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Technology In Sports

Technology has become an essential part of everything that we know, it is transforming the way we live and work. The sports industry has seen a huge technology shift over the last 50 years. From how athletes train and compete to how fans get entertained by some of the most famous and influential people in the world. These advancements have created new opportunities to enhance athletic performance using fitness trackers, promote fairness in competition using VAR in soccer, improve safety, and engage fans in ways that were once unthinkable.

The role of technology in sports can reach many different fields, for example wearable technology, data analytics, video replay systems, and injury prevention. Wearable bands monitor athletes' performance and health, allowing them to adjust their training and game strategies. Data analytics is changing how teams make decisions, and video technology is improving the fairness and accuracy of games. While this is happening new injury prevention techniques and advanced healing methods are keeping athletes healthier and extending their careers. As fans, we experience these changes in real time, thanks to the newer style of broadcasting, virtual reality, and fan engagement platforms.

Wearable technology has become a new and very important tool for athletes and coaches wanting to help their players get better. A few different devices like smartwatches, fitness trackers and heart rate monitors get data on athletes' movements and physical performance on and off the field. One of the more popular wearables in sports is the WHOOP band, this is a fitness tracker that is made to "track Recovery, cardiovascular Strain, and Sleep" (WHOOP.com). Wearable technology changed how athletes train and compete. Wearables like WHOOP provide real time data that athletes and coaches can use to adjust their training based on factual evidence provided by the wearable. With this knowledge in mind, training can be adjusted to make sure athletes are at their best for their game without risking overtraining or injury. For example, Patrik Mahomes, an NFL player, uses WHOOP during every game he plays in. The wearable monitors his speed, agility, and fatigue levels in game. After the game he can then adjust the intensity of practice or have rest days based on the data that is collected from the wearable.

One of the most important benefits of wearable technology is its likely possibility to prevent injuries. By monitoring important criteria such as muscle strain, joint stress, and overall workload, wearables provide an understanding into when an athlete might be overworked or fatigued. This data can help prevent injuries before they occur by allowing athletes and coaches to catch injuries early or even before it happens. For example, NBA players use wearable technology to monitor fatigue levels, reducing the risk of muscle strains and stress-related injuries during their long season.

Wearable devices collect lots of accurate amounts of data, it is then analyzed to show detailed understandings into an athlete's performance and health. This data allows for extremely personalized training and ongoing monitoring of an athlete's progress. Teams and sports organizations can track performance trends over time, enabling them to make long term decisions based on the coaches' agreements rather than facts on their wearable devices. Even with the benefits, there are some challenges linked with wearable technology. One big issue is data privacy, as athletes' health data is sensitive and needs to be protected. Additionally, advanced wearable devices can be expensive, making them less accessible to college and amateur athletes needing information on their body. Finally, while wearables provide valuable data, there is always the risk of over reliance on technology, where subjective factors like intuition and experience are undervalued in favor of raw data.

Video technology has seriously taken over in sports, making decisions more fair and more accurate. A good example of this is Video Assistant Referee (VAR) in soccer. "VAR can be used to review four types of decision: goals and the violations that precede them, red cards, penalties, and mistaken identity when awarding a card. In some cases, a decision made by the main referee can be overturned; however, it must be a '"clear error"' for this to happen." (thepfsa.co) VAR gives referees a chance to review very specific plays/calls during a game to make sure their in game calls are correct. It has had a huge impact on the sport by reducing human error in key moments and encouraging fairer outcomes. VAR is mainly used to help referees review calls related to goals, penalties, red cards, and missed or mistaken calls. During a game, the VAR team looks at video footage from different angles to help the on field referee in

making the correct call. While VAR has been helpful for improving fairness, it has also lots of controversy, with many fans and players arguing about its effect on the flow of the game.

The start of VAR has helped the accuracy of reffing in soccer. By looking over important moments in game, referees can make better decisions, lowering the risk of human error. For example, VAR can be used to determine whether a player was offside when scoring a goal or if a foul inside the penalty box is a penalty kick. While VAR has helped ensure fairer outcomes, some fans and players have expressed frustration with the delays and interruptions it causes. These pauses in game can mess the flow of the game and lead to discussions about certain fouls.

VAR is not the only technology in sports. Tennis's Hawk-Eye is an example of technology in sports. "Hawk-eye is a technology used in tennis for determining if the ball is in or out. This line-calling system uses multiple camera angles to trace the tennis ball's trajectory. Hawk-Eye uses six or more computer-linked television cameras situated around the court. The computer processes the video in real time and tracks the path of the tennis ball on each camera. These six separate views are then combined to produce an accurate 3D representation of the path of the ball." (Topendsports.com) In baseball and football, the NFL and MLB allows coaches/managers to challenge specific plays that happened in game, and it leads to a review by referees through multiple camera replays almost like VAR. This helps fix wrong calls, ensuring that important decisions, such as out calls, force play outs, tag ups, touchdowns and turnovers, are made correctly. The primary advantage of video technology in sports is the increased accuracy and fairness it brings to officiating. It minimizes human error, and makes sure that the right calls are made, and lowers the potential of bias. But one downside is that it can disrupt the flow of the game. The time spent reviewing video footage can frustrate fans and players. Additionally, video technology does not get rid of disagreements, as certain decisions remain subjective even after being reviewed by officials.

Data analytics has become one of the most popular technologies in modern sports history, changing how teams approach everything from trades to in game strategy. By looking over large

datasets, teams can make better decisions that give them a competitive edge. Teams are now using advanced statistics and data models to make in game decisions. In basketball, for example, teams use analytics to determine which shots have the highest expected value, leading to a greater emphasis on three-point shooting. In soccer, teams look over passing patterns and player positioning to help their approach.

Data analytics is also being used to track individual player performance, and it allows for more personalized training plans. Performance tracking devices and software analyze metrics such as speed, accuracy, stamina, and heart rate determine how well an athlete is performing. Teams in the NFL use sensors embedded in helmets and shoulder pads to track player movement and impact forces. This data helps coaches know areas where players can improve and monitor their progress over time. “Data collected from sensors has fueled efforts to remove avoidable head impacts and is being used to evaluate further changes to the kickoff play… To collect this data, sensors and trackers are placed in player shoulder pads and helmets, as well as embedded in some player mouthguards through use of iTero™ intraoral scanners from NFL partner Align Technology, manufacturer of the Invisalign System of clear aligners.” (NFL.com)

Data analytics is not only changing how teams play the game but also how fans watch/experience it. Fantasy sports, sports betting, and real-time analytics provided during TV broadcasts give fans a deeper understanding of the game. For example, ESPN made their own sportsbook in partnership with PENN Entertainment; to help fans get a better understanding of the game and most importantly they want fans' money. But unfortunately for ESPN they are in the red with losses of almost $2 million since the start of ESPN Bet.

Advancements in injury prevention and rehab have a huge impact on athletes' health and performance. Sports scientists are helping athletes recover faster and are preventing injuries before they even happen, extending their careers and improving their overall quality of life. Motion capture systems and force plates are used to analyze athletes movements and can catch certain risk factors for injury. “Motion capture enables researchers and practitioners to gain

deeper insights into the complex interplay of the nervous system, muscles, bone marrow, and joints during athletic performance." (ncbi.nlm.nih.gov) By finding weird movement patterns, these systems can help athletes correct their form before an injury occurs. For example, runners use motion capture technology to analyze their walking stride, which helps them adjust to avoid stress injuries. Another example is the use of heat and hydration monitoring devices in endurance sports like marathon running and cycling. These devices alert athletes to potential dehydration or overheating, which can be critical in preventing heat stroke or other heat related illnesses.

When injuries do occur, athletes rely on advanced rehab technologies to recover more quickly. Cryotherapy, which exposes athletes to extreme cold temperatures. This is used by athletes to reduce inflammation and help muscle recovery. Ultrasound and electrical stimulation devices are also common in sports rehab. They help tissue repair and help get rid of some pain. Wearable rehab devices, such as a brace, help athletes in regaining strength and mobility after an injury by providing controlled movements during exercises.

Virtual reality is another tool for injury rehab. VR allows the injured athletes to simulate real game scenarios in a controlled environment, helping them gain back their mental and physical readiness for their game. By practicing in a virtual space, athletes can safely go back over and get comfortable again using their movements without the risk of re-injury. This conditioning can make a big difference in the speed, length and effectiveness of an athlete's recovery.

Fan engagement has changed a lot due to technological development, especially in specific areas of TV broadcasting and social media. Today's fans have easier access to watch their favorite team than ever before due to many new innovations that help for real time interactions and different viewing experiences. Broadcasting technology improved a lot; certain channels now have the option to show 4K and 8K Ultra HD resolution, multiple camera angles, and virtual reality experiences. An example of this is in the NBA they have grown to use VR technology to their advantage, it is allowing fans to watch from courtside seats from the comfort

of their homes. With VR headsets, fans can feel they are in the stadium, even if they are thousands of miles away on their couch at home. All you need to do is “log in with your NBA ID on the Xtadium app to watch games with your League Pass subscription” (NBA.com)

Technology has become an important feature in the progress of modern sports, increasing performance, fairness, safety, and fan engagement. From wearable technology that monitors athletes' health to data analytics that shapes game strategy, the impact of these innovations is unbelievable. Video replay systems like VAR ensure fairer outcomes, while advancements in injury prevention and rehab keep athletes healthier and extend their careers. For fans, new broadcasting and streaming technologies have made it easier than ever to enjoy sports, while social media and smart stadiums create immersive and interactive experiences.

(Whoop.com, Whoop support. July 26,2024)

(thepfsa.co.uk, VAR EXPLAINED: WHAT IS IT AND HOW DOES IT WORK?)

(Robert Wood, "Hawkeye Tennis Line-Calling System." October 2, 2024)

(NFL.com, How Data is Helping to Keep Players Safe Published: Nov 14, 2023)

(ncbi.nlm.nih.gov, May 6,2024. Motion Capture Technology in Sports Scenarios: A Survey)

(support.watch.nba.com, Virtual Reality)