motion capturing technology using Inertial Measurement Unit (IMU) sensors is being developed at the University of Moratuwa for use in sport and rehabilitation applications. So far this technology has been used to provide a wearable solution for detecting chucking in cricket (Figure 7).

Conclusions

The future success in sports will be determined by those who have access to technology versus those who do not, where the advantage of natural talent will be largely outweighed by that provided through technology, making the use of technology almost an ethical issue. Needless to say that for countries like Sri-Lanka to excel in sports, there will need to be a well-coordinated effort among government, sporting bodies, private sponsorship and research institutions. Such arrangements would enable players to be coached and trained within an environment that facilitates technology to be used to optimize their performances, informed by relevant local research, the sport and players alike.

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