Softtek®

Olympics & Tech

Index

Prologue

Since the first contemporary edition of the Olympic Games held in 1896, this grand sporting event **has been in constant evolution** and, in the modern era, has become a testing ground for technological innovation. As the digital revolution advances, technology plays an increasingly crucial role in all aspects of the Olympic Games, from the preparation and performance of athletes to the fan experience, organization, and security of the event.

In the 2024 Paris Olympic Games, approximately **10,500 athletes from 32 different sports and 206 different nationalities** will participate, along with **22 adapted Paralympic sports**. In all disciplines, **technology will be an undeniable ally** to improve the performance of athletes, coaches, judges, referees, spectators, and members of the organization, ensuring that all events are conducted sustainably, safely, and without incidents.

The athlete's experience is one of the areas where technology will have the most significant impact. Athletes now have access to a greater variety of digital tools designed to help them improve their training and recovery, **optimizing performance during competitions.** In this field, one of the emerging trends is the adoption of virtual reality (VR) and augmented reality (AR) solutions that allow athletes and **coaches to simulate different competition scenarios**, practice in immersive environments, and overlay data and instructions directly into their field of vision during training and competitions.

On the other hand, t**he rise of generative artificial intelligence is revolutionizing how athletes plan their training and competitions.** In this regard, the Paris 2024 Games will mark the beginning of experimentation with intelligent training systems that provide detailed information and personalized real-time recommendations on athlete performance, helping to identify areas for improvement and develop more effective competition strategies.

This trend also includes an increase in the adoption of wearable technologies, connected sensors in sports clothing and facilities, as well as cameras equipped with computer vision that monitor the biomechanics and movements of athletes, providing high-value information for performance improvement.

Another area of innovation in this event will be related **to improving the fan and spectator experience.** The way fans consume sports content is changing rapidly, and traditional television broadcasting is shifting towards streaming platforms, online applications, and social networks. These new interaction channels allow viewers **to access on-demand content anytime and from anywhere.** Thus, it is expected that access to new personalized content consumption options will become widespread at the Olympics, through each viewer's preferred platform. Data indicates that 64% of content related to the Olympics will already be consumed through online platforms.

One of the main keys that will make the adoption of these new digital trends possible is improved connectivity. The high speed and low latency provided **by new 5G networks will allow for faster and more reliable data transmission,** which is crucial for live event coverage and the intelligent operation of infrastructures.

5G will enhance the functioning of all connected devices within sports facilities, **from cameras equipped with computer vision to smartphones, drones, IoT sensors, and any other connected device**. According to the organizers, this year there will be more than 12,000 connected screens, 8,000 WiFi terminals, and 13,000 computers connected by over 400,000 kilometers of fiber optic cable at the Olympics.

Thanks to new high-speed networks, **organizers will be able to manage large volumes of data transmitted in real-time from all these connected sensors and IoT devices to control centers.** Similarly, they will become the catalyst for the use of the aforementioned advanced immersive experience technologies, providing greater real-time interaction between fans and athletes.

Connectivity advances will also enable the incorporation of the first "**smart stadiums**" into the Olympics. Equipped with networks of sensors and connected IoT devices, **the smart infrastructures of the Games will feature virtual replicas in the form of digital twins,** providing organizers with detailed and exhaustive data on event development and real-time updates with traffic, transportation, pollution, or weather and climate conditions data. These innovations are directly linked to Paris' commitment to conducting the Games in accordance with **the global sustainability initiatives currently underway.** Thus, during the Games, host cities will implement innovative solutions in areas such as transportation, energy, and waste management, seeking to reduce pollutant emissions.

The plan to make **Paris the first "Olympic Smart City"** sets a precedent not only for sustainable Olympics but also for environmentally conscious sporting events.

All this increased connectivity at the Paris 2024 Games and the exposure to a huge volume of sensitive data hosted in the cloud make cybersecurity an increasingly critical concern at the Olympic Games, **making protection against cyberattacks** essential to safeguard the integrity of athlete data, event infrastructure, and spectator personal information.

Advances in cybersecurity now include the use of artificial intelligence to detect and **respond to threats in real-time**, and the formation of dedicated teams for incident monitoring and response. These efforts aim to ensure the security of the Paris 2024 Olympic Games.

Finally, Paris 2024 will be the prelude to the arrival of new disruptive trends such as the **integration of virtual sports** as a new Olympic discipline. Proof of this is that the International Olympic Committee has already created a specific commission for eSports this year.

On an even more futuristic level, there is also debate on the use of technology as a possible legitimate element to enhance human body capabilities in sports competitions, which invites thinking about the creation of **future bionic or hybrid games** where human athletes would be equipped with technological devices that function as an additional vital organ.

This entire digitization landscape presents **a future full of opportunities for the development of increasingly technological Olympic Games**, and this event in the French capital will give the starting signal for many of the major trends that will shape the course of sports innovation in the coming decades.

The power of technology in the Paris 2024 Olympic Games

Athletics

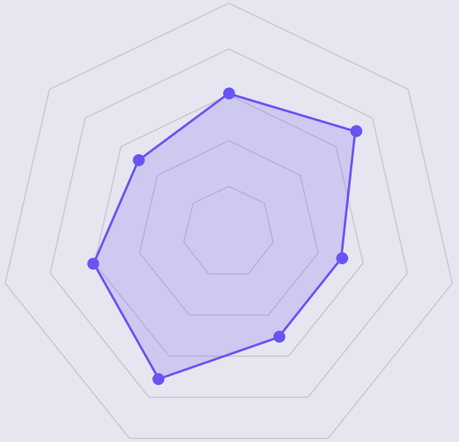
Known as the king of sports in the Olympic Games, athletics encompasses a variety of events and competitions based on fundamental physical skills such as running, jumping, and throwing. It is considered one of the oldest and most universal sports, with roots dating back to the ancient Greek Olympic Games.

Level of Technological Implementation

Artificial Intelligence : 7
AI is widely used for performance and running technique analysis, but not yet fully integrated at all competition levels, with many development opportunities ahead.

Smart Infrastructure : 6
Innovations in tracks and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 8
Predictive analytics is deeply integrated, especially at elite levels, where advanced platforms are essential for training planning and execution.



Communication Platforms : 7
Training management and strategy software is well-developed and fundamental in athlete preparation, although there is still room for innovation.

Augmented Reality: 5
AR is used mainly for visualizing and analyzing running techniques but is still limited and mostly experimental.

Sensors and Wearable Devices : 8
Connected sensor technology is highly advanced and widely used in shoes and clothing for performance analysis. Such devices are common in most professional teams and national squads.

Virtual Reality: 5
VR is used in specific training scenarios but is not widely adopted, although its potential to improve technique is promising.

1. AI & Data

- **Performance and technique analysis:** AI solutions analyze athletes' movement patterns and biomechanics, providing instant feedback on technique and suggesting adjustments to optimize training.
- **Injury prediction:** Machine learning algorithms analyze movement patterns and training loads to predict and prevent potential injuries, helping athletes maintain safer and more efficient training.

2. AR & VR

- **Immersive training:** VR is used to simulate different race and training scenarios, allowing athletes to practice in a controlled environment and improve their technique before facing real competition.
- **Technique analysis with AR:** Applications overlay data and diagrams onto training sessions in real-time, helping coaches analyze and correct athletes' techniques with greater precision.
- **Digital twins:** Virtual replicas of specific organs, such as the heart or legs, enable coaches and athletes to monitor vital functioning parameters in real-time and remotely.

3. Sensors and Wearable Devices

- **Smart shoes with sensors:** These monitor real-time metrics like force, speed, cadence, and running technique, providing detailed data to enhance performance and prevent injuries.
- **Compression clothing with sensors:** This helps coaches and athletes monitor postural aspects and biomechanics during training, offering valuable metrics for performance analysis.

4. Platforms and Software

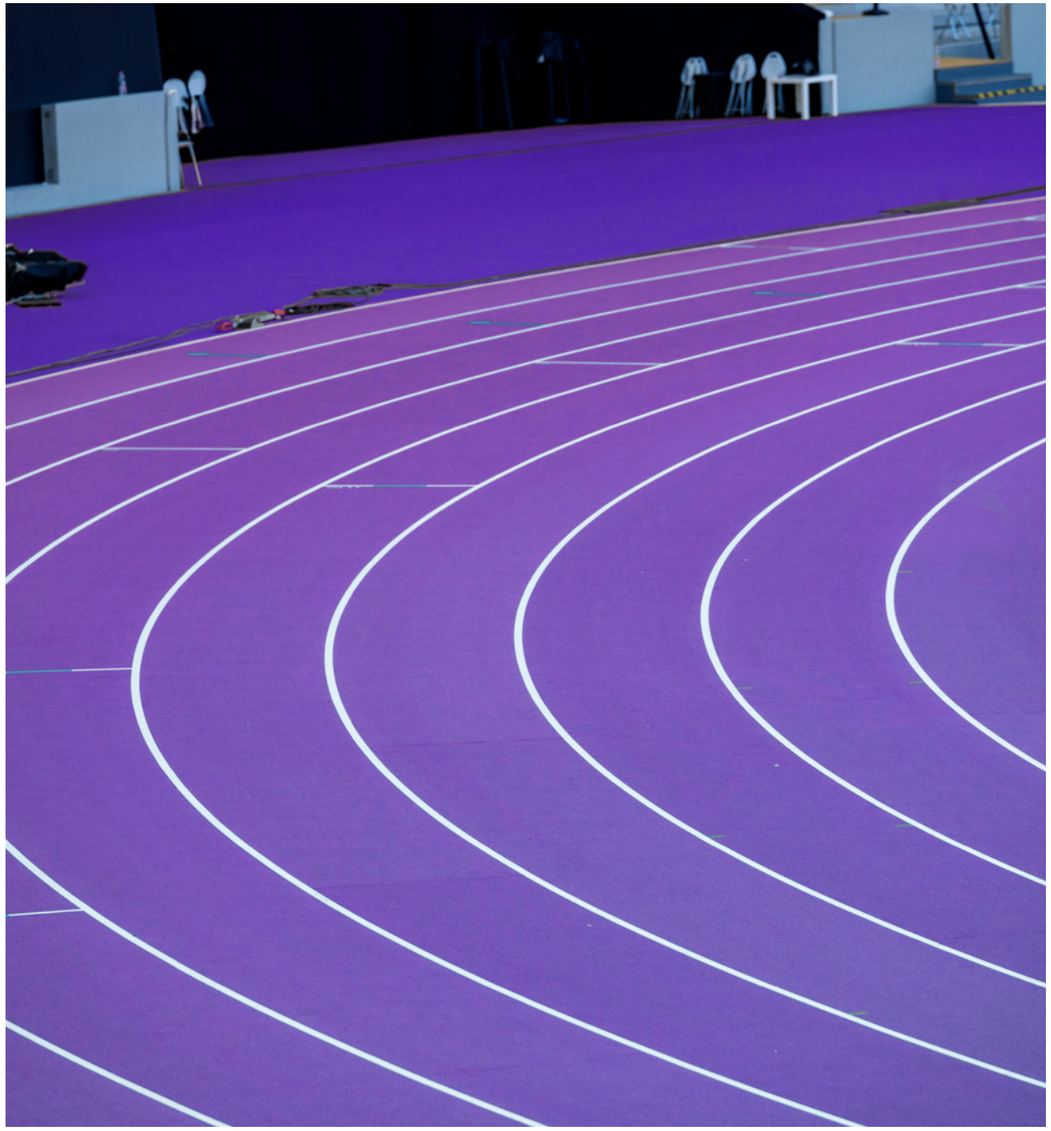
- **Training management software:** Intelligent platforms designed to assist coaches in planning and monitoring training, managing workloads, and analyzing athletes' progress.

- **Computer vision:** Systems equipped with smart cameras use AI algorithms to analyze images in real-time, automatically identifying key moments in competitions and training for later analysis to optimize athletic performance.

5. Infrastructure Innovations

- **Tracks with integrated sensors:** Tracks equipped with pressure sensors collect data on force distribution, speed, and balance during races, providing critical information for technique analysis and supporting judges in result evaluation.

- **Software-controlled dynamic lighting:** Lighting systems that automatically adjust during competitions to enhance visibility, athlete concentration, and energy efficiency, reducing the carbon footprint of facilities.



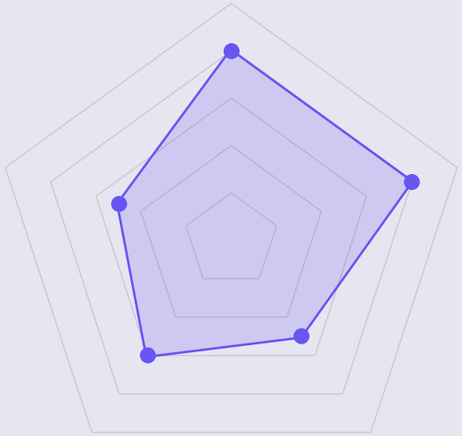
Use of Technologies by Category

E-Health: 8

Wearable devices connected to mobile apps and data platforms are widespread for monitoring athletes' health and personalizing treatment plans.

Cybertech: 5

The use of cybersecurity technologies in athletics is growing, focusing on protecting personal and performance data, ensuring competition integrity, and preventing doping through advanced monitoring and analysis systems.



Performance: 8

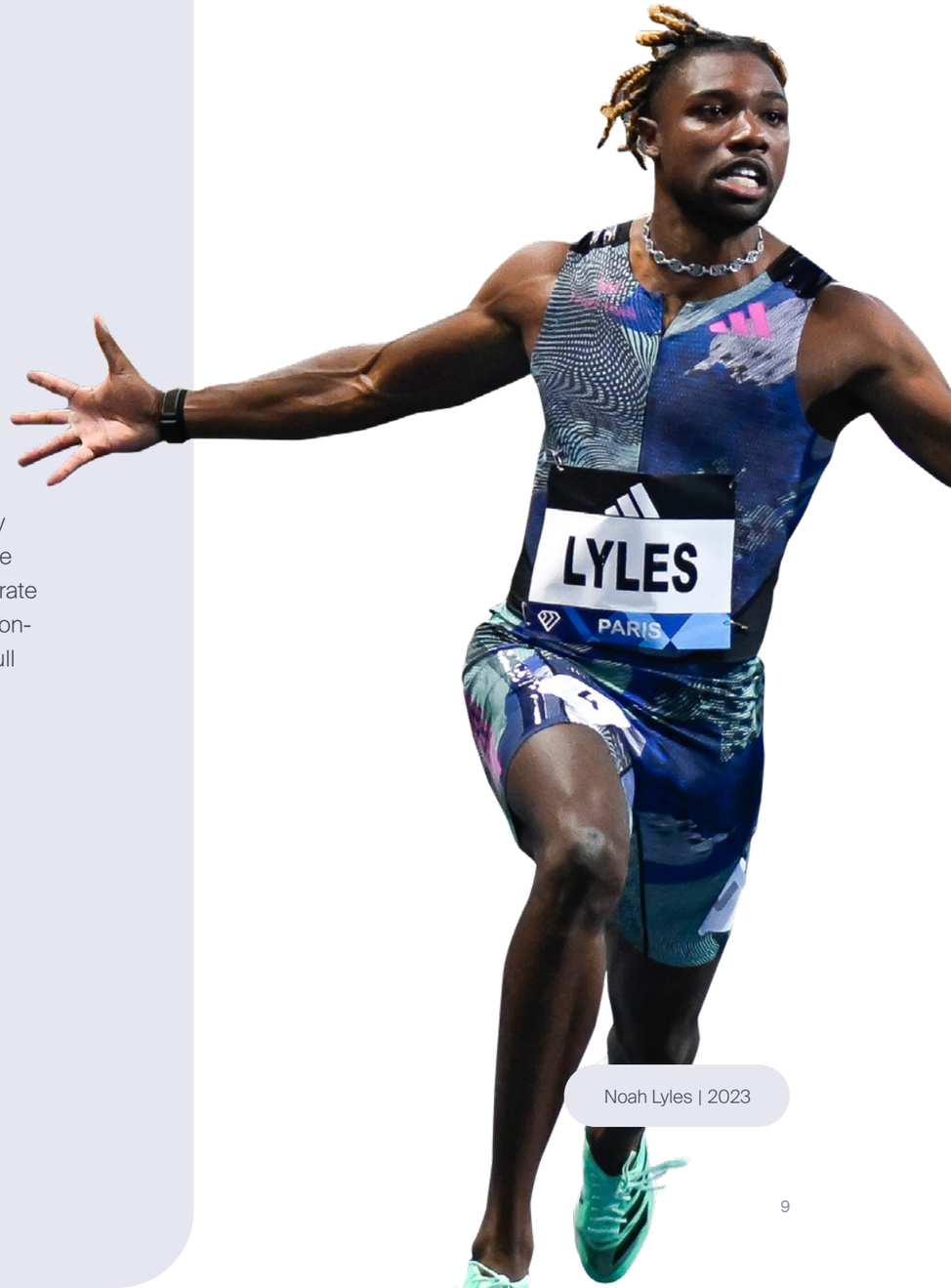
Data analysis platforms are widely integrated to evaluate and optimize athletic performance, providing accurate and reliable data for coaches' decision-making, but there is still room for full implementation.

Fan Engagement: 6

Social interaction platforms are growing, with much development potential ahead, especially in integrating innovative trends like AR and VR.

Audiovisual: 5

Immersive training and AR/VR applications are emerging and experimental, with uneven usage across competitions and national teams, more common in high-profile events and specialized training.



Noah Lyles | 2023

Current Use Cases

1. Applications like Stryd, Lumo Run, or RunScribe use **sensors integrated into shoes** to analyze athletes' movement patterns in real-time.

2. TrainingPeaks or Final Surge advanced tools designed for athletes and coaches **to improve performance through data analysis** and training planning.

3. Global universities and research centers develop AI algorithms **to analyze movement patterns and training loads** to predict and prevent potential injuries in runners.

4. Facilities like the United States High-Performance Center equipped with **tracks with integrated sensors collecting data** on force distribution and balance, providing critical information for technique analysis.

5. Some athletic championships have begun using software-controlled **dynamic lighting systems** to enhance visibility and athlete concentration during competitions.

6. Institutions like the Australian Institute of Sport use **motion capture technology** to analyze runners' biomechanics in detail, improving technique and reducing injury risk.

7. U.S. Olympic marathoner Des Linden the first person to receive **a digital twin replica of her heart.**

8. 3D Athlete Tracking (3DAT) **creates 3D models of athletes' bodies**, already being used by some coaches to optimize performance.

The Next 10 Years

1 Generative AI and machine learning applications will become even more sophisticated, enabling more comprehensive **predictive analyses to anticipate injuries** and adjust training strategies in real-time with greater precision.

2 **AR and VR** will be deeply integrated into **athletes' daily routines** and **fan experiences**, with interactive platforms offering unique competition perspectives.

3 **Biotechnology** will advance to provide even greater **personalization** in athletes' training and recovery regimens.

4 Wearable devices will continue to refine their functionality, allowing continuous and **detailed monitoring** of athletes' physical and mental states.

5 **Future sports facilities will be equipped with IoT infrastructure** and smart sensors, enhancing operational management and the athlete experience. 5G, and eventually 6G connectivity, will enable unprecedented interactivity, with personalized experiences for each athlete and fan, optimizing both training and competition viewing.

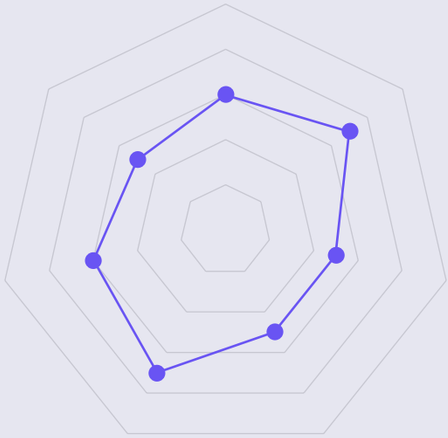
Badminton

Badminton is a racquet sport characterized by its speed and agility, requiring quick reflexes, precision, and excellent physical condition. Originating in Asia and with a strong competitive presence in countries like China, Indonesia, and Denmark, badminton has been part of the Olympic program since 1992 and is distinguished by its dynamic exchanges and strategic play.

Level of Technological Implementation

Artificial Intelligence: 6
AI is mainly used for technique analysis and training preparation, but its full integration is still in development. Adoption varies between competition levels and countries.

Smart Infrastructure: 5
Innovations in courts and lighting systems are being adopted but are still minor. Investment in smart infrastructure is ongoing, especially in high-level competitions.



Data Analysis: 7
Data analytics is increasingly integrated into performance and technique evaluation, although adoption is not yet universal.

Communication Platforms: 6
Training management software is well-developed and useful for optimizing training programs, but there is still room for adoption.

Augmented Reality: 5
AR is used primarily for technique analysis and correction but is limited and experimental.

Sensors and Wearable Devices: 7
Sensor technology is advancing and used in racquets and clothing for performance analysis, but not yet universally adopted.

Virtual Reality: 5
VR is being experimented with in specific training scenarios and shows promising potential, but large-scale adoption is still limited.

1. AI & Data

- **AI coaches:** Training assistants based on AI analyze data collected by cameras and sensors to monitor every athlete's movement during competitions and training sessions, providing detailed statistics and suggestions on players' movements, shot selection, precision, and endurance levels during matches.
- **Motion capture and advanced analytics:** AI systems analyze players' movements to identify potential injury risk factors or improve biomechanics and postural habits.
- **Material customization:** AI algorithms analyze game data (like swing speed, impact force, and control) to design racquets that maximize performance, whether by increasing shot power or improving net play.
- **Real-time match analysis:** AI systems process live video streams to provide insights into opponent tactics, predict game patterns, and suggest optimal strategic planning during competitions.

2. AR & VR

- **Immersive training:** Use of VR and AR devices to simulate different match scenarios and reproduce specific postures or racquet strokes, allowing players to practice in controlled immersive environments.
- **Interactive data visualization programs and devices:** Applications overlay data and diagrams onto training videos in real-time, helping coaches analyze and correct playing techniques.

3. Sensors and Wearable Devices

- **Smart equipment:** Compression clothing with integrated sensors offers information on movement patterns, speed, and overall physical condition of players. These not only improve training precision but also contribute to the growing trend of data-based sports analysis.
- **Smart racquets:** Equipped with sensors that measure the speed, force, and accuracy of shots, providing players and coaches with real-time performance data, including swing speed, shot accuracy, and shuttle impact.

4. Platforms and Software

- **Strategy optimization applications:** Digital tools designed to help coaches adjust strategies and match plans in real-time, based on data obtained during training sessions and matches.

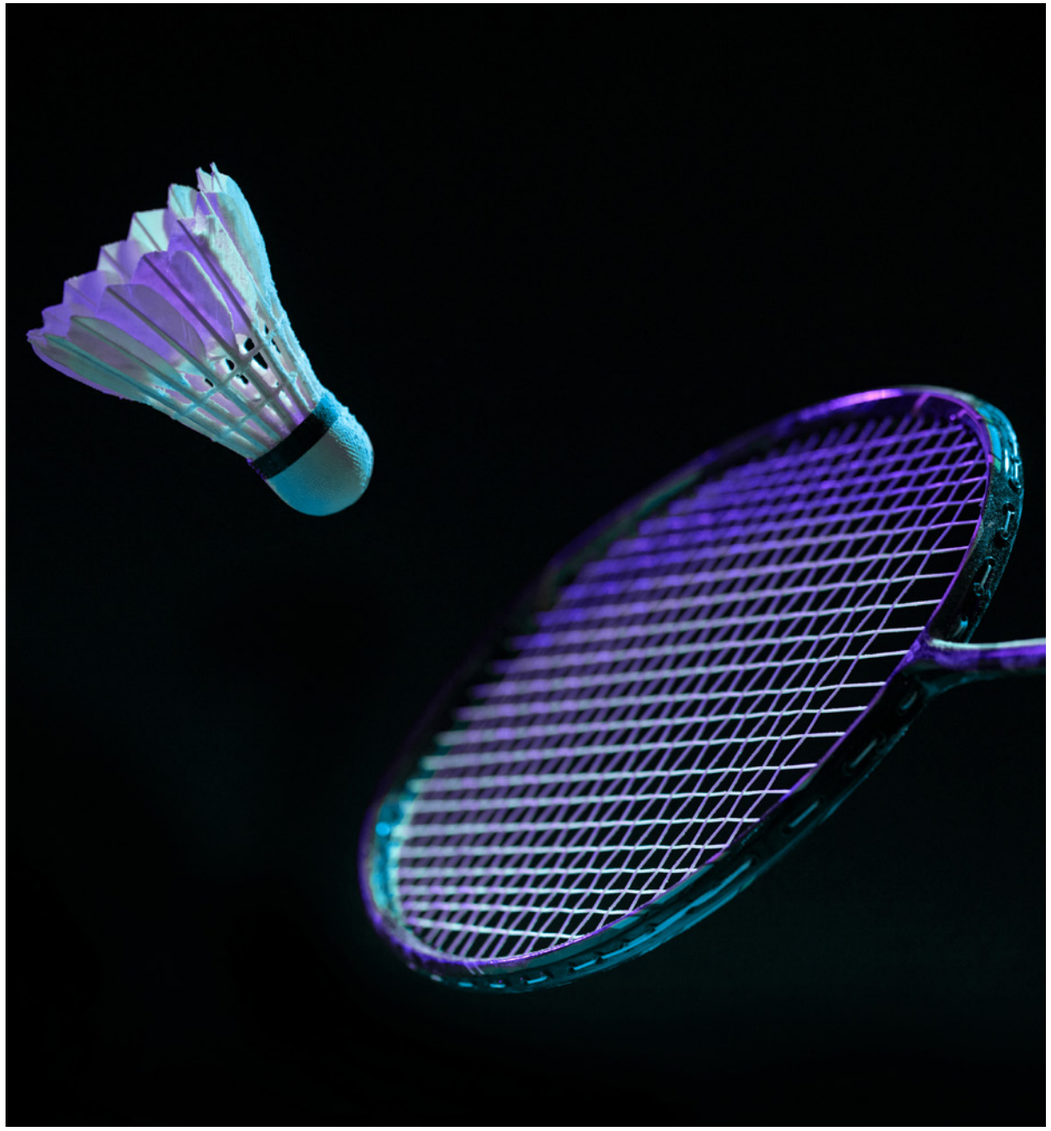
- **Smart glasses:** Allow coaches to visualize overlaid data with images and correct players in real-time.

5. Infrastructure Innovations

- **Courts with integrated sensors:** Courts equipped with sensors strategically located in different parts of the court and on the perimeter lines detect and record the shuttle's position, movement speed, and racquet impacts in real-time.

- **High-speed cameras:** Integrated within courts, they capture every game movement, providing precise data for subsequent performance analysis or referee decisions.

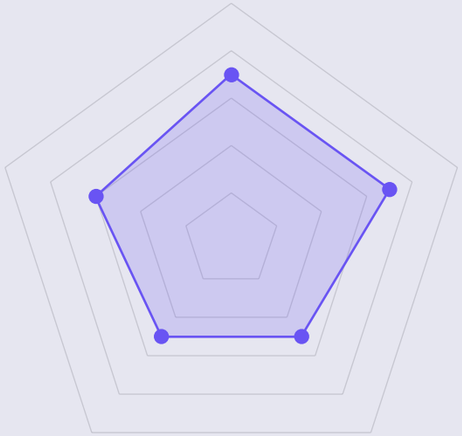
- **Lighting and climate control systems:** Advanced home automation systems help maintain optimal temperature and humidity conditions on the courts, creating a more comfortable and safe playing environment.



Use of Technologies by Category

E-Health: 7
Wearable devices and mobile apps are used to monitor players' health and personalize recovery plans. While adoption is not universal, it is widespread.

Cybertech: 6
Significant advancements have been made recently. National federations and sports organizations are adopting protocols to protect against cyber threats such as hacking and data fraud in competitions.



Performance: 7
AI Coaches and data analysis platforms are widely adopted as performance evaluation and optimization systems, although there is room for improvement in their implementation.

Fan Engagement: 5
Mobile apps and social media platforms are being developed to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 5
Immersive experiences and AR/VR applications are available, but usage is not uniform across competitions, being more common in high-profile events and specialized training.

Kunlavut Vitidsarn | 2024

Current Use Cases

1. Babolat's **smart racquets equipped with sensors** that monitor the force, speed, and accuracy of shots, providing detailed data to help athletes improve their technique and prevent injuries.

2. Spanish Olympic player Carolina Martín states that **advanced data analytics helps her know if she has recovered**, if she is ready for the next training loads, prevent injuries, and better understand her opponents, being better prepared for future matches.

3. The U.S. Department of Science and Innovation (GIST) and MIT developed the MultiSense Badminton Dataset, **a biomechanical dataset based on wearable sensors that includes 7,763 badminton swing** data points collected from 25 players of different skill levels, providing advanced metrics like eye and body tracking, muscle activity, or foot pressure. Motion Capture Technology used by institutions like the Australian Institute of Sport to analyze runners' biomechanics in detail, improving technique and reducing injury risk.

The Next 10 Years

1

IoT device and sensor connectivity will enable **access to increasingly precise and valuable data sets.**

2

Integration of **AI and machine learning tool will continue revolutionizing how players train** and refine their game, taking badminton performance to unprecedented levels.

3

AR and VR integration will become part of players' daily routines and fan experiences.

Basketball

Invented in 1891 by James Naismith, basketball has evolved into one of the most popular and widely played sports worldwide, with prominent leagues such as the NBA. The game is characterized by its speed, with constant changes of possession and strategic movements, including dribbling, passing, and shooting.

Level of Technological Implementation

Artificial Intelligence : 7

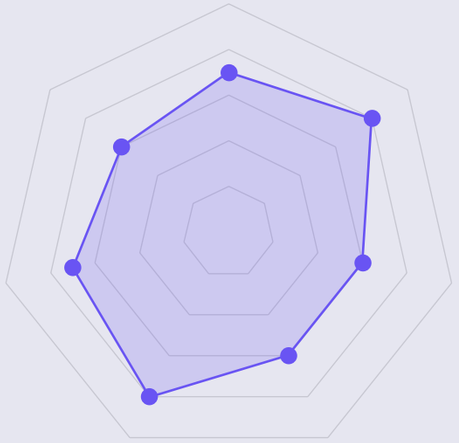
AI is widely used for data analysis and strategies but is not fully integrated at all levels of play. The sophistication and accessibility of these tools still vary among different leagues and competition levels.

Smart Infrastructure: 6

The adoption of IoT sensors in the court and smart lighting is growing. However, more investment in smart infrastructure is needed to develop its full potential.

Data Analysis: 8

Data analytics is deeply integrated into all aspects of basketball performance and tactics, especially in the NBA, where platforms like Second Spectrum are essential for planning and executing strategies.



Communication Platforms: 7

Team and tactic management software is well-developed and fundamental in team preparation, though full adoption of real-time communication tools still has much room for development.

Augmented Reality: 6

AR is mainly used for play visualization and analysis, but its adoption is still experimental. However, it is one of the most promising innovations for transforming basketball training experiences.

Wearables / Sensors: 8

Sensor technology is highly advanced and widely used in equipment and balls for performance analysis. Devices like smart jerseys and shoes are already common in most professional teams.

Virtual Reality: 6

VR is used in specific training scenarios, such as shooting or dribbling simulations, but is not universally adopted, although its potential for recreating real game situations is being explored by pioneering teams.

1. AI & Data

- **Personalized performance analysis:** Programs and mobile apps track and record shots, successes, failures, and positions. AI evaluates player techniques and offers instant performance metrics, allowing real-time adjustments during training and competitions.

- **Smart scouts and selectors:** Generative AI solutions compare metrics of emerging players to identify talent, select players, or determine the best lineup for each game.

2. AR & VR

- **VR-specific scenario simulation:** Virtual reality devices create immersive experiences where players can practice shots, dribbles, pivots, or complex defensive movements that may occur in real competition.

- **AR for play analysis:** Video analytics software with AR features processes images after games, providing detailed information by overlaying data and tactical diagrams on key plays.

3. Sensors and Wearable Devices

- **Smart jerseys with biometrics:** Equipment with sensors monitors real-time metrics such as heart rate, blood oxygen levels, and muscle workload.

- **Smart basketballs:** Equipped with sensors to measure rotation and trajectory, providing tactile feedback through vibrations. Data is sent to a mobile app for real-time analysis.

4. Platforms and Software

- **Training management software:** Platforms for planning detailed training sessions, managing workloads, and analyzing player progress, optimizing training program efficiency and ensuring continuous performance tracking.

- **Computer vision platforms:** Connected with mobile devices and screens to observe player movements and biomechanics on the court during training, correct shooting techniques, or prevent injuries. They also help coaches communicate strategies, reorganize player positions, and adjust tactics in real-time during games.

5. Infrastructure Innovations

- **Courts with integrated sensors:** Flooring with pressure sensors collects data on player movements and interactions with the surface, offering valuable information for game and training analysis.

- **Domotic controls:** Smartly controlled LED lighting systems automatically adjust during the game to enhance visibility and reduce energy consumption.

- **3D printing:** Additive manufacturing techniques optimize the design and production of sports equipment such as balls or shoes.

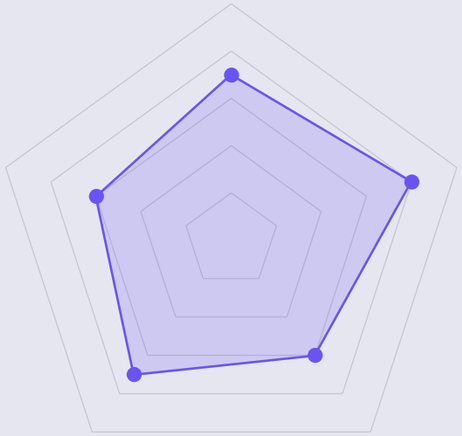
Use of Technologies by Category

E-Health: 7

Monitoring health and physical parameters of players through digital tools is widely adopted and used to personalize treatment and rehabilitation plans.

Cybertech: 6

Teams and federations are implementing advanced measures and multi-factor authentication systems. However, greater integration of dedicated teams and continuous threat analysis is needed to prevent and detect new cyber intrusions.



Performance: 8

Tools like Catapult and Hudl are integrated to evaluate and optimize performance, providing accurate and reliable data for decision-making, but there is still room for innovation in these tools.

Fan Engagement: 7

Mobile apps, social media, and gamification platforms are well-developed for interacting with fans, but the implementation of AR and VR experiences still has much room for growth.

Audiovisual: 6

High-definition broadcasts and immersive experiences are available, but their use is not uniform across all competitions, being more common in high-profile leagues like the NBA.

Stephen Curry | 2014

Current Use Cases

1. HomeCourt an advanced mobile basketball training app using **AI and computer vision to help players improve their skills.** HomeCourt uses the mobile device's camera to capture player movements and analyze their performance in real-time.

2. Cleveland Cavaliers implemented **VR systems allowing players to practice free throws** and other shots in a simulated environment, replicating real game conditions. This helps players improve their accuracy and prepare for high-pressure situations.

3. Wilson Sporting Goods developed **smart basketballs with integrated technology to measure and analyze each shot**, providing real-time data through a mobile app. This allows players to adjust their shooting technique based on instant feedback.

4. **CoachMePlus used by many basketball teams for planning** training sessions, monitoring player health, and adjusting tactics on the fly. This platform optimizes team management and ensures continuous performance tracking.

5. **Kinexon used by several NBA teams** to monitor performance through precise data on workload and player physical condition, helping to prevent injuries and improve recovery.

6. Toronto Raptors use **AI tools and advanced analytics for player scouting**, analyzing thousands of data points to identify talent and adjust recruitment strategies.

7. **Drones used in training and games** to capture images from unique angles, providing detailed material for technical and tactical analysis. NBA teams like the Dallas Mavericks have experimented with this innovation to improve game analysis.

8. **Hudl allows coaches and analysts to cut and tag game videos** for detailed and personalized analysis of key plays. This facilitates the identification of strengths and weaknesses at both individual and team levels.

9. Golden State Warriors: Implemented AR applications allowing fans **to overlay real-time statistics and tactical diagrams during games,** enhancing understanding and enjoyment of the game.

10. Toronto Raptors and **IBM use IBM's Watson AI analytics system** to analyze a vast set of data points, including shooting information, effectiveness percentages, and various metrics related to specific game situations.

11. NBA Top Shot a **blockchain-based platform that allows fans to buy, sell, and trade officially** licensed NBA highlight moments as collectibles. Each highlight is represented by a unique non-fungible token (NFT), giving fans a sense of scarcity, exclusivity, and authenticity.

12. Paralympic Basketball: Also leverages advanced data analytics and **connected wearables to obtain** real-time performance metrics, helping athletes and coaches make smarter decisions, adapt training, or perfect techniques.

The Next 10 Years

1. **Machine learning algorithms** will not only analyze every aspect of individual games but **also predict patterns and suggest increasingly** specific and personalized improvements.

2. **Wearable devices and integrated sensors in sportswear** will provide real-time data on physical and technical performance, allowing immediate adjustments during training and games.

3. Game broadcasts will greatly benefit from AR and VR. These technologies will offer **immersive experiences for both spectators and players/coaches.**

4. VR simulations and immersive experiences will continue to grow in popularity as **methods for practicing plays and strategies** in controlled environments.

5. **Blockchain technology and tokenization will have a significant impact on basketball management and commercialization.** Smart contracts will simplify player contract administration and sponsorship deals, while tokenization will allow teams and leagues to create new revenue streams through tokens and NFTs related to highlights, exclusive merchandise, and unique fan experiences.

6. Other disruptive **innovations like 3D printing and IoT sensing will transform** how current infrastructures, courts, and sports equipment are built and presented.

Handball

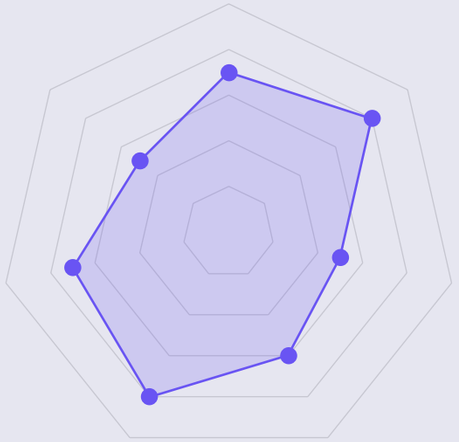
Handball is a fast-paced and physical team sport characterized by rapid offensive and defensive movements, precise passing, and powerful throws. Originating in Europe in the late 19th century, handball has gained worldwide popularity and is known for its intensity and dynamism, being an Olympic sport since 1972 for men and 1976 for women.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data analysis and strategy but is still developing. Accessibility to these tools varies by competition level and country.

Smart Infrastructure: 5
Innovations in courts and lighting systems are being explored, and initial integrations have been seen, but much development is still needed.

Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in team preparation.



Data Analysis: 8
Data analysis is deeply integrated into all aspects of handball performance and tactics, especially at elite levels, where advanced platforms are essential for training planning and execution.

Augmented Reality: 5
The adoption of AR in handball is limited and mainly experimental.

Sensors and Wearable Devices: 8
Integration of sensors in jerseys, knee pads, and balls for performance analysis is advanced. Such devices are common in most professional teams.

Virtual Reality: 6
The adoption of VR in handball is in its early stages and far from universal, but its potential to improve decision-making is very promising.

1. AI & Data

- **Real-time intelligent analysis:** AI tools analyze player movements and strategy in real-time, providing instant feedback and suggesting tactical adjustments to optimize team performance during the game.
- **AI-based planning:** Generative AI solutions allow coaches to compare metrics from previous competitions, select players for each game based on specific parameters, and fine-tune strategies according to competitor profiles.

2. AR & VR

- **Play simulations:** VR allows simulating different game and training scenarios for players to practice before competition, including shooting, defense, and decision-making under pressure.
- **Smart strategic analysis:** Devices and applications overlay information on retrospective images of key plays or real-time cameras, helping coaches analyze and adjust team strategy more precisely.

3. Sensors and Wearable Devices

- **Smart jerseys and knee pads:** Equipment with integrated sensors monitor posture, workload, and force distribution during ball throws in real-time, providing detailed data to improve technique and prevent injuries.
- **Smart balls:** Balls equipped with sensors measure the speed, rotation, and trajectory of throws, offering valuable information for performance analysis and technique improvement.

4. Platforms and Software

- **Training monitoring programs:** Planning and management platforms for coaches to manage workloads, analyze player progress, compare metrics, and optimize training programs.

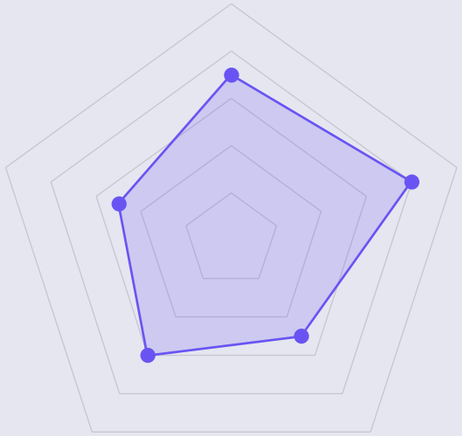
5. Infrastructure Innovations

- **Smart courts:** Designed to enhance the game experience, incorporating computer vision systems, smart LED lighting, and motion and biomechanics sensors.

Use of Technologies by Category

E-Health: 7
Monitoring players' physical condition through wearables and fitness trackers is very common, and the use of AI for personalizing treatments and dosing loads is becoming more common.

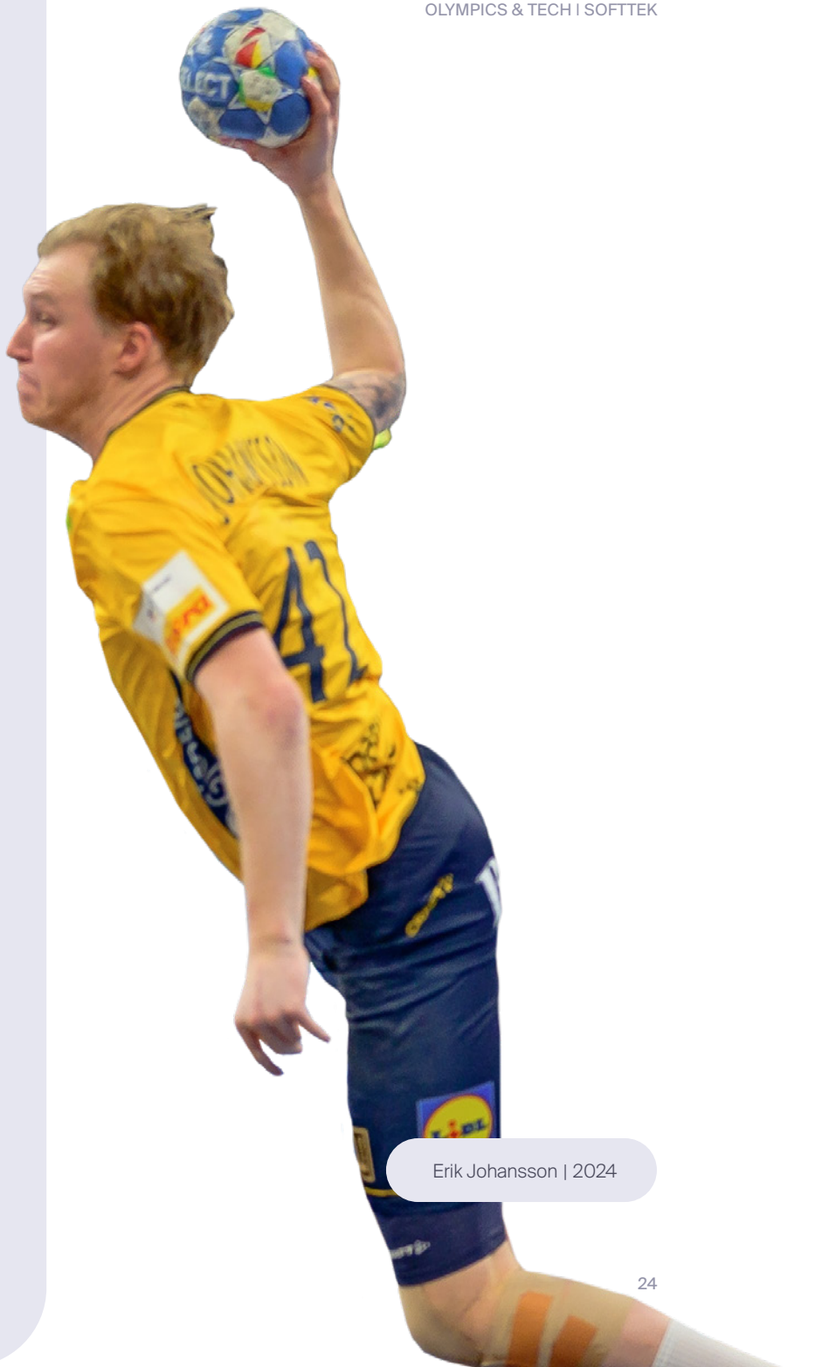
Cybertech: 5
There is growing awareness and training in cybersecurity among players, coaches, and technical staff to ensure a secure and reliable digital environment in all aspects related to basketball.



Performance: 8
Data analysis platforms are integrated to evaluate and optimize performance, providing accurate and reliable data for decision-making, but there is still room for full implementation.

Fan Engagement: 6
Mobile apps and social media platforms are being developed to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 5
Immersive experiences and AR/VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.



Erik Johansson | 2024

Current Use Cases

1. Kinexon sports analytics application uses **sensors to analyze player movements and strategy in real-time**, providing instant feedback on technique and tactics, and suggesting adjustments to improve performance.

2. **Hexoskin smart jerseys equipped** with sensors that monitor heart rate, breathing, and physical activity in real-time.

3. **SELECT smart balls equipped** with sensors that monitor the speed, rotation, and trajectory of throws, providing detailed data to help athletes improve their technique and accuracy.

4. Sportlyzer a tool used by handball teams **to plan and monitor training sessions**, manage workloads, and analyze player progress, optimizing training programs.

5. Universities and research centers have developed **AI algorithms that analyze movement patterns** and training loads to predict and prevent potential injuries in handball players.

6. German High-Performance Center facilities equipped with **courts that collect data on force distribution and movement,** providing critical information for technique and strategy analysis.

7. **Dynamic lighting systems** controlled by software are used in some handball championships to improve visibility and player concentration during matches.

8. Institutions like the Biomechanics Institute of Valencia use **motion capture technology** to analyze players' biomechanics in detail, improving technique and reducing injury risk.

The Next 10 Years

1 Coaches will use these tools to analyze player performance with greater precision, **identifying patterns and areas for improvement** from large volumes of data.

2 **Sensors and wearable devices** will become increasingly common, providing real-time data on players' physical condition, allowing for personalized training and more effective injury prevention.

3 **AR and VR will integrate into training enhancement and fan experiences** through interactive platforms offering unique game perspectives.

4 In refereeing and game management greater integration of technology is expected to improve decision accuracy and fairness. The use of **computer vision and automated foul detection systems will be refined**, reducing human errors and speeding up decision-making processes.

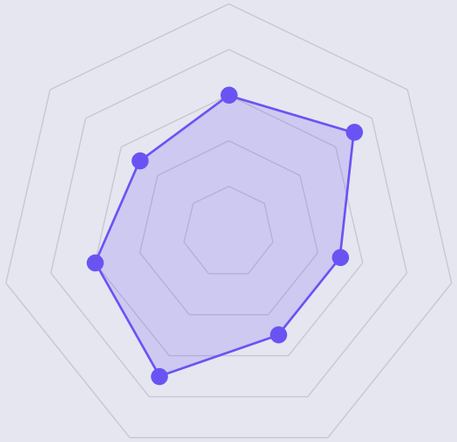
Boxing

Boxing is a traditional sport known for its physical intensity, tactical strategy, and the technical skill of the fighters, who must combine agility, endurance, and mental toughness to achieve victory. As a popular sport worldwide, boxing has a long history and is renowned for its world championships and as one of the standout events in the Olympic Games.

Level of Technological Implementation

Artificial Intelligence: 6
AI is mainly used for technique analysis and injury prediction, but its full integration is still developing. Accessibility to these tools varies by competition level and country.

Smart Infrastructure: 5
Innovations in rings and lighting systems are being adopted, but investment in smart infrastructure is in its early stages, even in high-level competitions.



Data Analysis: 7
Data analytics is increasingly integrated into performance and technique evaluation, although adoption is not universal.

Communication Platforms: 6
Training management software is well-developed and useful for optimizing training programs, but full adoption is still in progress.

Augmented Reality: 5
AR is primarily used for technique analysis and correction but is limited and experimental.

Wearable Sensors: 7
Sensor technology is advancing and used in gloves and helmets for performance analysis but is not universally adopted.

Virtual Reality: 5
VR is used in specific training scenarios but is not widely adopted, although its potential to improve technique is promising.

1. AI & Data

- **Advanced analytics applications:** AI-based tools analyze boxers' movements, providing instant feedback on technique and suggesting adjustments to optimize performance.
- **Fitness trackers:** Monitor all physical activity, including heart rate and sleep patterns, to optimize conditioning and recovery routines.
- **AI-powered training robots:** Can observe and learn a boxer's style, adapting their responses or recommendations accordingly, acting as virtual coaches.

2. AR & VR

- **Immersive training experiences:** Allow boxers to engage in simulated, interactive scenarios to practice specific combat situations and refine their movements against virtual opponents from their homes or gyms.

3. Sensors and Wearable Devices

- **Smart gloves and helmets:** Integrate sensors that monitor and track the speed, force, and trajectory of each punch. This information allows real-time adjustments or post-training technique refinement, highlighting areas of strength or improvement.
- **Wrist sensors:** Provide comprehensive metrics on punch volume, speed, and intensity, helping boxers and coaches tailor training sessions more precisely.
- **Corner boxing trackers:** Small devices placed under boxing gloves track the speed, power, and combinations of punches.

4. Platforms and Software

- **Live strategy applications:** Tools that allow coaches to adjust strategies and fight plans in real-time, based on data obtained during training sessions and fights.

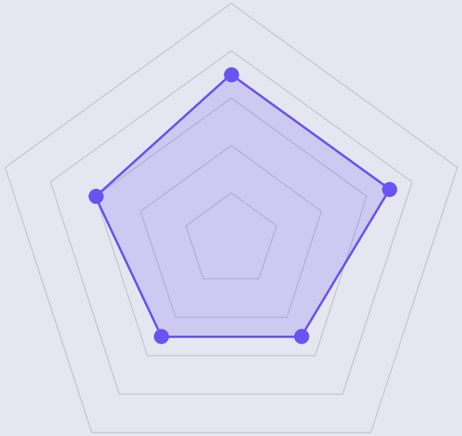
5. Infrastructure Innovations

- **Rings with integrated sensors:** Equipped with pressure sensors that collect data on force distribution and balance during bouts, providing critical information for technique analysis.

Use of Technologies by Category

E-Health: 7
Wearable devices and mobile apps for monitoring boxers' health and personalizing treatment plans are advanced and universally used in elite categories.

Cybertech: 6
The level of cybersecurity adoption in boxing varies significantly among different organizations and championships. Major leagues and promoters are typically better equipped with advanced cybersecurity measures.



Performance: 7
Data analysis platforms for evaluating and optimizing performance are increasingly used, with generative AI solutions playing an increasingly relevant role.

Fan Engagement: 5
Mobile apps and social media platforms are growing, but interaction with spectators through AR and VR is yet to be fully explored.

Audiovisual: 5
Immersive experiences are available in boxing but are far from reaching mass adoption, beyond elite and specialized training.

Arlen López | 2015

Current Use Cases

1. FightCamp uses **sensors in gloves** to analyze boxers' movements in real-time, providing instant feedback on technique and suggesting adjustments to improve performance and prevent injuries.

2. VR programs like PunchLab allow **boxers to practice in a virtual environment,** simulating different combat scenarios and improving their technique without injury risk.

3. CAJAVR a popular tool in boxing training with virtual reality, transforming workouts into **immersive experiences based on the boxer's rhythm.**

4. Hykso smart gloves equipped with sensors that monitor the force, speed, and accuracy of punches, **providing detailed data** to help athletes improve their technique and prevent injuries.

5. U.S. Olympic Training Center equipped with smart rings that collect data on force distribution and balance, **providing critical information for technique analysis.**

6. **Dynamic lighting systems** controlled by software to improve visibility and boxer concentration during matches.

7. Everlast and PIQ wrist device analyzes **punch speed, retraction time, and impact, providing valuable information to improve performance.**

8. **Botboxer a high-speed robotic punching bag** designed to improve boxers' precision, speed, and reflexes. Uses computer vision to track and react to a boxer's movements, dodging punches like a real opponent.

9. Striketec combines connected sensors with an **AI algorithm to track and record punch data**, providing real-time feedback.

The Next 10 Years

1 AI applications for **automated training** and preparation plans will become universal.

2 More advanced **extended reality applications** will be used by more trainers and boxers to recreate punches and perfect techniques through immersive experiences.

3 AR and VR integration will deepen into the fan experience, **with interactive platforms offering unique perspectives of matches.**

4 **Rings equipped with sensors and IoT** devices will continue to improve, with increased investment in infrastructure enhancements.

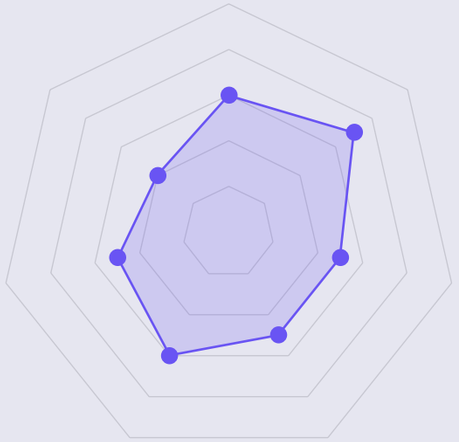
Breaking

Breaking, also known as breakdancing, is an urban dance that emerged in the 1970s in the Bronx, New York, as part of hip-hop culture. Characterized by its combination of acrobatic movements, agility, strength, and creativity, it is structured around four main elements: toprock, downrock, power moves, and freezes. Its inclusion in the 2024 Paris Olympic Games marks its first appearance as an Olympic discipline, reflecting an effort to modernize the Olympic program, attract a younger and more diverse audience, and recognize the athletic and artistic value of breaking.

Level of Technological Implementation

Artificial Intelligence: 6
AI is mainly used for technique and style analysis and injury prediction, but its full integration is still developing. Accessibility to these tools varies by competition level and country.

Smart Infrastructure: 4
Innovations in dance floors and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing.



Data Analysis: 7
Data analytics is increasingly integrated into performance and technique evaluation, although adoption is not universal.

Communication Platforms: 5
Training management software is well-developed and useful for optimizing training programs, but full adoption is still in progress.

Augmented Reality: 5
AR is primarily used for technique and style analysis and correction but is limited and experimental.

Wearable Sensors: 6
Sensor technology is advancing and used in clothing and protectors for performance analysis but is not universally adopted.

Virtual Reality: 5
VR is used in specific training scenarios but is not widely adopted, although its potential to improve technique and style is promising.

1. AI & Data

- **Technique and style analysis:** Various tools use AI to analyze dancers' movements, providing instant feedback on technique and style and suggesting adjustments to optimize performance and choreography.
- **Injury prediction:** Machine learning algorithms analyze movement patterns and training loads to predict and prevent potential injuries, helping dancers maintain safe and efficient training.

2. AR & VR

- **Virtual and augmented reality training:** Use of VR to simulate different competition and training scenarios, allowing dancers to practice in a controlled environment and improve their technique without injury risk.
- **Technique analysis with VR:** Applications overlay data and diagrams onto training videos in real-time, helping coaches analyze and correct athletes' technique and style with greater precision.

3. Sensors and Wearable Devices

- **Compression clothing with sensors:** Equipped with sensors that monitor posture, balance, and workload during training, providing information for performance analysis and injury prevention.
- **Live strategy applications:** Tools that allow coaches to adjust training strategies and plans in real-time based on data obtained during training sessions and competitions.

4. Platforms and Software

- **Training management software:** Platforms that allow planning and monitoring breaking training, managing workloads, and analyzing dancers' progress, optimizing training programs.

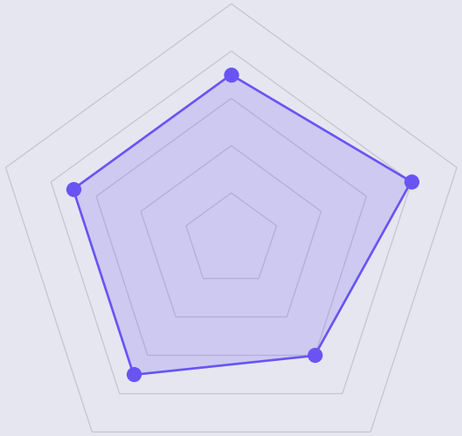
5. Infrastructure Innovations

- **Dance floors with integrated sensors:** Equipped with pressure sensors that collect data on force distribution and balance during routines.

Use of Technologies by Category

E-Health: 7
Wearable devices and mobile apps help monitor dancers' health and personalize treatment plans, although adoption is not universal across all competition levels.

Cybertech: 7
The state of cybersecurity in breaking as a professional sport is developing, with a growing focus on protecting personal data and digital systems used by athletes, coaches, and organizations.



Performance: 8
Data analysis tools and platforms are integrated to evaluate and optimize performance, providing accurate and reliable data for decision-making, but there is still room for full implementation.

Fan Engagement: 7
Mobile apps and social media platforms are developing to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 6
Immersive experiences and AR/VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Víctor Montalvo | 2017

Current Use Cases

1. DanceNote for technique and style analysis, **a movement analysis tool** called DanceNote has been developed to analyze dancers' body movements and provide detailed information about them.

2. AR training and simulation with Dance Reality, this application uses **augmented reality to teach and guide dancers** in real-time while they practice. For example, the app can show a hologram of a dance instructor or even display real-time graphics and animations to guide the user in their movements.

3. DanceForms motion capture tool helps choreographers design and visualize dance movements in 3D space and export them to various formats, such as VR, AR, or games. This helps **predict the possibility of injuries in a controlled environment.**

4. University of Ljubljana researchers used a wearable device consisting of a **3D accelerometer with a microelectromechanical system** (MEMS) attached to one leg to estimate dancers' rhythm, improve movement, and prevent injuries.

5. Move.AI Motion Capture technology uses motion capture technology to analyze **dancers' biomechanics in detail.**

6. University of Bath's Sound Pad project focuses on developing technology for dance, emphasizing the inclusive participation of people with visual disabilities. **It uses sensory technology with collaborative platforms and sounds** to guide blind dancers.

7. Breaking in Chinese university entrance exams some universities in China have introduced breakdancing as a subject in their entrance exams, which **will grow this sport and boost the surrounding technologies.**

The Next 10 Years

1. AI and machine learning applications will become more sophisticated, allowing **predictive analysis to anticipate injuries** before they occur and adjust training strategies in real-time with greater precision.

2. AR and VR will integrate more deeply, not only in training but also in the fan experience, with **interactive platforms offering unique competition perspectives.**

3. Biotechnology advances **will provide even greater personalization** in dancers' training and recovery regimes.

4. **Wearable devices will become more accurate and less invasive**, allowing continuous monitoring not only of physical but also mental health.

5. Sports center floors will be equipped with pressure and motion sensors capable of detecting and analyzing each step, jump, and turn in real-time, **providing instant feedback to dancers via a holographic interface.**

6. Smart lighting will be completely adaptable, with intelligent LED lights that follow and highlight dancers' movements, **creating a visual spectacle synchronized with music and rhythm.**

7. **Interactive high-definition screens** on walls will allow dancers to view instant replays, perform detailed movement analyses, and receive virtual instructions from coaches worldwide.

BMX Freestyle

BMX Freestyle is an extreme cycling discipline that focuses on performing spectacular tricks and stunts using bicycles designed to withstand high stress and complex maneuvers. Practiced in a variety of environments such as skate parks, ramps, half-pipes, and urban settings, cyclists execute jumps, spins, and flips with great precision and creativity.

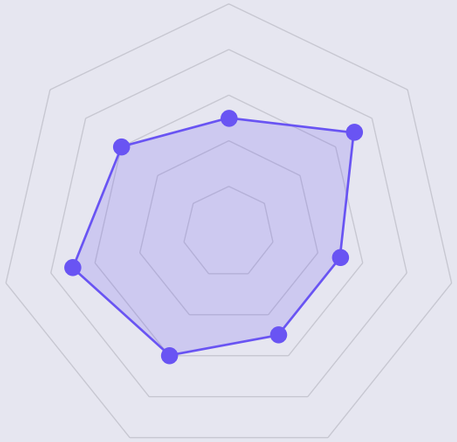
Level of Technological Implementation

Artificial Intelligence: 5

BMX riders are beginning to use generative AI solutions to consult metrics and profile competitions, but this trend is still in its early stages.

Smart Infrastructure: 6

Innovations in BMX parks and lighting systems are being adopted, but they are not yet universal. This is an area with significant opportunities for integrating IoT sensors and other advanced features like smart cameras.



Data Analysis: 7

Data analysis is integrated into the very nature of BMX Freestyle performance and technique, especially at elite levels. Advanced data analysis platforms are common in these categories.

Communication Platforms: 7

Training management software is commonly used, similar to other cycling and urban sports disciplines.

Augmented Reality: 5

AR application has much potential in this discipline, but its application so far is experimental.

Sensors and Wearables: 6

The use of wearables is widespread and used to monitor riders' physical patterns and measure power, height, and speed of jumps. However, implementing connected sensors in parks is more challenging since competitions are held in urban environments.

Virtual Reality: 5

VR offers a great opportunity to simulate competition scenarios in the park and perfect riders' technique, but the trend is still underdeveloped.

1. AI & Data

- **Technique and maneuver analysis:** Applications incorporating AI algorithms to analyze cyclists' movements and techniques in real-time, helping to improve technique and prevent falls.

- **Result prediction with Generative AI:** Use of conversational generative AI tools to analyze data from previous competitions, park conditions, competitor statistics, and other factors to predict cyclists' performance and potential results.

2. AR & VR

- **Virtual reality training:** Use of VR devices to simulate competition scenarios in the park, allowing cyclists to practice tricks from home.

3. Sensors and Wearable Devices

- **Physiological monitoring devices:** Clothing and wearable devices that monitor physical patterns (heart rate, breathing, and other health indicators).

- **Jump meters:** Applications that collect data from sensors connected to BMX bikes, measuring data related to speed or height achieved in jumps and tricks.

4. Platforms and Software

- **Training management software:** Connected platforms that allow planning and monitoring of BMX Freestyle training, analyzing statistics related to progress in tricks, jumps, and maneuvers to reinforce training programs.

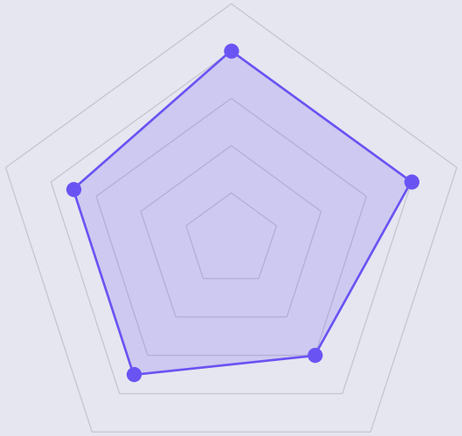
5. Infrastructure Innovations

- **Smart BMX parks:** Facilities equipped with sensors that collect data on force distribution and movement during maneuvers, providing critical information for technique and strategy analysis.

Use of Technologies by Category

E-Health: 8
Wearable devices and fitness watches are very helpful for recovery in case of injuries and for measuring riders' physical condition.

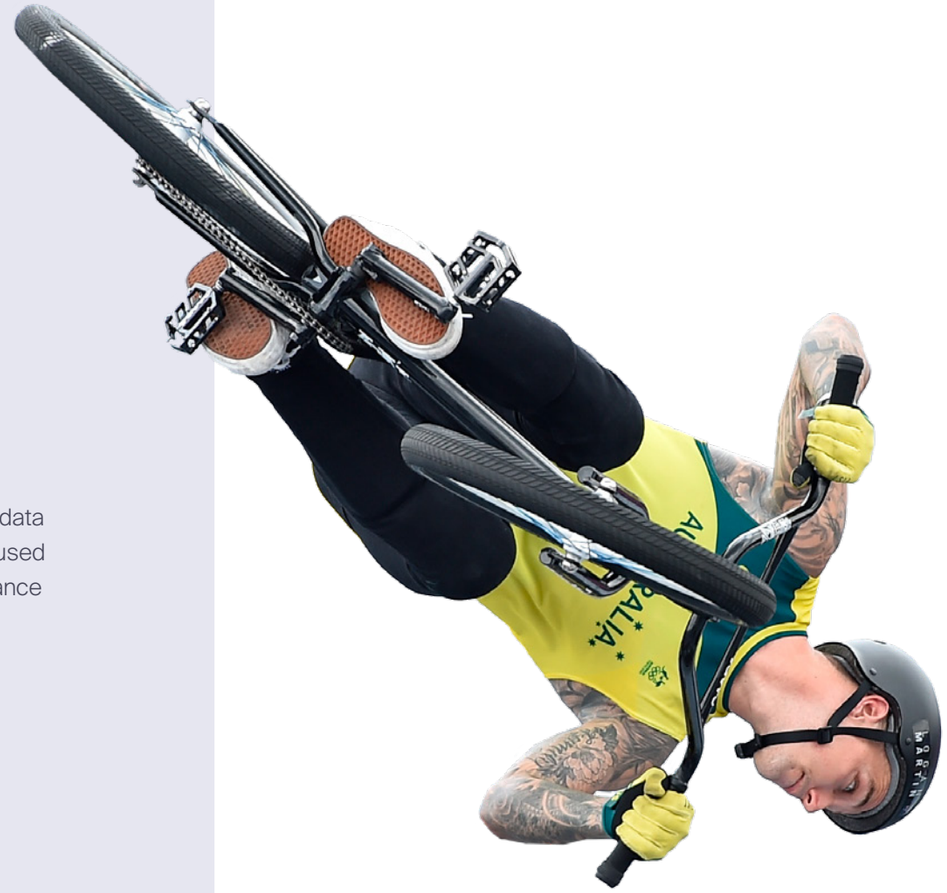
Cybertech: 7
Cybersecurity is a priority for this sport given the large volume of data it handles, and its implementation is in progress.



Performance: 8
Mobile applications connected to data analysis platforms are commonly used to evaluate and optimize performance in BMX Freestyle, especially in elite categories.

Fan Engagement: 7
Mobile apps and social media platforms are well-developed for interacting with fans.

Audiovisual: 6
There is still much room for adoption and development of the great opportunities offered by immersive experiences in this discipline.



Logan Martin | 2021

Current Use Cases

1. **Applications like Dartfish or Kinovea allow real-time analysis of cyclists' movements**, providing instant feedback on technique and strategy, and suggesting adjustments to improve performance and prevent falls or injuries.

2. **Wearable** devices like Whoop Strap are commonly used to monitor heart rate, breathing, and other **physical indicators in real-time.**

3. **Training management applications like TrainingPeaks** are used by BMX Freestyle teams to plan loads and monitor progress.

The Next 10 Years

1 **Generative AI applications open up a range of opportunities** for monitoring metrics in such a data-rich discipline. In the future, more sophisticated and specialized applications are expected to emerge in this sport, enabling much more accurate predictive analysis.

2 Augmented and virtual reality presents an untapped area and will be more deeply integrated, not only in training but also in the fan experience, with **interactive platforms offering unique perspectives of competitions.**

3 **IoT sensor technology presents a great opportunity to perfect jump and trick monitoring systems** in parks and evaluate riders' performance. However, its implementation is more complex compared to other disciplines since Freestyle is practiced in various environments, including skate parks, ramps, half-pipes, and adapted urban areas for tricks.

4 Other innovation areas like **computer vision will also begin to be experimentally implemented**, allowing real-time jump analysis or automatically identifying the most spectacular tricks and spins.

BMX Racing

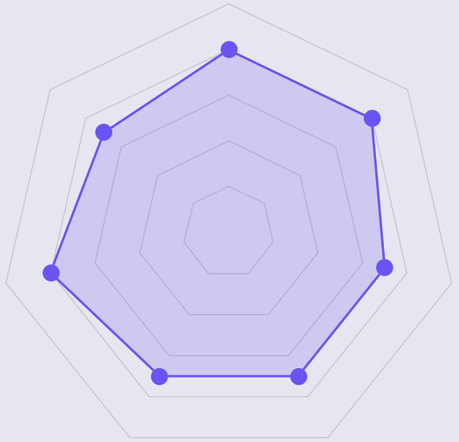
BMX Racing is a cycling discipline focused on high-speed races on specifically designed dirt tracks featuring jumps, tight turns, and obstacles. Cyclists must maneuver with skill and agility to overcome the challenges of the circuit. The goal is to cross the finish line first, requiring a combination of explosiveness, technique, and strategy.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still in development and varies by competition.

Smart Infrastructure: 7
Innovations in BMX tracks and lighting systems are being adopted and are more common than in other cycling disciplines, but not yet universal.

Data Analysis: 8
Data analysis is deeply integrated into all aspects of BMX Racing performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 8
Training management and strategy software is well developed and fundamental in cyclists' preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is limited and primarily experimental.

Sensors and Wearables: 7
Sensor technology in smart bikes is not as advanced as in other cycling disciplines, but there is significant development potential.

Virtual Reality: 7
VR is used in specific training sessions to simulate race scenarios, improving cyclists' decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Real-time technique and performance analysis:** AI tools analyze cyclists' movements and techniques to optimize conditions such as biomechanics, cadence, and bike movements.
- **Result prediction:** Use of generative AI to analyze data from previous competitions, track conditions, and other factors to predict cyclists' performance and potential results.

2. AR & VR

- **Virtual training:** Use of VR devices to simulate different race conditions, allowing cyclists to practice in controlled environments as if they were on the actual tracks.

3. Sensors and Wearable Devices

- **Smart bikes:** Equipped with sensors that monitor posture, force distribution, and cyclists' biomechanics during races. They also provide numerous metrics on speed and cadence that coaches and cyclists can analyze to improve performance.
- **Physiological monitoring devices:** Connected watches, sensor-equipped clothing, and wearable devices monitor cyclists' physical condition to optimize training and recovery.

4. Platforms and Software

- **Training management software:** Digital platforms for planning and monitoring training sessions, where cyclists share their performance data for coaches to analyze workload and progress.

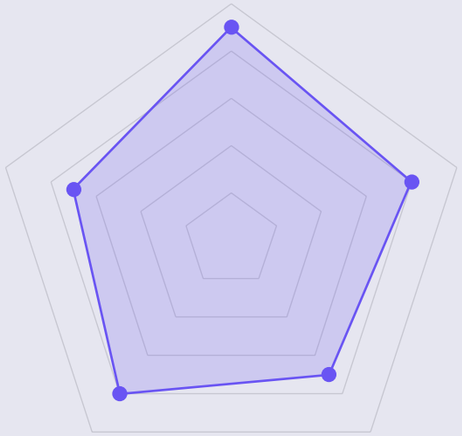
5. Infrastructure Innovations

- **Smart BMX tracks:** Facilities equipped with sensors that collect data on force distribution and movement during races, providing critical information for technique and strategy analysis.
- **Software-controlled dynamic lighting:** Intelligent lighting systems that adjust automatically during training sessions and competitions to improve lighting conditions and reduce energy consumption.

Use of Technologies by Category

E-Health: 9
The adoption of wearables and mobile apps to monitor cyclists' health and personalize treatment plans is almost universal at elite levels.

Cybertech: 7
Cybersecurity is a priority, though full implementation and universal adoption are still in progress.



Performance: 8
Data analysis platforms are commonly used in teams and integrated to evaluate and optimize cyclists' performance.

Fan Engagement: 8
Efforts are being made to develop and improve mobile apps and social media platforms to enhance fan interaction and broadcast spectacular events.

Audiovisual: 7
Immersive experiences and AR and VR applications are available but still have significant room for development and adoption.

Current Use Cases

1. Applications like **TrainingPeaks or Coach's Eye** are used by BMX Racing teams to plan and monitor training sessions.

2. Kinovea is a sports **analysis program that uses cameras and software to analyze cyclists' movements in real-time**, providing feedback on technique and strategy.

3. The BMX club in Blegny, in the province of Liege (Belgium), **has installed an innovative intelligent LED lighting system on its track**, which can be controlled by organizers from a mobile phone, tablet, or smart watch.

4. The British BMX Racing team is one of the most technologically advanced, **having adapted software previously used in drone trials to improve cyclists' performance.**

5. IDLab, a research group at Ghent University, **has leveraged data mining, machine learning, and computer vision** to make BMX Racing more attractive to spectators.

The Next 10 Years

1. Augmented and virtual reality will become more common for **immersive training and enhancing the spectator experience.**

2. **Biotechnology will continue to advance**, providing cyclists with increasingly advanced physical monitoring tools.

3. The implementation of **smart bikes equipped with sensors** will move out of the initial phase, and their use will advance rapidly.

4. **Sensor-equipped tracks** will become more common, allowing for much more comprehensive performance metric control and improvements in other aspects such as spectator experience and energy management.

Mountain Biking

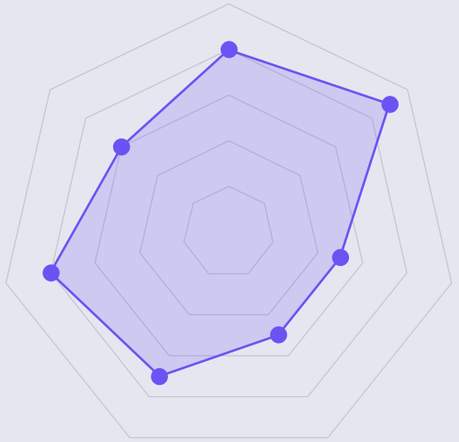
Mountain biking is an exciting and challenging discipline practiced on natural and rugged terrains such as forest trails, mountains, hills, and technical descents. Cyclists use specially designed bikes with robust suspensions and wide tires to tackle obstacles like rocks, roots, and steep slopes, offering a unique experience that combines adrenaline with a connection to nature.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still in development.

Smart Infrastructure: 6
Innovations in integrating technologies into mountain routes require further development, though investments and developments are underway.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of mountain biking performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in cyclists' preparation, though full adoption still has room to grow.

Augmented Reality: 5
Some applications are in development, but adoption is still limited in this discipline.

Sensors and Wearables: 7
Sensor technology in smart bikes is available and becoming common in elite teams, but it is still in the deployment and experimentation phase.

Virtual Reality: 5
Although there is development potential for immersive training, recreating realistic scenarios is more complex than in other cycling disciplines, and adoption is still limited.

1. AI & Data

- **Technique and performance analysis:** AI tools incorporating intelligent tracking systems to analyze cyclists' movements and techniques in real-time.
- **Predictive result analysis:** Algorithms embedded in generative AI tools analyze data from previous competitions, terrain conditions, and other factors to predict cyclists' performance and potential results.

2. AR & VR

- **Immersive training:** Use of VR to simulate different race conditions on varied terrains, allowing cyclists to practice in a controlled environment and improve their technique without the risk of injury.

3. Sensors and Wearable Devices

- **Smart bikes:** Equipped with sensors that monitor posture, workload, and force distribution in real-time during races, providing detailed data to improve technique and prevent injuries.
- **Physiological monitoring devices:** Jerseys, shorts, helmets, and compression garments equipped with sensors that analyze heart rate, breathing, and other indicators related to the cyclist's physical condition.

4. Platforms and Software

- **Route and training management platforms:** Digital tools that help plan and monitor mountain routes, evaluate critical points, and establish split forecasts per kilometer to prepare for competitions or assess progress.

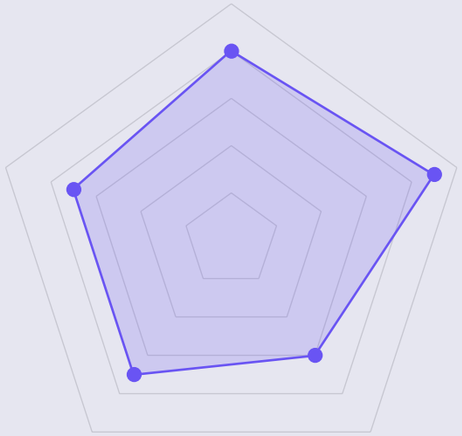
5. Infrastructure Innovations

- **Mountain routes with integrated sensors:** Integration of connected devices at critical points on the routes to automatically collect and analyze data related to passage speed or exact positions.
- **Drones with computer vision:** Unmanned aerial vehicles with smart cameras to process images of races from different viewpoints, enhancing the experience for spectators and cyclists.

Use of Technologies by Category

E-Health: 8
Wearable devices and mobile applications for monitoring cyclists' health and physical condition are widely adopted at all competition levels.

Cybertech: 7
Federations and race organizations increasingly prioritize cybersecurity to protect race safety given the large volume of data handled.



Performance: 9
Applications like TrainingPeaks or Strava are commonly used and integrated as essential elements for evaluating and optimizing athletes' performance.

Fan Engagement: 7
Efforts are underway to improve spectators' viewing experience, and trends like drones, IoT sensor technology, and computer vision offer significant opportunities.

Audiovisual: 6
Immersive experiences and VR applications are starting to be available, but professional use is not yet widespread.

Tom Pidcock | 2023

Current Use Cases

1. Strava is one of the most commonly used applications by mountain biking teams. **This platform connects with wearable devices** and allows recording training sessions, comparing metrics and results obtained on routes such as pace per kilometer or fastest split times.

2. Bikes with built-in AI, like CAROL and Renpho, **use sensors and biometric data to personalize training based on power**, pedaling force, or cadence. Renpho, for example, uses training algorithms that automatically adjust the resistance level.

3. Bike Vender VR is one of the pioneering tools in **creating immersive virtual reality scenarios for mountain biking.** Using a stationary bike and a VR headset, the application recreates mountain scenarios where users can practice at a non-professional level.

The Next 10 Years

1

The integration of **generative AI as a regular tool in training and competition planning**, as well as the automatic measurement of comparative performance metrics in races.

2

AR and VR have a vast experimental field ahead, and in the coming years, we could see the emergence of **more precise and advanced applications** to help professional cyclists prepare for competitions and improve race technique.

3

Bikes, sensor-equipped clothing, and wearable devices will continue to offer increasingly advanced features, allowing **each cyclist to measure their performance in detail and monitor their health in real-time.**

Track Cycling

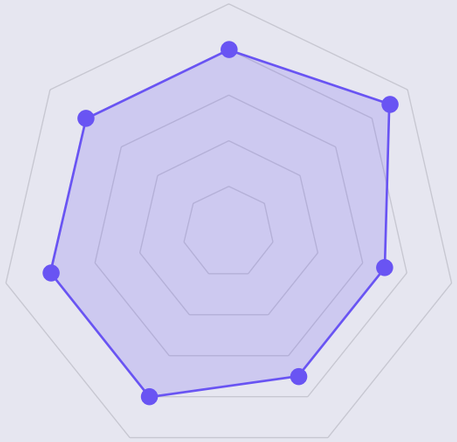
Track cycling is a discipline that combines speed, endurance, and strategy in a controlled environment. The bikes used in track cycling are optimized for speed and aerodynamics, requiring cyclists to maintain precise control and use the track's inclinations to achieve high speeds. This sport blends the dynamism of short-duration competitions with the tactics and endurance needed to excel in a highly competitive setting.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and statistical learning, as well as for rider selection and result prediction.

Smart Infrastructure: 8
Innovations in velodromes and lighting systems are being adopted, but further investment is needed for universal adoption.

Data Analysis: 9
Advanced data analytics is already deeply integrated into all aspects of performance control and technique and biomechanics improvement in track cycling.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in cyclists' preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is already applicable in technique visualization and analysis, but there is still significant room for improvement and adoption.

Sensors and Wearables: 8
Sensor technology is advancing, and smart riding is already a prominent trend in track cycling, pending future advancements in tool features and sophistication.

Virtual Reality: 7
VR is very useful for studying and perfecting aerodynamics. Its adoption is still experimental, but it presents a field of significant potential opportunities.

1. AI & Data

- **Technique and performance analysis:** AI tools analyze cyclists' movements, cadence, biomechanics, and techniques in real-time, providing instant feedback and suggesting adjustments to optimize performance.

- **Predictive result analysis:** Machine learning systems analyze historical and current datasets related to previous competitions, track conditions, and other factors to predict expected performance and likely competition outcomes.

2. AR & VR

- **Virtual aerodynamics:** Track cycling has significant potential for integrating virtual simulation tools to study cyclists' biomechanics and find ways to adopt more aerodynamic positions.

- **Real-time race analysis:** AR applications overlay data and diagrams on training and race images, allowing coaches and cyclists to analyze and correct techniques more precisely based on data.

3. Sensors and Wearable Devices

- **Smart bikes:** Equipped with sensors and smart devices placed strategically, such as on the pedals or saddle, to monitor posture, force, and pedaling cadence in real-time.

- **Smart equipment:** Clothing specifically designed to enhance aerodynamics and performance, incorporating sensors to measure muscle temperature, heart rate, and breathing in real-time.

4. Platforms and Software

- **Training management software:** Metric measurement platforms analyze parameters such as speed or endurance and provide personalized estimates on optimal workloads for each cyclist.

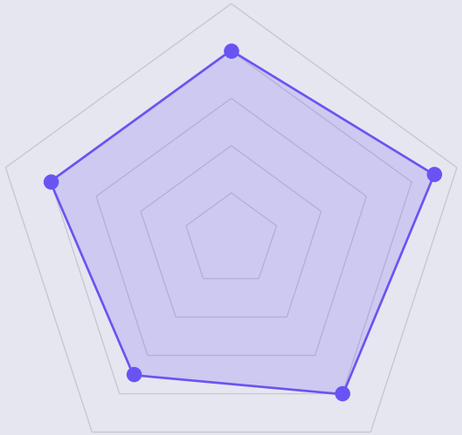
5. Infrastructure Innovations

- **Smart velodromes:** Tracks equipped with sensors that collect precise data on test execution and passing speed. They also incorporate IoT-connected device networks and smart home systems to remotely control all aspects of lighting and efficient energy consumption.

Use of Technologies by Category

E-Health: 8
Personalized injury treatment plans and health monitoring via wearable devices are widely adopted.

Cybertech: 8
Cybersecurity is a priority, with advanced encryption and blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9
Mobile apps integrated with data analysis platforms are commonly used to evaluate and optimize cyclists' performance, providing precise and reliable data for decision-making.

Fan Engagement: 7
Mobile apps and social media platforms are well-developed for interacting with fans, though their adoption is not yet universal.

Audiovisual: 8
Immersive experiences and AR and VR applications are already available for analyzing and improving aerodynamics and biomechanics, though there is still room for improvement.

Harrie Lavreysen | 2019

Current Use Cases

1. Bkool Cycling, **one of the first indoor cycling software launched on the market.** Through a bike, a trainer, and cadence and power sensors, it allows simulating cycling competitions in various disciplines, including track cycling.

2. **VeloViewer, one of the most used applications** by elite cycling teams in various disciplines, including track cycling, where the platform allows coaches to analyze cyclists' performance in real-time across segments and make strategic adjustments on the fly.

The Next 10 Years

1

IoT Sensoring and Smart Velodromes the evolution of connected devices and control applications will continue to present opportunities for measuring race parameters, **enhancing spectator experience, and achieving more precise and efficient lighting and energy management.**

2

Virtual and Augmented Reality, these technologies will continue to develop, leading to new specialized applications in track cycling that allow cyclists **to optimize their posture and improve biomechanics to unprecedented levels.**

3

Smart Riding Advances, innovations in smart riding will continue to guide technological progress in bikes, **incorporating increasingly advanced performance control features.**

Road Cycling

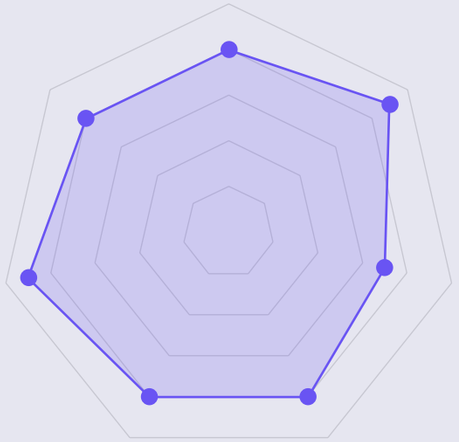
Road cycling is a discipline practiced on paved roads, ranging from short urban circuit races to grueling multi-week endurance events like the Tour de France. It requires a combination of physical endurance, speed, and excellent decision-making skills, attracting a large and passionate global audience.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and statistical learning, as well as for predicting results based on race conditions and physical parameters of the riders.

Smart Infrastructure: 8
Investment in smart infrastructure is ongoing, especially in high-level competitions, and significant advancements are already being seen in major tours.

Data Analysis: 9
Advanced data analytics is deeply integrated into all aspects of performance control and improvement of technique and biomechanics in road cycling.



Communication Platforms: 9
Training and strategy management software is well-developed and fundamental in cyclists' preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is already applicable in visualizing and analyzing pedaling technique, posture, and aerodynamics.

Sensors and Wearables: 8
Sensor technology is highly advanced and widely used in bikes and equipment for performance analysis. These devices are common in most professional teams.

Virtual Reality: 8
Used for perfecting aerodynamics and recreating race scenarios. Road cycling is one of the disciplines where this trend has advanced the most.

1. AI & Data

- **AI-designed clothing:** Some professional teams use generative AI to design jerseys and shorts, requesting proposals for color combinations, styles, and fit models.
- **Bike and component design:** AI is used in designing bikes for professional teams to optimize performance and efficiency. Through simulations and data analysis, AI can evaluate the aerodynamics of designs, identifying shapes and materials that reduce wind resistance or enhance speed.
- **Training and nutrition planning:** AI analyzes each cyclist's physical and performance data, combining it with the type of route and weather conditions for each stage or race, offering predictions on expected calorie expenditure and the most appropriate training level for each cyclist.

2. AR & VR

- **Immersive training:** Using VR simulators, cyclists can train on virtual replicas of specific race routes and stages, allowing them to familiarize themselves with the terrain, curves, slopes, and other critical details without being physically present.
- **Aerodynamic optimization:** Extended reality is used to analyze and improve pedaling technique and posture on the bike, visualizing biomechanics in more detail and from different angles.

3. Sensors and Wearable Devices

- **Cadence and speed sensors:** Integrated into key elements of the bikes, these connected devices wirelessly transmit pedaling frequency data in real-time to be monitored through mobile applications.
- **Smart clothing:** Garments equipped with cutting-edge technology, such as jerseys with smart sensors that measure performance indicators like heart rate, speed, and distance.

4. Platforms and Software

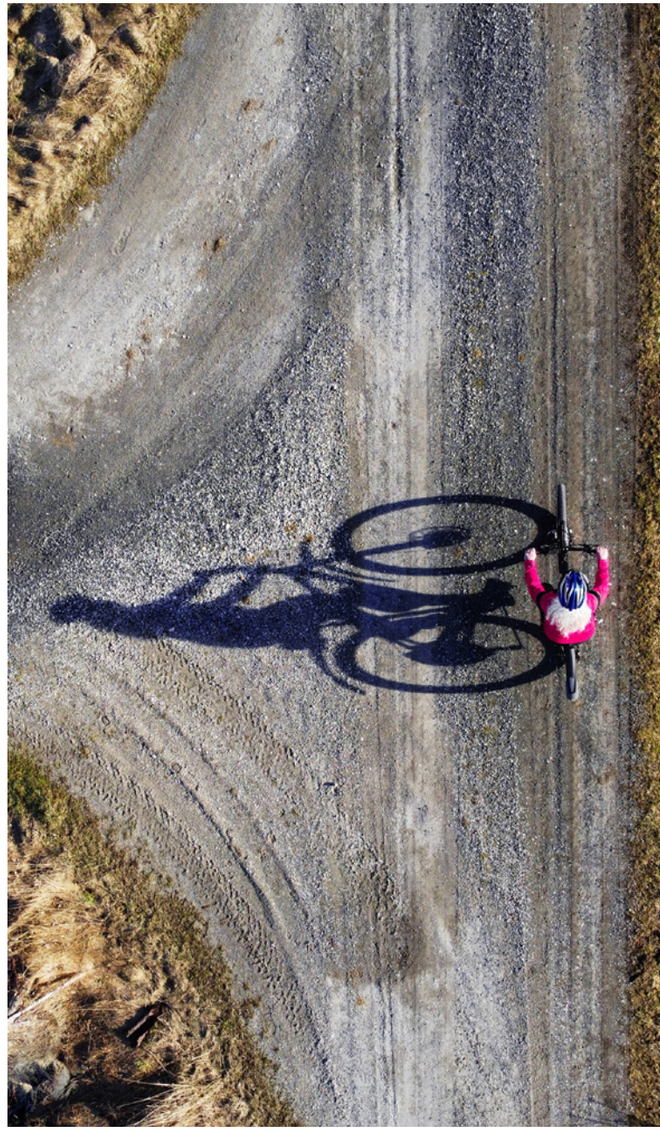
- **Training and data analysis applications:** Online platforms where cyclists and team directors can track performance. They analyze patterns in speed, power, heart rate, and cadence to adjust training plans and race strategies.

5. Infrastructure Innovations

- **Advanced timing systems:** Using RFID chips and GPS systems at key race points for more precise and real-time timing. These systems provide accurate tracking of each cyclist's position and split times at various points on the route, offering instant and precise data to organizers and spectators.

- **Cameras with computer vision:** Installed on bikes, motorcycles, and support cars, these cameras allow spectators to enjoy live broadcasts from multiple angles, offering a more immersive and exciting view of the races while automatically capturing crucial race moments.

- **Drones:** Provide comprehensive views of the race through aerial images and help maintain greater security and surveillance during the competition.



Use of Technologies by Category

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Cybertech: 8
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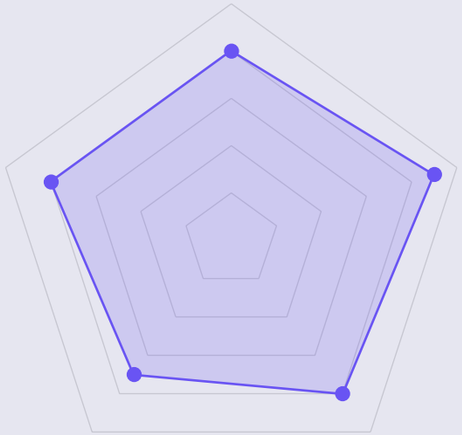
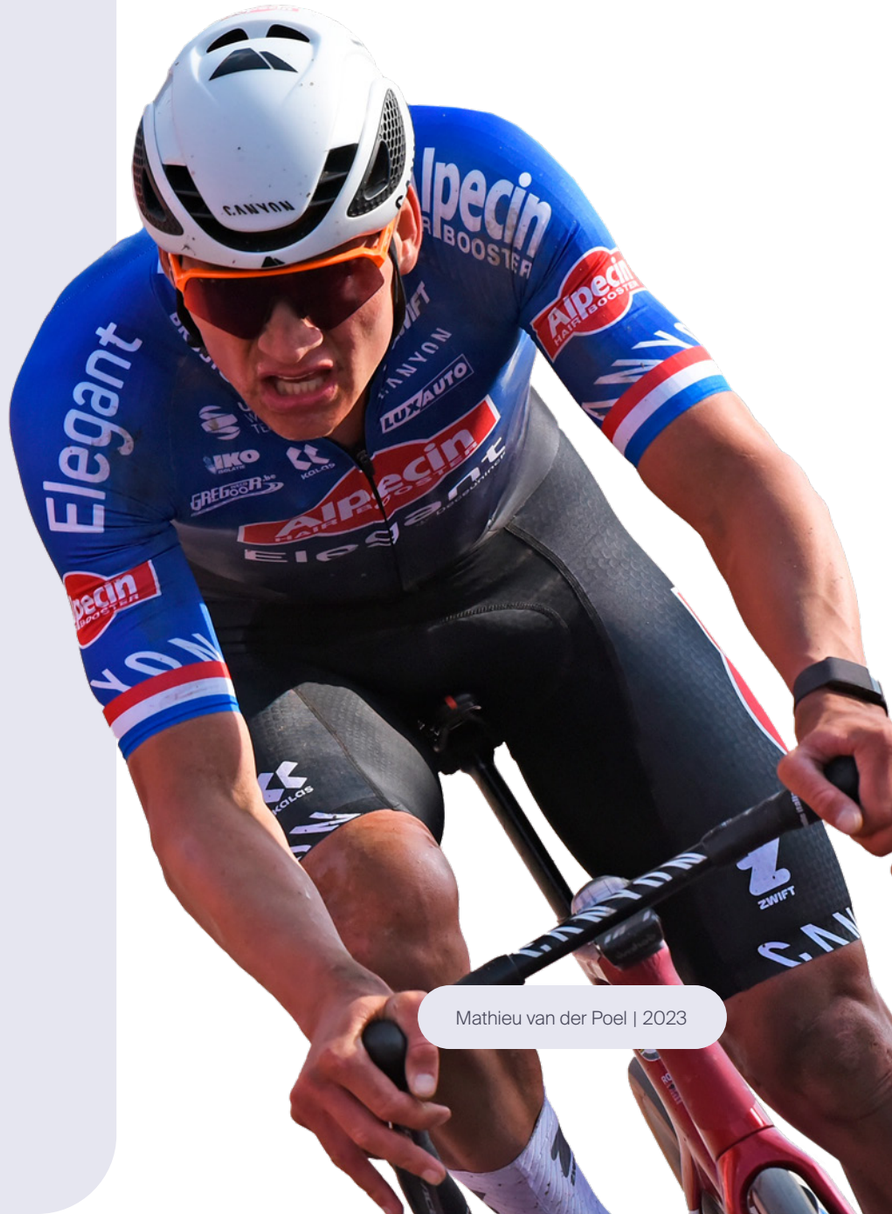


Performance: 9
Mobile apps integrated with data analysis platforms are commonly used to evaluate and optimize cyclists' performance, providing precise and reliable data for decision-making.

Fan Engagement: 7
Mobile apps and social media platforms are well-developed for interacting with fans, though their adoption is not yet universal.

Audiovisual: 8
Immersive experiences and AR and VR applications are available for analyzing and improving aerodynamics and biomechanics, though there is still room for improvement.



Mathieu van der Poel | 2023

Current Use Cases

1. Leading professional teams like Jumbo-Visma, UAE, Ineos, and Movistar **use AI systems to deeply analyze their cyclists' metrics and determine calorie consumption and preparation plans** for each race.

2. Major bike manufacturers like Decathlon use **generative AI design systems to develop** their new aerodynamic bike models.

3. **Applications like TrainingPeaks and Strava are commonly used in road cycling.**

4. There are many **VR applications that recreate road cycling scenarios**, such as CycleVR and CadenceVR.

5. **The company Core, maker of the body temperature sensor of the same name, claims that about 70% of the professional peloton already uses its tool** to measure skin temperature, heat stress index, and precise heat stress scores for each rider.

The Next 10 Years

1. **Greater integration of AI and Machine Learning will be used to analyze real-time performance data**, optimize race strategies plan stages, and establish personalized training regimes.

2. Enhanced Use of **AR and VR will play an increasingly crucial role**, allowing cyclists to train in realistic simulations of routes and improving spectator experience with live data overlays.

3. Innovations in materials and equipment design **continued development of lighter, more aerodynamic, and durable structures.**

4. **Advanced connectivity more precise and detailed real-time** tracking will improve team coordination and race safety.

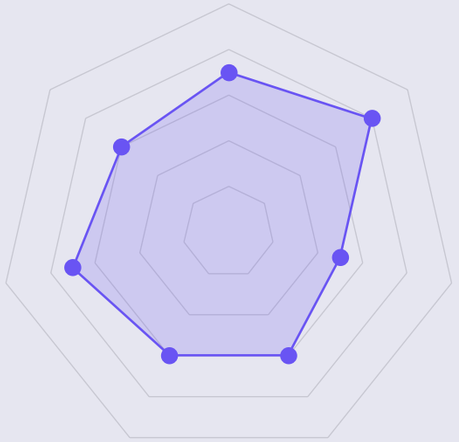
Sport Climbing

Sport climbing is a form of climbing practiced on pre-established routes on natural or artificial walls, using fixed protection equipment such as anchors and bolts to ensure ascent. Focusing on physical and technical challenges, climbers use ropes, harnesses, and climbing shoes to tackle demanding routes without worrying about placing protection, unlike traditional climbing. Sport climbing competitions are divided into lead climbing, bouldering, and speed climbing, each with its own challenges and techniques. This discipline was included in the Olympic Games for the first time in Tokyo 2020.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data and technique analysis, but full integration is still in development. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure: 6
Innovations in climbing walls and lighting systems are being adopted, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.



Data Analysis: 8
Data analysis is deeply integrated into all aspects of climbing performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.

Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in climbers' preparation, though full adoption still has room to grow.

Augmented Reality: 5
AR is mainly used for route visualization and analysis, but its adoption is limited and primarily experimental.

Sensors and Wearables: 6
Sensor technology is in the development phase and used in portable devices and clothing for performance analysis.

Virtual Reality: 6
VR is used in specific training, but not widely adopted, although its potential to improve technique and planning is promising.

1. AI & Data

- **Technique and strategy analysis:** Some apps use AI to analyze climbers' movements, providing instant feedback on technique and suggesting adjustments to optimize performance.
- **Injury prediction:** Machine learning algorithms analyze movement patterns and training loads to predict and prevent potential injuries.

2. AR & VR

- **Virtual reality training:** Use of VR to simulate different climbing routes and conditions, allowing climbers to practice in a controlled environment and improve their technique without risk of injury.
- **Route analysis with AR:** Applications that overlay data and diagrams on climbing routes in real-time to help climbers and coaches analyze and plan strategies more accurately.

3. Sensors and Wearable Devices

- **Performance monitoring climbing walls:** Interactive walls with LED sensors help climbers optimize their climbing routes and monitor their performance.
- **Wearables:** Clothing, footwear, harnesses, and other gear integrated with sensors that monitor posture, balance, and applied force during climbing, providing valuable information for performance analysis.

4. Platforms and Software

- **Training management software:** Intelligent platforms allow planning and monitoring of climbing training, managing workloads, and analyzing climbers' progress, optimizing training programs.
- **Live strategy applications:** Tools that enable coaches to adjust strategies and climbing plans in real-time based on data obtained during training sessions and competitions.

5. Infrastructure Innovations

- **Climbing walls with integrated sensors:** Walls equipped with pressure sensors that collect data on force distribution and movement during climbs, providing critical information for technique and strategy analysis.

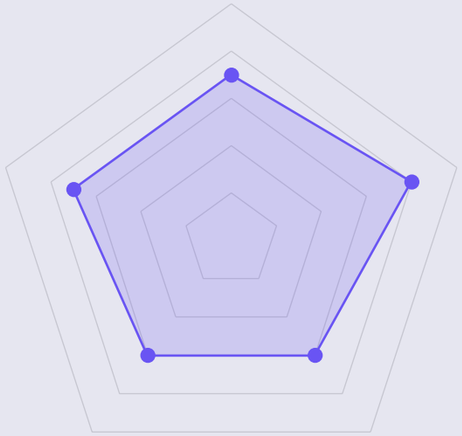
Use of Technologies by Category

E-Health: 7

Wearable devices and mobile applications help monitor climbers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity in professional climbing is implemented through advanced technologies, including secure networks, data encryption, multifactor authentication, and secure passwords. Security audits and awareness programs are also conducted, but full implementation and universal adoption are still in progress.



Performance: 8

Tools with data analysis platforms are integrated to evaluate and optimize performance, providing precise and reliable data for decision-making, but there is still room for improvement in full implementation.

Fan Engagement: 6

Mobile apps and social media platforms are being developed to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 6

Immersive experiences and AR and VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Nonaka Miho | 2018

Current Use Cases

1. Zlagboard uses **sensors and software to analyze climbers' movements and technique in real-time**, providing instant feedback and suggesting adjustments to optimize performance and prevent injuries.

2. **Kilter Board an interactive climbing panel using app-controlled LED lights to guide climbers through different problems.** The panels are adjustable in angle and equipped with various holds. This technology allows climbers to train on a variety of routes and difficulty levels, recording their climbs and sharing problems with a global community.

3. The Climbing Guide a mobile app designed to help climbers identify and navigate climbing routes. **By pointing the phone's camera at a rock or wall, the app uses augmented reality to recognize and instantly display 3D routes.** Users can also view 3D scans of routes from home, with detailed information such as height and angles, and receive precise mapping guides to the location.

4. ValoClimb Walls **integrate augmented reality games and interactive features to gamify the climbing experience.** These walls can adjust difficulty and provide real-time information to climbers.

5. Bruno Kessler Foundation's Sensors developed a set of sensors integrated into a climbing harness and shoes. This system includes pressure and motion sensors that capture detailed data on the climber's technique and performance. **The data collected by these sensors are transmitted to a mobile application, where they are analyzed to provide real-time feedback** on aspects such as grip strength, weight distribution, and movement coordination.

6. Tension Board App offers an **AI-based virtual coach called Skillscape.** This coach suggests new climbing problems, identifies training needs, and helps design personalized sessions.

The Next 10 Years

1 Smart climbing facilities **will feature smart walls equipped with advanced sensors that provide real-time data** on climbers' strength, technique, and performance.

2 This data will be analyzed by artificial intelligence, offering instant and personalized feedback **to improve skills and prevent injuries.**

3 Climbers **will use smart clothing and equipment with integrated sensors** to monitor their vital signs and adapt training accordingly.

4 VR and AR will play a crucial role, allowing climbers **to practice in virtual environments that simulate extreme conditions and complex routes** without needing to be physically present. These technologies will also enable global virtual competitions, where climbers worldwide can compete in real-time on digitally replicated routes.

5 Bioengineering will develop lighter and more durable materials for climbing gear, **improving safety and performance.**

6 **Interaction between climbers and technology will become more intuitive**, with user interfaces responding to voice commands and gestures, making the climbing experience more immersive and efficient.

Fencing

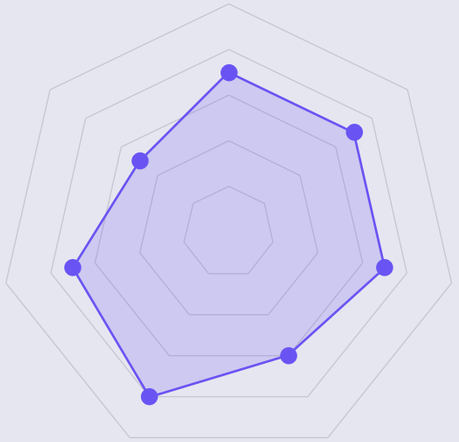
Fencing, also known as sport fencing, is a combat sport in which two competitors face off using bladed weapons such as the foil, epee, and saber, following a specific set of rules. The objective is to touch the opponent with the tip or edge of the weapon, depending on the type of fencing practiced, to score points. Fencing is known for its speed, precision, and strategy, and is practiced both recreationally and competitively, including its inclusion in the Olympic Games. This sport combines physical skills such as agility and coordination with mental skills such as anticipation and quick decision-making.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data and technique analysis, but full integration is still in development. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure : 5
Innovations in fencing pistes and lighting systems are being adopted, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 7
Data analysis is deeply integrated into all aspects of fencing performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in fencers' preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is mainly used for technique visualization and analysis, but its adoption is limited and primarily experimental. However, companies are increasingly focusing on developing solutions in this area.

Sensors and Wearables: 8
Sensor technology is very advanced and widely used in suits and weapons for performance analysis. These devices are common in most professional teams.

Virtual Reality: 6
VR is used in specific training, but not widely adopted, although its potential to improve technique and planning is promising.

1. AI & Data

- **Technique and strategy analysis:** Tools like video analysis systems use AI to analyze fencers' movements, providing instant feedback on technique and suggesting adjustments to optimize performance.
- **Injury prediction:** Machine learning algorithms analyze movement patterns and training loads to predict and prevent potential injuries.

2. AR & VR

- **Virtual reality training:** Use of VR to simulate different combat and training scenarios, allowing fencers to practice in a controlled environment and improve their technique without risk of injury.
- **Technique analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, helping coaches to analyze and correct their athletes' technique and strategy more precisely.

3. Sensors and Wearable Devices

- **Smart suits with sensors:** Equipment with sensors that monitor posture, force distribution, and movement precision in real-time during combat.
- **Smart foils:** Weapons equipped with sensors that measure speed, precision, and impact of strikes to improve fencers' technique.

4. Platforms and Software

- **Training management software:** Various platforms allow planning and monitoring of fencing training, managing workloads, and analyzing fencers' progress.
- **Live strategy applications:** Tools that enable coaches to adjust strategies and combat plans in real-time based on data obtained during training sessions and matches.

5. Infrastructure Innovations

- **Fencing pistes with integrated sensors:** Pistes equipped with pressure sensors that collect data on force distribution and movement during matches.

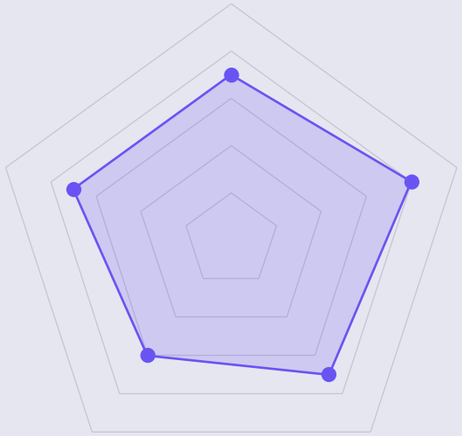
Use of Technologies by Category

E-Health: 7

Wearable devices and mobile applications help monitor fencers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity in fencing is primarily implemented through the protection of electronic systems and data management used in competitions and training. This includes the security of competition management platforms, electronic scoring systems, and athlete and coach databases, but full implementation and universal adoption are still in progress.



Performance: 8

Tools and data analysis platforms are integrated to evaluate and optimize performance, providing precise and reliable data for decision-making, but there is still room for improvement in full implementation.

Fan Engagement: 6

Mobile apps and social media platforms are being developed to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Tommaso Marini | 2020

Current Use Cases

1. Fencing Platform used by fencing teams **to plan and monitor training**, manage workloads, and analyze fencers' progress, optimizing training programs.

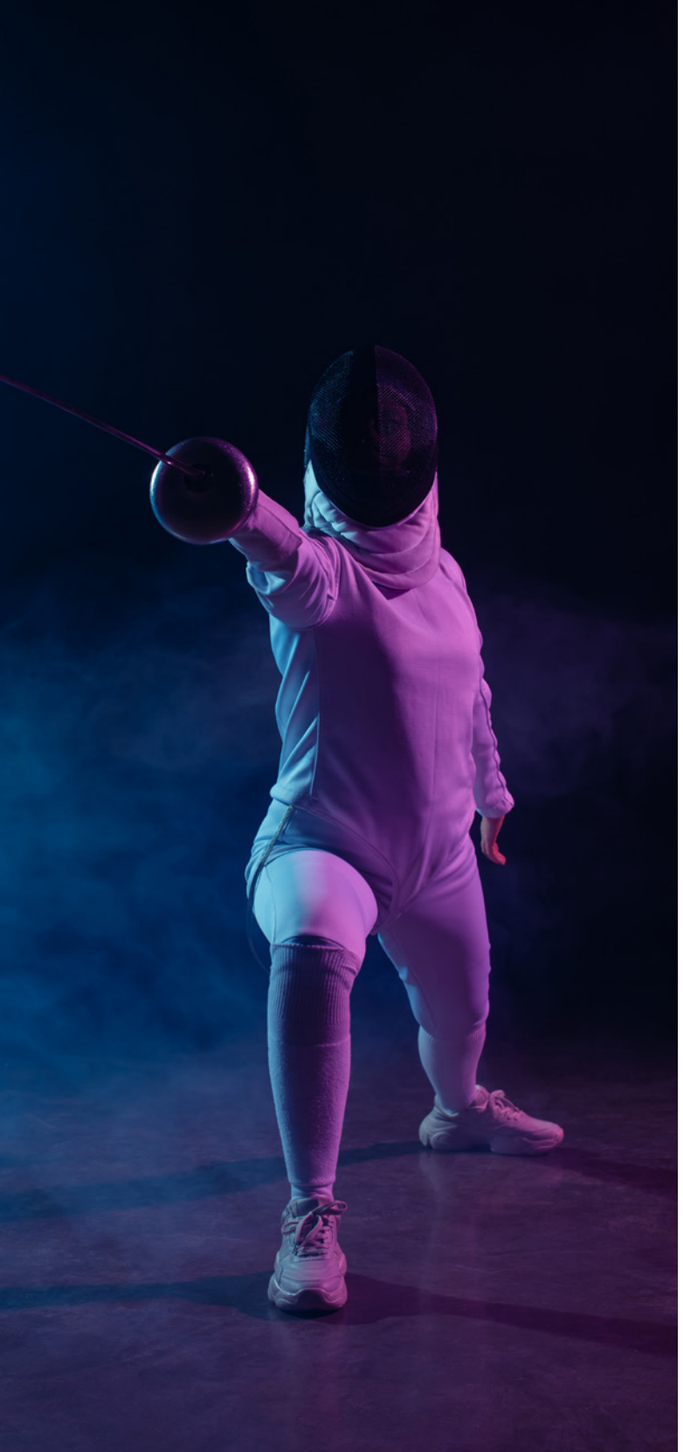
2. UNAM Virtual Reality Project developed a VR system for fencing training. This simulator uses sensors placed on the fencer's wrist, forearm, and back to record their movements and **recreate them in a virtual environment**. The goal is for athletes to practice fencing movements and strategies without the need for a physical coach.

3. Fencer VR is a virtual reality fencing trainer designed to improve fencing skills through gamified exercises. **It uses Oculus Quest VR glasses combined with a real sword or an accessory integrated with its platform.** Users practice different fencing techniques, such as attacks, defenses, and parries, through a series of interactive exercises that help develop muscle memory and precision.

4. Leon Paul Smart Sabers **are equipped with sensors that monitor the speed, precision, and impact of strikes**, providing detailed data to help fencers improve their technique and precision. These sabers are known to be used by professionals preparing for the 2024 Olympic Games.

5. **Calibur Scoring System uses AI to track scores in real-time.** The technology consists of a compact wireless scoring device that fencers connect to their foils and link to a mobile app. This system allows recording touches and transferring information wirelessly.

6. **Rhizomatiks Research uses augmented reality technology** to visualize the trajectory of sword tips in real-time. It has evolved from using markers to detecting sword tip positions solely from camera images.



The Next 10 Years

1

One of the main changes will be the adoption of advanced technologies to improve accuracy and tracking during competitions. **Fencing suits and weapons will be equipped with more advanced sensors that will not only detect touches more accurately**, but also record detailed data on the speed, force, and angles of attacks.

2

Augmented reality and virtual reality will transform the way fencing is trained and enjoyed. Coaches and athletes will be able to use VR simulations to practice in virtual environments that replicate real competition conditions. For viewers, AR could provide an immersive viewing experience, displaying additional real-time information on strategies, athlete history, and movement analysis, all overlaid on the live stream.

3

Artificial intelligence will play a crucial role in performance analysis and training personalization. Advanced algorithms will analyze large volumes of data to identify patterns and recommend specific improvements for each athlete, optimizing both technique and strategy.

4

AI programs will also help prevent injuries by detecting early signs of stress or overuse in fencers, allowing for proactive interventions.

Soccer

Soccer, known as football in most countries, is a team sport played by two teams of eleven players on a rectangular field with goals at each end. The objective is to score more goals than the opponent, using primarily the feet to control and shoot the ball, except for the goalkeeper who can use their hands. It is the most popular sport in the world, globally regulated by FIFA, which organizes the World Cup, one of the largest sporting events. Soccer promotes teamwork, strategy, and cooperation, and is an integral part of culture in many societies. Additionally, soccer is a prominent discipline in the Olympic Games, where both men's and women's teams compete for Olympic glory.

Level of Technological Implementation

Artificial Intelligence: 8

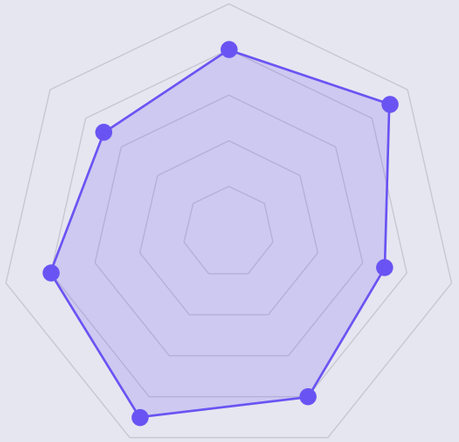
AI is widely used for data and strategy analysis, but full integration is still in development. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure: 7

Innovations in soccer fields and lighting systems are being adopted, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9

Data analysis is deeply integrated into all aspects of soccer performance and tactics, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 8

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Augmented Reality: 7

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Sensors and Wearables: 9

Sensor technology is highly advanced and widely used in jerseys, footwear, and balls for performance analysis. These devices are common in most professional teams.

Virtual Reality: 8

VR is used in specific training, but not widely adopted, although its potential to improve decision-making and technique is promising.

1. AI & Data

- **Performance and strategy analysis:** Some tools use AI to analyze player movements and strategies in real-time, providing instant feedback and suggesting tactical adjustments to optimize team performance.

- **Injury prediction:** Machine learning algorithms analyze movement patterns and training loads to predict and prevent potential injuries, helping players maintain safe and efficient training.

2. AR & VR

- **Virtual reality training:** Use of VR to simulate different game and training scenarios, allowing players to practice in a controlled environment and improve their technique and decision-making without risk of injury.

- **Strategy analysis with AR:** Applications that overlay data and tactical diagrams on training videos in real-time, helping coaches analyze and adjust team strategy with greater precision.

3. Sensors and Wearable Devices

- **Smart equipment:** Gear with sensors that monitor posture, workload, and force distribution in real-time during play.

- **Smart balls:** Balls equipped with sensors that measure speed, rotation, and trajectory, providing valuable information for performance analysis.

4. Platforms and Software

- **Training management software:** Various platforms allow planning and monitoring of soccer training, managing workloads, and analyzing player progress.

- **Live strategy applications:** Tools that enable coaches to adjust strategies and game plans in real-time based on data obtained during training sessions and matches.

5. Infrastructure Innovations

- **Soccer fields with integrated sensors:** Fields equipped with pressure sensors that collect data on force distribution and movement during matches, providing critical information for technique and strategy analysis.

- **Smart lighting:** Some soccer stadiums incorporate smart lighting to grow the grass more efficiently, save energy, or adjust lighting based on match needs.

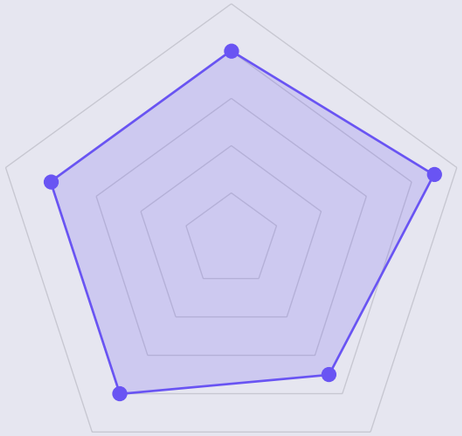
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor players' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity in soccer has advanced significantly in recent years, with many clubs and organizations adopting robust technologies and practices to protect their systems and data. Professional soccer teams now employ advanced measures like multi-factor authentication, data encryption, and the implementation of firewalls and intrusion detection and prevention systems. However, as in many other sectors, there are still challenges and areas for improvement.



Performance: 9

Tools and data analysis platforms are integrated to evaluate and optimize performance, providing precise and reliable data for decision-making, but there is still room for improvement in full implementation.

Fan Engagement: 8

Mobile apps and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Alexia Putellas | 2024

Current Use Cases

1. **Catapult, uses sensors and AI software to analyze player movements and strategy in real-time**, providing instant feedback on technique and tactics, and suggesting adjustments to improve performance. This tool is used by 1200 soccer teams worldwide, including clubs like Real Madrid, Chelsea FC, and national organizations like the French Football Federation.

2. Stats Perform uses AI to analyze player movements through its Opta platform. This technology collects and processes large volumes of data in real-time, offering detailed and precise metrics on every action on the field. **AI models identify patterns and generate advanced analyses, helping teams make informed decisions about tactics, performance, and recruitment.**

3. Hudl uses AI to enhance player movement analysis in soccer through **its advanced platform that combines video and data.** Tools like Hudl Focus, Sportscode, and WIMU Pro allow automatic video capture, personalized performance analysis, and monitoring of athletes' physical performance, improving each player's training.

4. **Bundesliga AR Experience the German Bundesliga has developed augmented reality experiences for fans using the ARISE platform from Immersiv.io.** This allows fans in the stadium or watching from home to access real-time statistics, 3D player visualizations, and replays of key plays through AR-enabled devices or smart glasses.

5. **ESPN AR Technology uses augmented reality to enhance its soccer broadcasts.** It overlays interactive graphics and data visualizations on the live broadcast to provide viewers with additional information and context about the game.

6. Xtadium, Meta Quest, and Oculus Venues platforms that allow fans **to watch live soccer matches in a virtual reality environment,** providing a more immersive viewing experience.

7. **Rezzil offers VR training platforms for professional soccer teams and players.** These immersive environments allow athletes to practice skills and tactics in simulated game scenarios without the risk of injury.

8. **YouCare Sports Shirts from AccYouRate Group, these shirts are equipped with sensors** that monitor heart rate, breathing, and physical activity in real-time, providing detailed data that helps players improve performance and prevent injuries.

9. **Adidas miCoach Smart Ball, features Bluetooth and a mobile app to provide information on power**, visual trajectories, spins, and impact points through the miCoach SMART BALL app. These data can be used to train players, providing guidance on how to adjust shooting techniques.

10. Al Rihla Smart Ball used in the Qatar 2022 World Cup, manufactured by Adidas. **This ball incorporates a 500 Hz IMU (Inertial Measurement Unit) sensor inside**, providing real-time data on its movement, helping referees and VAR make more accurate decisions. This technology allows detailed analysis of each play, improving precision and game dynamics. A similar smart ball will be used in the Paris 2024 Olympic Games.

11. **Johan Cruijff Arena features an innovative LED lighting system that ensures grass growth**; smart sensors to monitor the field; a sustainable heating system to prevent field freezing; and water cooling in locker rooms and offices.

The Next 10 Years

1 **AI and Data Analysis Integration will continue to revolutionize how soccer is played, trained, and enjoyed.** Advanced sensors and smart balls will become standard, providing real-time data on ball speed, trajectory, and force, as well as player positions and movements.

2 AR and VR Enhancements will further integrate into the soccer experience. Coaches and players will use VR simulations to practice strategies and game situations in a controlled and highly realistic environment. For fans, **AR will enhance the viewing experience by overlaying statistical data and real-time analysis** during live broadcasts, providing a more immersive and educational experience.

3 Player tracking technology, such as wearables and smart cameras, will be refined to monitor physical and performance parameters with greater accuracy. **Coaches will have access to detailed metrics that allow them to adjust workloads and tactics based on each player's individual needs.**

4 **Innovative Broadcasting the use of drones and high-definition cameras to capture innovative angles and aerial perspectives will enrich broadcasts and post-match analysis.** These devices will provide more comprehensive views of the field and tactical positioning, facilitating a deeper understanding of game strategies.

5 **Blockchain Integration will ensure transparency and security** in managing contracts and player transfers, minimizing the risk of fraud and improving confidence in transactions.

Artistic Gymnastics

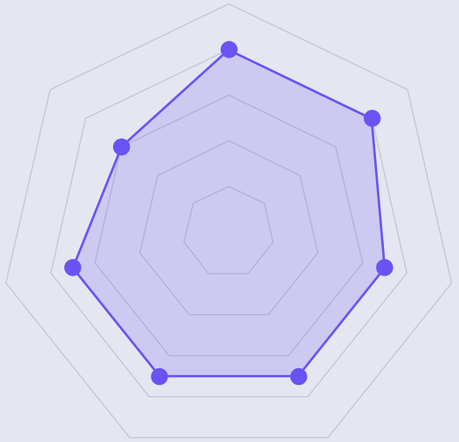
Artistic gymnastics is a sport that combines elements of strength, flexibility, agility, coordination, and balance. Competitors perform on different apparatus, such as the balance beam, floor exercise, uneven bars, and vault for women, and pommel horse, rings, parallel bars, horizontal bar, and floor exercise for men. This sport demands both technical skills and great artistic expression. In the Olympic Games, artistic gymnastics is one of the most popular and oldest disciplines, present since the first modern Olympic Games in 1896. Gymnasts compete for individual and team medals, and the event is a highlight of the Olympic calendar.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still in development. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure: 6
Innovations in gyms and lighting systems are being adopted, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 8
Data analysis is deeply integrated into all aspects of performance and technique in artistic gymnastics, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in gymnasts' preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is mainly used for technique visualization and analysis, but its adoption is limited and primarily experimental.

Sensors and Wearables: 7
Sensor technology is highly advanced and widely used in clothing and equipment for performance analysis. These devices are common in most professional teams.

Virtual Reality: 7
VR is used in specific training to simulate routines and apparatus, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and performance analysis:** Advanced platforms use AI to analyze gymnasts' movements and techniques in real-time, providing instant feedback and suggesting adjustments to optimize performance.
- **Result prediction:** AI algorithms analyze data from previous competitions, conditions of the apparatus, and other factors to predict gymnasts' performance and potential results.

2. AR & VR

- **Virtual reality training:** Use of VR to simulate different routines and apparatus, allowing gymnasts to practice in a controlled environment and improve their technique.
- **Routine analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, helping coaches analyze and correct their gymnasts' techniques.

3. Sensors and Wearable Devices

- **Smart clothing and motion sensors:** Equipped with sensors that monitor posture, workload, and force distribution in real-time during routines, providing detailed data to improve technique.
- **Physiological monitoring devices:** Wearables that monitor heart rate, breathing, and other health indicators, helping gymnasts optimize their training and recovery.

4. Platforms and Software

- **Training management software:** Platforms that allow planning and monitoring of artistic gymnastics training, managing workloads, and analyzing gymnasts' progress.
- **Live strategy applications:** Tools that enable coaches to adjust strategies and routine plans in real-time based on data obtained during training sessions and competitions.

5. Infrastructure Innovations

- **Smart gyms:** Facilities equipped with sensors that collect data on force distribution and movement during routines, providing critical information for technique and strategy analysis.

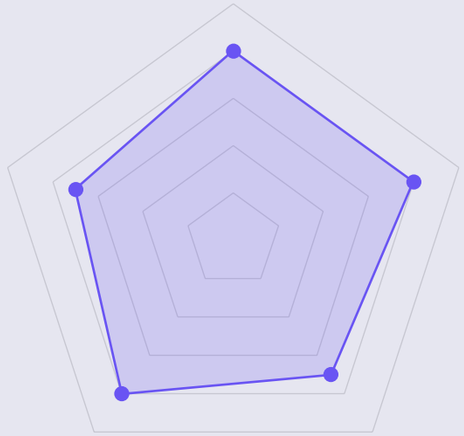
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor gymnasts' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity and digital technology in artistic gymnastics focus mainly on data protection and the integrity of systems used to manage events and analyze athletes' performance. Gyms and sports organizations implement cybersecurity measures such as encryption of gymnasts' personal and biometric data, multi-factor authentication for access to management systems, and constant network monitoring to prevent unauthorized access and cyberattacks, though it is still in the process of development and implementation.



Performance: 8

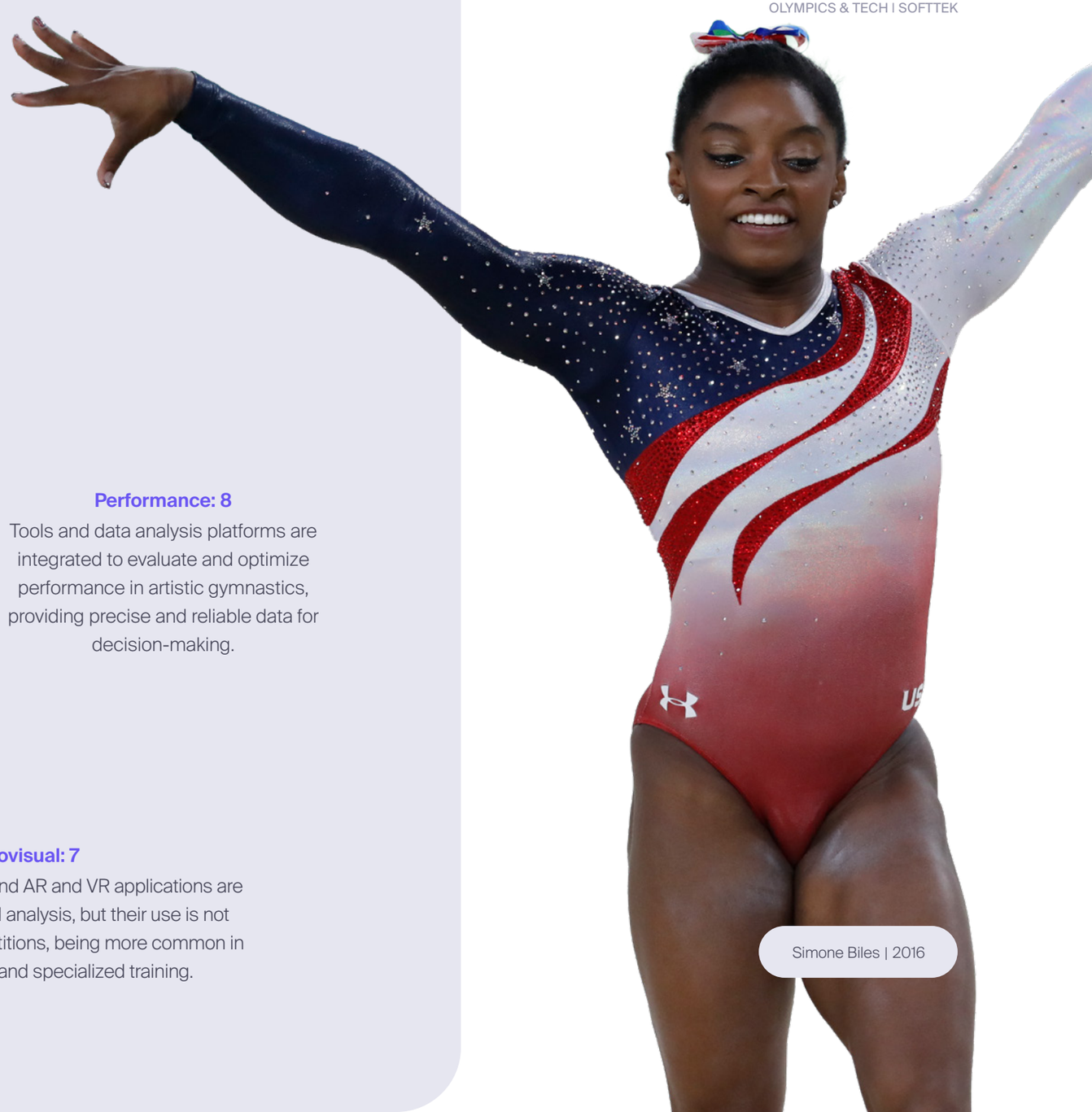
Tools and data analysis platforms are integrated to evaluate and optimize performance in artistic gymnastics, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile apps and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.



Simone Biles | 2016

Current Use Cases

1. Fujitsu and FIG **AI judge assistance system uses Human Motion Analytics** (HMA) technology to improve scoring accuracy. It captures and analyzes human movements in four dimensions, providing detailed feedback and reducing estimation errors in scoring.

2. **Fujitsu AI Scoring Software analyzes gymnasts' routines by examining their three-dimensional body coordinates** and comparing them with a database of routines. Used in major competitions like the World Gymnastics Championships, it provides objective and precise evaluations.

3. **EzML uses computer vision to analyze and track the intricate details of gymnastic movements**, providing coaches with precise information on technique and performance metrics. It generates multi-dimensional skeletal maps and can compare positioning metrics across different routines to identify areas for improvement.

The Next 10 Years

1. **Augmented reality and virtual reality will allow gymnasts to train in simulated environments that replicate competition conditions**, providing instant and detailed feedback on their performance. These virtual environments will help athletes perfect their routines and mentally prepare for important competitions.

2. **Artificial intelligence will play a crucial role in analyzing movements and preventing injuries.** Sensors embedded in sportswear and monitoring devices will capture biometric and motion data in real-time.

3. AI will analyze this data to identify patterns and suggest technical adjustments, optimizing performance and reducing the risk of injury. In addition, **AI algorithms will be able to evaluate gymnasts' performance during competitions, helping judges make more accurate and fair decisions.**

Trampoline Gymnastics

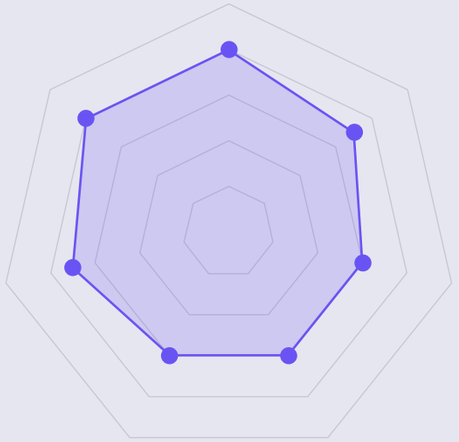
Trampoline gymnastics is an acrobatic discipline where athletes perform jumps, twists, and flips on a trampoline. It requires great coordination, strength, and body control to execute precise and spectacular routines in the air. Introduced at the Sydney 2000 Olympic Games, this discipline allows gymnasts to compete individually in events that highlight their technical and aesthetic difficulty. Gymnasts are evaluated based on the difficulty, execution, and height of their movements.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still in development. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure: 8
Innovations in gyms and smart trampolines are being adopted, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 7
Data analysis is deeply integrated into all aspects of trampoline gymnastics performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in gymnasts' preparation, though full adoption still has room to grow.

Augmented Reality: 6
AR is mainly used for technique visualization and analysis, but its adoption is limited and primarily experimental.

Sensors and Wearables: 6
Sensor technology is widely used in clothing and equipment for performance analysis, but not specifically for trampoline gymnasts. These devices are common in most professional teams.

Virtual Reality: 6
VR is used in specific training to simulate routines and conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and performance analysis:** Various tools use AI to analyze gymnasts' movements and techniques in real-time, providing instant feedback and suggesting adjustments to optimize performance.

- **Result prediction:** AI algorithms analyze data from previous competitions, trampoline conditions, and other factors to predict gymnasts' performance and potential results.

2. AR & VR

- **Virtual reality training:** Use of VR to simulate different routines and conditions, allowing gymnasts to practice in a controlled environment and improve their technique without risk of injury.

- **Routine analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, helping coaches analyze and correct their gymnasts' techniques.

3. Sensors and Wearable Devices

- **Smart clothing and motion sensors:** Equipped with sensors that monitor posture, workload, and force distribution in real-time during routines, providing detailed data to improve trampoline technique.

- **Physiological monitoring devices:** Clothing and wearables that monitor heart rate, breathing, and other health indicators.

4. Platforms and Software

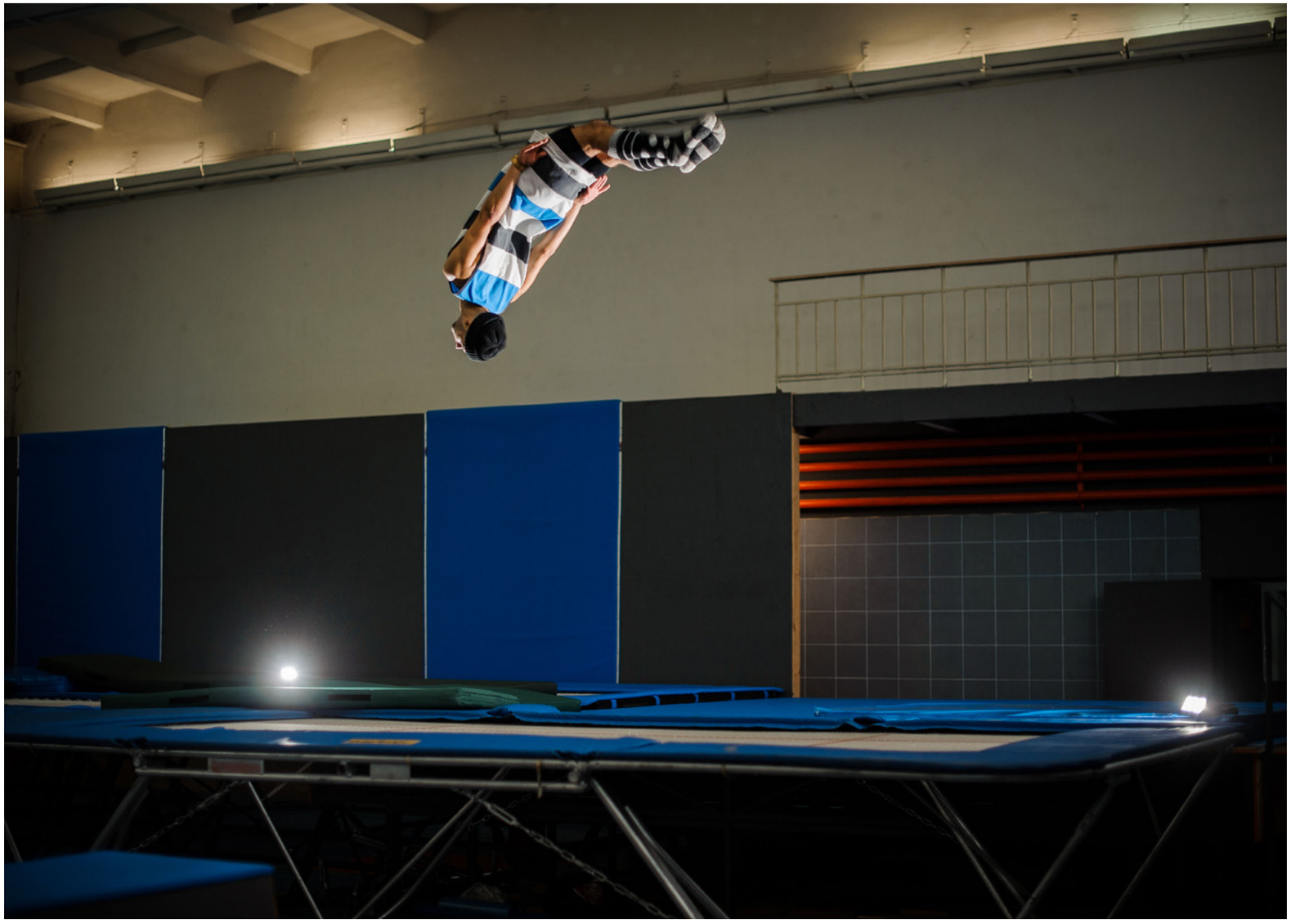
- **Training management software:** Platforms that allow planning and monitoring of trampoline gymnastics training, managing workloads, and analyzing gymnasts' progress.

- **Live strategy applications:** Tools that enable coaches to adjust strategies and routine plans in real-time based on data obtained during training sessions and competitions. .

5. Infrastructure Innovations

- **Smart gyms:** Facilities equipped with sensors that collect data on force distribution and movement during routines, providing critical information for technique and strategy analysis.

- **Smart trampolines:** Equipped with sensors that monitor the gymnast's performance and the trampoline's response in real-time.



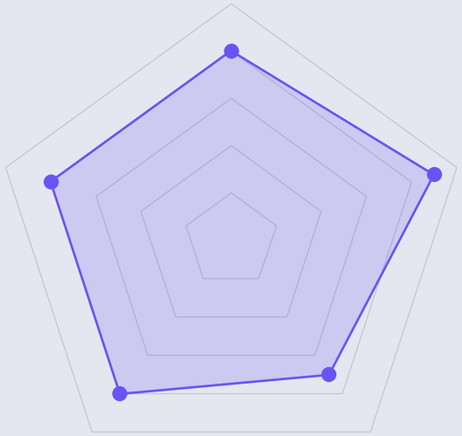
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor gymnasts' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and blockchain technologies to protect data and transactions. Event management systems and athletes' personal data are protected through encryption and multi-factor authentication. High-speed cameras and sensors are used to capture and analyze gymnasts' movements in real-time, though full implementation and universal adoption are still in progress.



Performance: 9

Tools and data analysis platforms are integrated to evaluate and optimize performance in trampoline gymnastics, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile apps and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Current Use Cases

1. **University of Dresden researchers have developed machine learning models to automatically detect and classify different types of trampoline jumps** using inertial measurement units (IMU). The most accurate models achieved over 96% accuracy in classifying jumps based on sensor data. This technology can help judges count somersaults and twists to determine routine difficulty.

2. **North Minzu University, Hebei Sport University, and Baoding Technical and Vocational Institute have applied deep learning techniques to analyze key steps and events** in trampoline somersaults. By breaking down the movement, AI can recognize and classify different actions, providing information for training and performance analysis.

3. **Fukui University of Technology developed a motion detection method on a trampoline using a smartwatch.** They present a method to detect movements on a trampoline using accelerometer data from a smartwatch, potentially providing feedback to gymnasts during training.

The Next 10 Years

1. **The incorporation of sensors and biometric monitoring devices will allow coaches and gymnasts to collect precise data** on each jump, twist, and movement, optimizing training programs through detailed and personalized analysis.

2. AI will play a crucial role in evaluating and perfecting routines. **Advanced algorithms will analyze executions in real-time, providing instant feedback on technique and execution.**

3. Augmented reality and virtual reality will transform both training and spectator experience. **Gymnasts will practice in virtual environments replicating competition conditions, allowing for more comprehensive and detailed preparation.** For spectators, these technologies will offer innovative viewing angles and an immersive experience, enabling them to follow every detail of the performances with real-time information overlaid on the difficulty and precision of the movements.

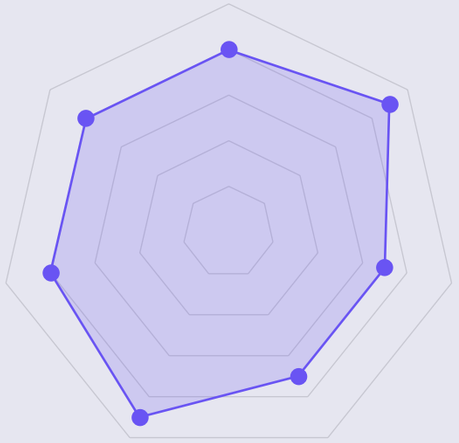
Rhythmic Gymnastics

Introduction Rhythmic gymnastics is a sport that combines elements of ballet, dance, and gymnastics with the use of apparatus such as the rope, hoop, ball, clubs, and ribbon. Gymnasts perform choreographed routines that emphasize grace, coordination, and flexibility, accompanied by music. Since its inclusion in the 1984 Olympic Games, rhythmic gymnastics has been a highlight event, where gymnasts compete in both individual and team categories. Evaluations are based on the difficulty, artistic execution, and technical performance of the routines.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still in development. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure: 8
Innovations in gyms and smart apparatus are being adopted, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.



Data Analysis: 9
Data analysis is deeply integrated into all aspects of performance and technique in rhythmic gymnastics, especially at elite levels where advanced platforms are essential for training planning and execution.

Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in gymnasts' preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is mainly used for technique visualization and analysis, but its adoption is limited and primarily experimental.

Sensors and Wearables: 9
Sensor technology is highly advanced and widely used in clothing and equipment for performance analysis. These devices are common in most professional teams.

Virtual Reality: 7
VR is used in specific training to simulate routines and conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and performance analysis:** Some tools use AI to analyze gymnasts' movements and techniques in real-time, providing instant feedback and suggesting adjustments to optimize performance.
- **Result prediction:** AI algorithms analyze data from previous competitions, floor conditions, and other factors to predict gymnasts' performance and potential results.

2. AR & VR

- **Virtual reality training:** Use of VR to simulate different routines and conditions, allowing gymnasts to practice in a controlled environment and improve their technique without risk of injury.
- **Routine analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, helping coaches analyze and correct their gymnasts' techniques with greater precision.

3. Sensors and Wearable Devices

- **Smart clothing and motion sensors:** Equipped with sensors that monitor posture, workload, and force distribution in real-time during routines, providing detailed data to improve technique and prevent injuries.
- **Physiological monitoring devices:** Clothing and wearables that monitor heart rate, breathing, and other health indicators.

4. Platforms and Software

- **Training management software:** Various platforms allow planning and monitoring of rhythmic gymnastics training, managing workloads, and analyzing gymnasts' progress, optimizing training programs.
- **Live strategy applications:** Tools that enable coaches to adjust strategies and routine plans in real-time based on data obtained during training sessions and competitions.

5. Infrastructure Innovations

- **Smart gyms:** Facilities equipped with sensors that collect data on force distribution and movement during routines.

- **Smart apparatus and floors:** Equipped with sensors that monitor gymnasts' performance and apparatus response in real-time, providing precise data to improve technique and safety.

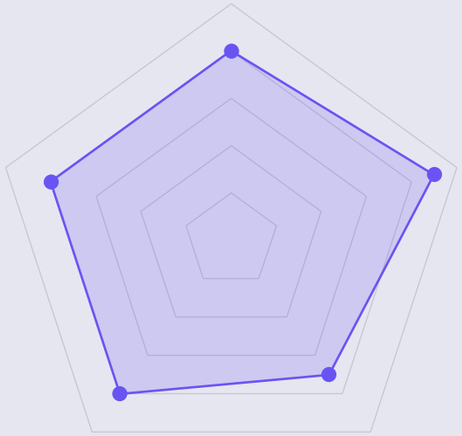
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor gymnasts' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity in rhythmic gymnastics is implemented through various measures to protect athletes' personal and professional data, as well as the integrity of competition and event management systems. Federations and clubs use data encryption, multi-factor authentication, and secure networks to safeguard information. Additionally, intrusion detection and monitoring systems are employed to prevent unauthorized access and cyberattacks, though full implementation and universal adoption are still in progress.



Performance: 9

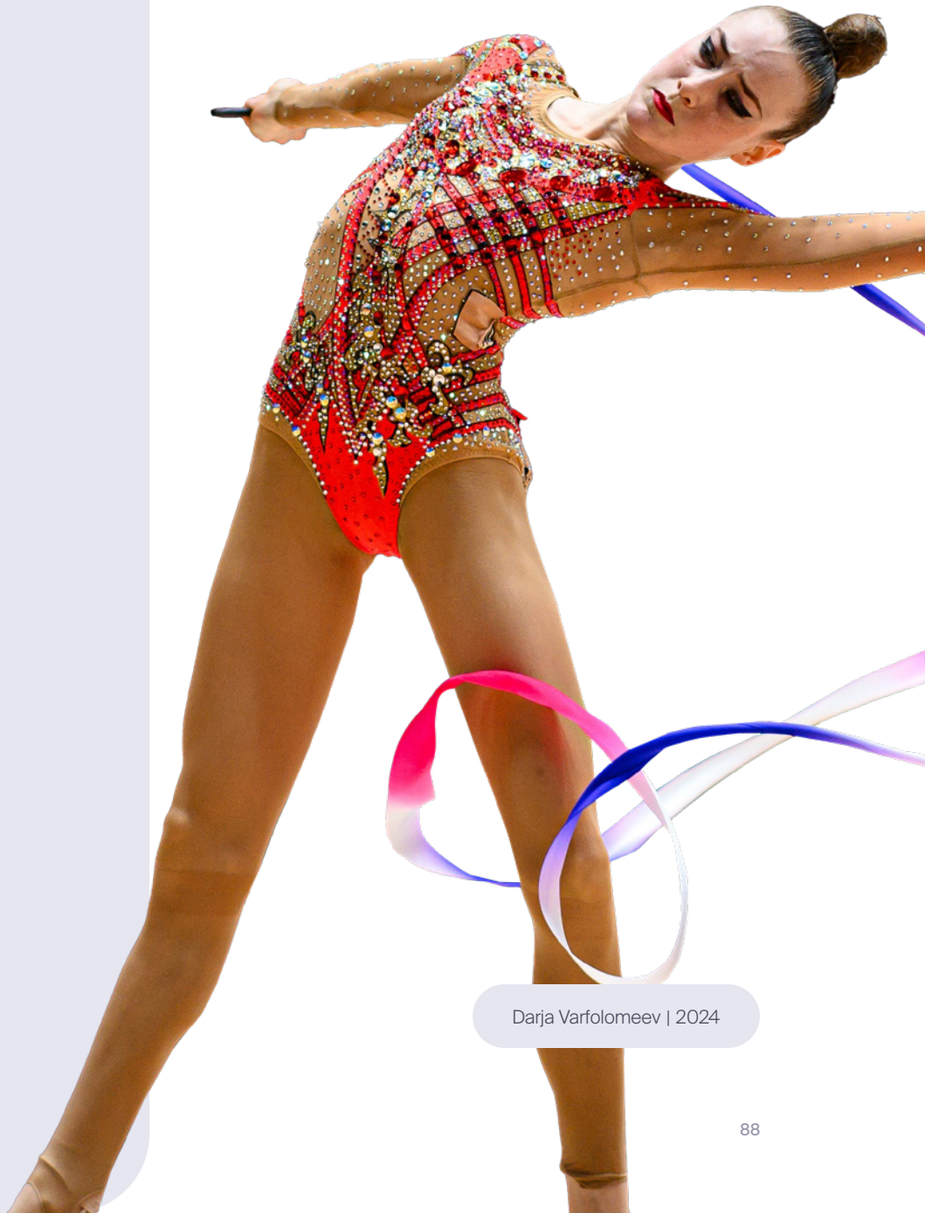
Tools and data analysis platforms are integrated to evaluate and optimize performance in rhythmic gymnastics, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile apps and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.



Darja Varfolomeev | 2024

Current Use Cases

1. **Cuatroochenta and Ros Collaboration developed an augmented reality experience for rhythmic gymnastics and other Olympic sports at the EDP multinational pavilion.** This technology allows visitors to virtually compete in sports challenges, including rhythmic gymnastics, with virtual competitors displayed on a giant screen. The experience was designed for the 60th International Sample Fair of Asturias and uses advanced technology to create immersive and dynamic interactions.

2. Chinese Researchers implemented a **computer-assisted motion design system for rhythmic gymnastics based on the characteristics and rules of the sport.** The system uses various motion capture, editing, synthesis, and musical feature extraction technologies. This system assists coaches throughout the motion design process for both individual and team athletes.

3. Huaibei University built a series of mobile multimedia classrooms for rhythmic gymnastics. These facilities integrate various technologies, including virtual reality, to enhance the teaching and learning experience of rhythmic gymnastics. **It incorporates analysis software, multimedia presentation software, and social networking software to create a comprehensive teaching model.**

4. Chinese Researchers developed a virtual reality tool for rhythmic gymnastics that **uses image recognition and digital twins to create detailed simulations** of gymnasts' movements. This system allows coaches and athletes to analyze and refine techniques in a virtual environment, providing instant and accurate feedback.

The Next 10 Years

1. **Virtual reality and augmented reality will be integrated into training, allowing gymnasts to practice in simulated environments** that replicate competition conditions and providing real-time feedback on the precision and aesthetics of their movements.

2. Digital twins will enable detailed simulation of gymnasts' performances, **facilitating deep and personalized analysis to improve techniques and strategies.**

3. **Artificial intelligence will play a crucial role in the evaluation and refinement of routines.** Sensors and monitoring devices will collect biometric and movement data in real-time, which will be analyzed by AI algorithms to identify areas for improvement and prevent injuries by detecting early signs of stress or fatigue.

4. The broadcasting and viewing experience of competitions will be enhanced with **high-definition cameras, drones, and 360-degree capture technology, offering viewers an immersive and detailed experience.**

Golf

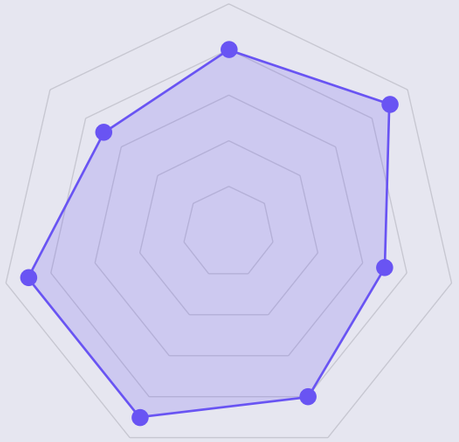
Golf is an outdoor sport played on extensive natural courses where technique, precision, and strategy are essential, as players must calculate factors such as force, wind direction, and terrain topography. Known for its competitive and recreational nature, golf is also valued for its social component and its ability to offer a tranquil and scenic environment.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and strategy development, but full integration is still in progress.

Smart Infrastructure: 7
The development potential of automated golf courses is enormous, and investment in smart infrastructure is ongoing, but innovation in areas like sustainability and IoT sensing needs to continue advancing.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of golf performance and tactics, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 9
Training and strategy management software is well-developed and fundamental in player preparation.

Augmented Reality: 7
AR for visualizing and analyzing courses with data overlaid on images is available but still has room for development and evolution.

Sensors and Wearables: 9
Sensor technology is highly advanced and widely used in gloves, shoes, and clubs for performance analysis.

Virtual Reality: 8
Golf is one of the disciplines with the greatest adoption of VR as a simulation system through immersive experiences, though there is still room for growth in this trend.

1. AI & Data

- **Swing and strategy analysis:** Employs a combination of advanced technologies, including high-speed cameras, motion sensors, and machine learning algorithms. These tools capture and analyze detailed data on body movement, club speed and trajectory, and ball impact, providing precise and personalized feedback.

- **Performance improvement:** AI-based data analytics help golfers better understand their technique and physical condition, accelerating improvements achieved through training and conditioning.

- **Material design:** Using advanced algorithms and machine learning techniques, manufacturers can optimize the creation and improvement of clubs, balls, and other equipment.

2. AR & VR

- **Immersive courses:** VR allows players to experience famous or customized golf courses from their homes. These simulators offer detailed recreations of courses, including terrain, weather, and obstacles, enabling players to practice and strategize as if on the actual course.

- **Trajectory analysis:** AR can show expected ball trajectories before taking a shot. This is achieved by projecting lines and curves in the air, helping players visualize the ball's path and better plan their shots.

- **Course analysis with AR:** Applications that overlay data and diagrams on the golf course in real-time, helping players and coaches analyze and plan strategies with greater precision.

- **Biomechanical visualization:** Extended reality solutions that precisely visualize golfer movements and identify postural improvements in swing or hitting techniques.

3. Sensors and Wearable Devices

- **Smart gloves and shoes:** Equipment with integrated sensors that monitor posture, pressure, and force distribution in real-time during the swing, allowing comparison with the ball's trajectory to perfect technique.

- **Smart clubs:** Equipped with sensors that measure swing speed, trajectory, and impact, offering valuable information for subsequent analysis of technique, shot angle, and club force.

4. Platforms and Software

- **Digital solutions for training and competition management:** Mobile applications designed to plan and monitor real-time data, manage performance metrics, and analyze tournament results.

5. Infrastructure Innovations

- **Smart golf courses:** Courses equipped with IoT networks that measure ball trajectory and connect with software that collects data, providing valuable information for judges and players, such as determining the exact point of ball landing.

- **Connected visors:** Smart devices with cameras and options to control field temperature or measure ball height.

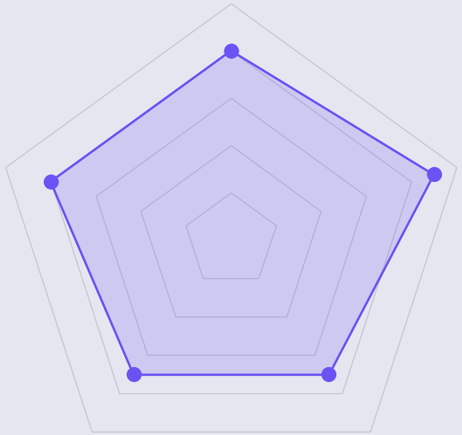
- **Robotic caddies:** Equipped with computer vision and GPS, these caddies help players transport their gear and quickly identify ball location.

- **AI-powered precision agriculture:** Enhances turf management, ensuring water savings and reducing waste, contributing to more sustainable infrastructures.

Use of Technologies by Category

E-Health: 8
Wearable devices and mobile platforms for physical monitoring are widely accepted and commonly used at elite levels.

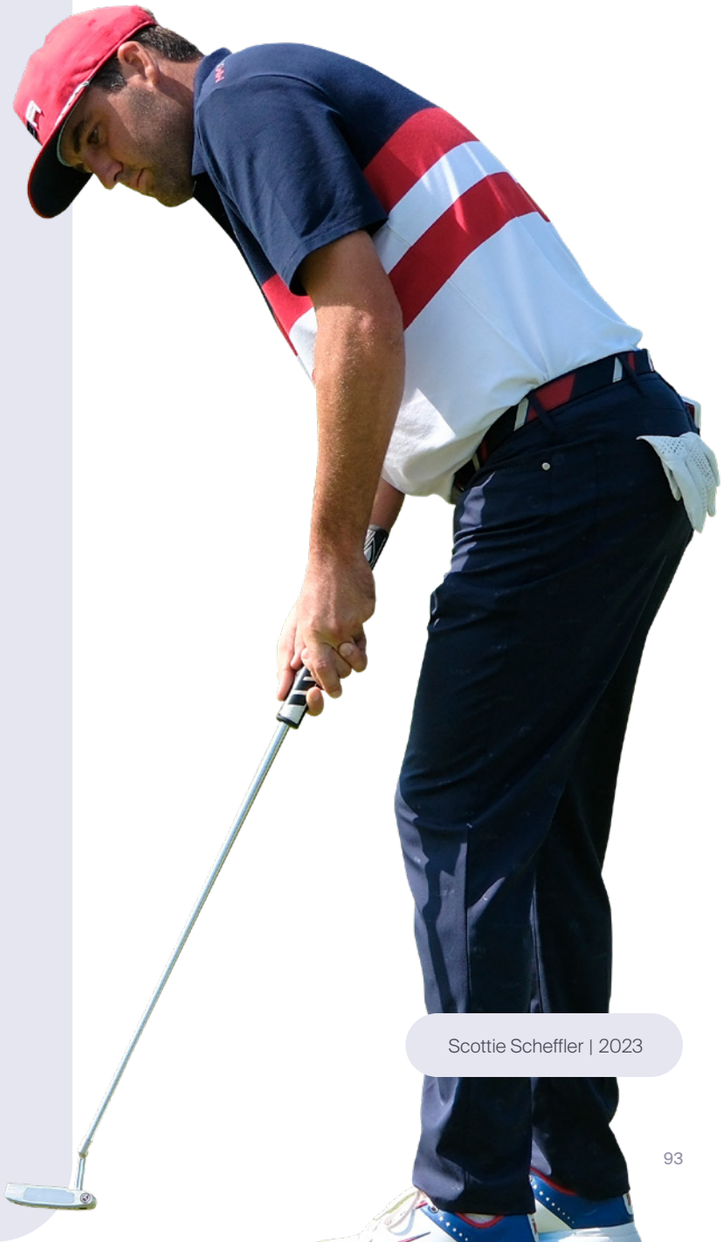
***Cybertech:* 8**
Cybersecurity is a priority in golf, and organizations are committed to information protection standards.



Performance: 9
Mobile solutions and data analysis platforms to evaluate and optimize performance are commonly used in golf.

Fan Engagement: 7
Interactive data platforms and image visualization are available and used to increase viewer engagement, but there is still room for improvement, especially in AR and VR.

Audiovisual: 7
Immersive experiences and AR and VR applications are available, and golf is one of the most advanced disciplines in this area, but there is still room for further exploitation.



Scottie Scheffler | 2023

Current Use Cases

1. Arccos Caddie and TrackMan, these tools **use sensors in golf clubs to analyze swings**, ball trajectory, and overall gameplay in real-time, suggesting adjustments to improve performance. They also offer strategies based on historical data, course conditions, and other relevant statistics. PGA Tour players like Bryson DeChambeau and Rory McIlroy use these tools to refine their skills.

2. **SensoGlove Smart Gloves equipped with sensors**, these gloves include a device with integrated software that measures factors such as grip pressure and hand sweat levels, helping monitor posture and technique during the swing.

3. Cobra Connect Smart Clubs connected to the Arccos mobile platform, **these clubs' integrated sensors track and monitor metrics.**

4. Digital Platforms like Rapsodo and Foresight Sports used by golfers of all levels, **providing data and insights previously available only to elite golfers.**

5. PGA Tour **ShotLink a data collection and swing analysis system invaluable for players and caddies in developing game strategies**, considering factors like course layout, weather conditions, and predictions based on historical results.

6. **Callaway and TaylorMade, these manufacturers use AI to design materials like clubs and balls to improve their performance.** Callaway's MAVRIK driver line, for example, used an AI supercomputer to iterate 15,000 face architecture designs, optimizing each one to maximize performance.

7. Virtual Golf Platforms like Topgolf, growing in popularity, **these platforms incorporate AI features to provide advanced immersive experiences.**

The Next 10 Years

1. **The use of sensors and devices embedded in clubs and balls will continue to advance** in order to improve player performance, providing increasingly accurate and detailed AI-based data analytics.

2. **Customizing equipment using 3D printing and intelligent design of advanced materials will optimize performance** according to the individual characteristics of each player.

3. Virtual and augmented reality will continue to improve their performance, giving rise to increasingly **realistic immersive training and simulations.**

4. Robotic caddies and AI caddies will offer not only equipment transport, but also strategic **assistance based on real-time analytics.**

5. In terms of golf course management, IoT (Internet of Things) technology will facilitate **more efficient and sustainable management of resources**, optimizing maintenance and reducing resource expenditure.

6. Mobile apps and digital platforms **will enrich fan interaction and engagement**, offering detailed statistics and immersive experiences.

7. The popularity of indoor golf simulators and digital training **programs will democratize access to the sport**, making it more accessible and popular for people of all locations and skill levels.

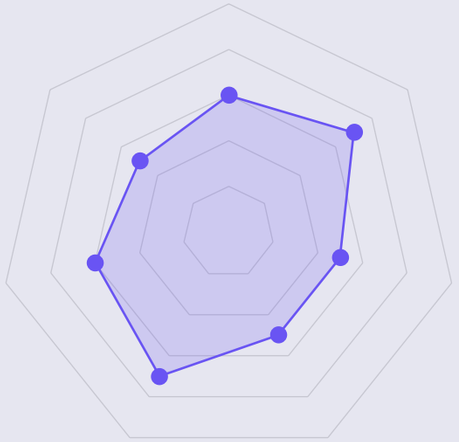
Weightlifting

Weightlifting, also known as Olympic weightlifting, is a strength sport that involves lifting the maximum possible weight on a barbell loaded with weight plates, following specific techniques. This sport requires not only brute strength but also precise technique, speed, flexibility, and balance. Together, these skills make weightlifting a demanding sport that combines physical strength with technical precision and a competitive mindset to achieve successful lifts and personal goals.

Level of Technological Implementation

Artificial Intelligence: 6
AI is mainly used for technique analysis and injury prediction, but full integration is still in development. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure: 5
Innovations in lifting platforms and lighting systems are being adopted, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.



Data Analysis: 7
Data analysis is increasingly integrated into performance and technique evaluation, although adoption is not universal.

Augmented Reality: 5
AR is primarily used for technique analysis and correction, but its adoption is limited and experimental.

Communication Platforms: 6
Training management software is well-developed and useful for optimizing training programs, though full adoption is still in progress.

Sensors and Wearables: 7
Sensor technology is advancing and used in equipment and lifting bars for performance analysis, but not yet universally adopted.

Virtual Reality: 5
VR is used in specific training, but not widely adopted, though its potential to improve technique is promising.

1. AI & Data

- **Technique and performance metrics analysis:** Digital tools using AI algorithms analyze lifters' movements in real-time, providing instant feedback and suggesting adjustments.
- **Smart nutrition:** AI-based systems offer personalized recommendations on calorie intake according to each preparation stage or the goals of each lifter in terms of recovery or muscle mass increase.
- **Injury prediction:** Machine learning algorithms based on historical data and personalized metrics predict and prevent potential injuries, improving aspects such as postural hygiene.

2. AR & VR

- **Immersive visualization with AR:** Extended reality applications that overlay data and diagrams on real-time lifting images, helping coaches analyze and correct their athletes' technique or biomechanics with greater precision.

3. Sensors and Wearable Devices

- **Smart belts, gloves, and knee sleeves:** Equipped with sensors that provide real-time data on posture, balance, body temperature, and force distribution during the lift.
- **Barbells with sensors:** Collect and transmit data to measure factors like speed, force, and lifting trajectory, offering valuable information for later analysis.

4. Platforms and Software

- **Training management software:** Digital platforms that help lifters and their teams plan and monitor training, manage workloads, and measure progress.

5. Infrastructure Innovations

- **Lifting platforms with integrated sensors:** Platforms equipped with pressure sensors that collect data on force distribution and balance during the lift, providing critical information for technique analysis or result measurement.
- **Software-controlled dynamic lighting:** Lighting systems that automatically adjust during competitions to improve athletes' visibility and concentration.

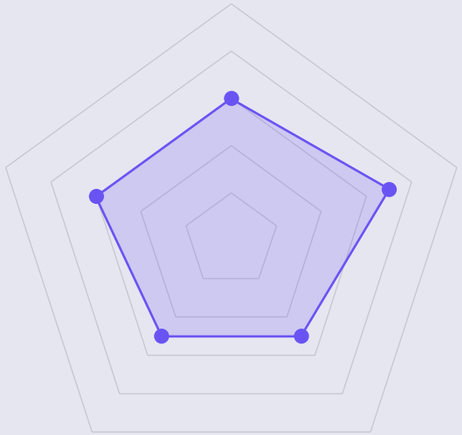
Use of Technologies by Category

E-Health: 6

Wearable devices and mobile applications help monitor athletes' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 6

Cybersecurity is a priority with advanced encryption and blockchain technologies to protect data and transactions, but full implementation and universal adoption are still in progress.



Performance: 7

Tools like SmartSpot and data analysis platforms are integrated to evaluate and optimize performance, providing precise and reliable data for decision-making, but there is still room for improvement in total implementation.

Fan Engagement: 5

Mobile applications and social media platforms are being developed to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 5

Immersive experiences and AR and VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Current Use Cases

1. Lumo Lift smart belts are equipped with **sensors that monitor posture and balance** during lifting, providing detailed data that helps athletes improve their technique and prevent injuries.

2. Companies like GymAware have developed **lifting bars with sensors that measure the speed, force, and trajectory of the lift**, offering valuable insights for performance analysis.

3. **Training management apps like TrainHeroic** are used by weightlifting teams to manage workloads or analyze athlete progress metrics.

4. Facilities like those at the Colorado Springs Performance Center **are equipped with lifting platforms that collect data on force distribution and balance.**

The Next 10 Years

1. **Generative AI will become a fundamental tool for designing lifters' training and nutrition plans**, reaching an unprecedented level of precision and personalization.

2. Connected Sensors and Advanced Wearables, advances in this field will enable **real-time monitoring of lifters' performance**, providing increasingly precise data on speed, force, and technique during training and competitions. This will facilitate immediate and accurate adjustments in execution, helping to prevent injuries and optimize personalized training.

3. Integration of VR and AR will allow lifters and coaches **to visualize images in immersive environments with data overlays**, helping them improve technical and postural precision.

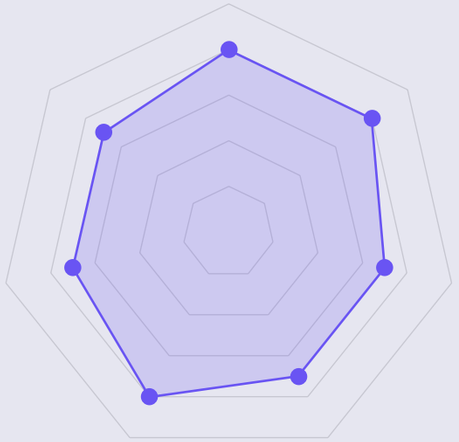
Equestrian Sports

Equestrian sports, also known as horseback riding, encompass various disciplines ranging from classical riding, which includes jumping and dressage, to high-level competition sports such as show jumping, dressage, and eventing. This practice requires both physical and mental skills, where rider and horse work in harmony to execute precise movements and overcome obstacles in different environments, whether on sand arenas, grass fields, or indoor tracks.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data and technique analysis, but full integration is still in development. Accessibility varies between competition levels and countries.

Smart Infrastructure: 7
Innovations in tracks and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.



Data Analysis: 8
Data analysis is deeply integrated into performance and technique evaluation, especially at elite levels where advanced platforms are essential for training planning and execution.

Communication Platforms: 7
Training and strategy management software is well-developed and fundamental for rider preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is mainly used for technique visualization and analysis, but adoption is limited and experimental.

Sensors and Wearables: 8
Sensor technology is highly advanced and widely used in equipment for performance and well-being analysis for both riders and horses. Such devices are common in most professional teams.

Virtual Reality: 7
VR is used in specific training sessions but is not widely adopted, although its potential for improving technique and planning is promising.

1. AI & Data

- **Performance and technique analysis:** Tools utilizing AI to analyze the movements of both horse and rider, providing real-time insights on technique and suggesting adjustments to optimize performance.
- **Result prediction:** Machine learning algorithms analyzing historical patterns of riders and horses to estimate competition outcomes.
- **Horse care:** Automatic monitoring systems using integrated cameras and sensors to process images of horses, detecting potential abnormal behaviors or physical patterns that might indicate health issues.

2. AR & VR

- **Equestrian simulators:** VR devices simulating various scenarios and horse movements, allowing riders to practice in controlled environments and improve their technique.
- **Augmented riding:** Applications overlaying data and diagrams on video images, helping to identify possible faults in riding technique or make real-time corrections during competitions.

3. Sensors and Wearable Devices

- **Sensor-equipped gear:** Smart girths and saddles with sensors monitoring multiple factors related to posture, balance, and force distribution during riding for both the rider and the horse.
- **Connected horse:** Collars and other wearables monitoring horses' physical condition in real-time, including data on heart rate and body temperature.

4. Platforms and Software

- **Specialized software:** Digital platforms specialized in equestrian sports optimizing training and measuring performance for both riders and horses.
- **Live strategy applications:** Tools allowing riders and trainers to adapt strategies in real-time during competitions based on advanced data analytics from multiple information sources (smart cameras, wearables, etc.).

5. Infrastructure Innovations

- **Smart equestrian tracks:** Tracks equipped with sensors and IoT devices collecting data on speed, movement, height, and exact positioning of horses, providing critical information for technique and strategy analysis, as well as for judges' evaluations.

- **Computer vision systems:** Cameras with AI algorithms automatically identifying standout jumps and analyzing movement patterns.

- **Remote-controlled lighting systems:** Lighting systems automatically adjusting during competitions to improve visibility and concentration for riders and horses.

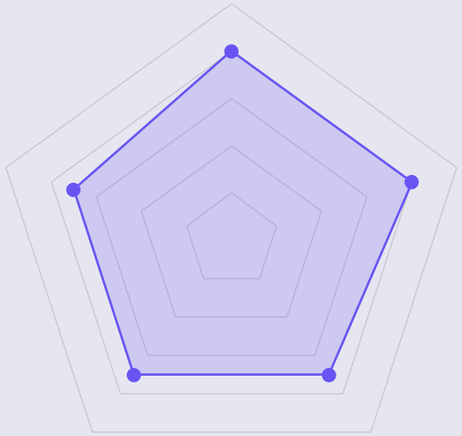
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor the health of riders and horses, personalizing treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity is a priority with advanced encryption and blockchain technologies to protect data and transactions, but full implementation and universal adoption are still in progress.



Performance: 8

Tools like Equestic and data analysis platforms are integrated to evaluate and optimize performance, providing precise and reliable data for decision-making, but there is still room for improvement in total implementation.

Fan Engagement: 7

Mobile applications and social media platforms are being developed to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Juan Antonio Jiménez Cobo | 2018

Current Use Cases

1. Equestic Tools using sensors in the girth to analyze real-time movements of horse and rider, providing data **to improve riding technique, biomechanics, and horse performance.**

2. EquiRatings Solutions used in equestrian sports for training planning and monitoring and **analyzing the progress** of both riders and horses.

3. **Magic AI's StableGuard AI solution designed to improve the performance of competition horses through 24/7 video monitoring of stables**, collecting and analyzing data on the animals' comfort and physical condition to detect abnormal behaviors early and maintain their well-being and safety.

The Next 10 Years

1 Firstly, the **use of sensors and advanced wearable technology** will allow detailed monitoring of the physical performance and health of the horses. These devices will be able to measure parameters such as heart rate, body temperature, stress levels and movement biomechanics, providing accurate data that will help trainers and veterinarians optimize the well-being and performance of horses.

2 **Artificial intelligence will play a fundamental role in predictive analysis and strategic decision-making in equestrianism**. Advanced algorithms will be able to analyze large volumes of real-time and historical data to predict performance trends, optimize training and competition strategies, and improve the overall management of equestrian events.

3 Virtual and augmented reality will continue to revolutionize equestrian **training by offering immersive simulations** of competition scenarios and technical training. Riders will be able to practice complex maneuvers and improve their technique in realistic and safe virtual environments, which can reduce the risk of injury to both riders and horses.

4 **The combination of immersive experiences with computer vision systems will also enrich the spectator experience** by offering detailed, real-time analytics during competitions.

Hockey

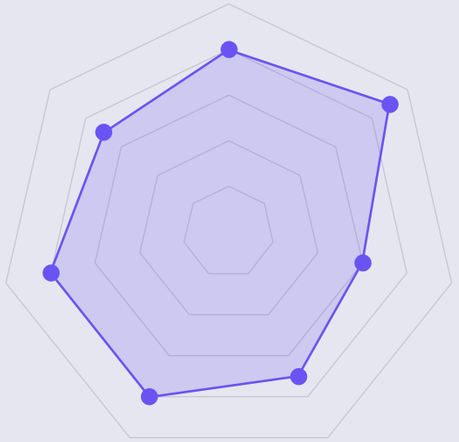
Hockey is a team sport played in various forms, with field hockey and ice hockey being the most popular. In field hockey, two teams of eleven players use curved sticks to hit a ball and score goals in the opponent's net. Field hockey has been a notable event in the Olympic Games since its inclusion in 1908 for men and 1980 for women. Ice hockey, present in the Winter Olympics since 1924, follows similar rules but is played on an ice rink. Both sports require high technical skill, strategy, and teamwork.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data and strategy analysis, but full integration is still in development. Accessibility varies between competition levels and countries.

Smart Infrastructure: 7
Innovations in hockey fields and lighting systems are being adopted, but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of performance and tactics, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in team preparation, though full adoption still has room to grow.

Augmented Reality: 6
AR is mainly used for strategy visualization and analysis, but adoption is limited and experimental.

Sensors and Wearables: 8
Sensor technology is highly advanced and widely used in jerseys, footwear, balls, and sticks for performance analysis. Such devices are common in most professional teams.

Virtual Reality: 7
VR is used in specific training sessions, but is not widely adopted, though its potential for improving decision-making and technique is promising.

1. AI & Data

- **Performance and strategy analysis:** Various platforms and tools use AI to analyze players' movements and strategies in real-time, providing instant feedback and suggesting tactical adjustments to optimize team performance.

- **Injury prediction:** Machine learning algorithms analyze movement patterns and training loads to predict and prevent potential injuries, helping players maintain safe and efficient training.

2. AR & VR

- **Training in Virtual Reality:** Using VR to simulate different game and training scenarios, allowing players to practice in a controlled environment and improve their technique and decision-making without risk of injury.

- **Strategy analysis with AR:** Applications overlaying data and tactical diagrams on training videos in real-time, helping coaches analyze and adjust team strategies with greater precision.

3. Sensors and Wearable Devices

- **Smart equipment:** Gear with sensors monitoring posture, workload, and force distribution in real-time during the game.

- **Smart balls and sticks:** Balls and sticks equipped with sensors measuring speed, rotation, and trajectory, offering valuable information for performance analysis and improving players' techniques.

4. Platforms and Software

- **Training management software:** Platforms that allow planning and monitoring hockey training sessions, managing workloads, and analyzing player progress.

- **Live strategy applications:** Tools enabling coaches to adjust strategies and game plans in real-time, based on data obtained during training sessions and matches.

5. Infrastructure Innovations

- **Hockey fields with integrated sensors:** Fields equipped with pressure sensors collecting data on force distribution and movement during matches.

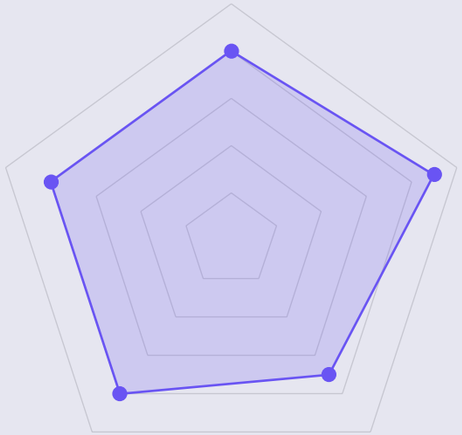
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor players' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity in both field and ice hockey has advanced significantly, focusing on protecting player and team data and competition management systems' integrity. Leagues and federations implement measures like personal data encryption, multifactor authentication, and network monitoring to prevent cyberattacks. However, full implementation and universal adoption are still in progress.



Performance: 9

Tools and data analysis platforms are integrated to evaluate and optimize performance, providing precise and reliable data for decision-making, but there is still room for improvement in full implementation.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for fan interaction, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Jordi Bonastre | 2022

Current Use Cases

1. **Pixellot's AI-powered system utilizes multiple cameras and computer vision algorithms to automatically capture, produce, and live-stream** hockey matches without a large camera crew. It provides features like instant replay, interactive statistics, and integrated OTT platforms.

2. Spiideo's smart camera system and cloud platform automatically record entire field hockey matches and practices. **Its AI-powered gaming tracker focuses on the action and offers a smart viewing experience.**

3. TeamTV offers an **automatic camera system** for hockey that uses artificial intelligence to follow the game. It offers features such as instant replay, dynamic overlays on the scoreboard, and multi-camera views.

4. Researchers at the University of Waterloo have developed an **artificial intelligence tool that can track and identify field hockey players** with high accuracy, scoring 94.5% on correct player tracking and 83% on individual player identification.

5. Drive Hockey's sensor-based analytics system uses 1**6 mobile tracking sensors to collect more than 3000 data points per second on players' position**, movements, and speed. Its AI analyzes this data to provide information on more than 25 individual skills and compare players to each other.

6. Catapult offers performance tracking and analysis solutions for ice hockey, using advanced sensor technology and wearables to monitor and evaluate player movements. **Its tools collect real-time data on athletes' speed, acceleration, and workloads, providing detailed insights** that help coaches optimize workouts, improve strategies, and prevent injuries.

7. The NHL Sense Arena **platform offers virtual reality training for hockey players to improve skills such as decision-making**, anticipation, and situational awareness. It allows players to perform hundreds of reps and puck taps in just 20 minutes per day.

8. The STX Ai 1001 field hockey stick **incorporates sensor technology to monitor and control player performance.**

The Next 10 Years

1

AI and machine learning-based analysis systems will provide detailed, **real-time analysis of players' performance,** monitoring speed, endurance, and tactics.

2

Augmented and Virtual Reality will transform training and viewing experiences. Players will practice in realistic simulations, enhancing their response and decision-making skills. For spectators, AR will offer real-time statistics and analysis during live broadcasts, providing an immersive and educational experience.

3

Advancements in cybersecurity will be crucial to protect sensitive data of players and teams. Leagues and clubs will adopt **robust security measures like advanced encryption and multifactor authentication** to ensure the integrity of information and competitions.

4

Sensor and wearable technology will enable constant monitoring of players' health and performance. T**hese devices will collect biometric and activity data, helping medical teams quickly identify and manage health issues.**

Judo

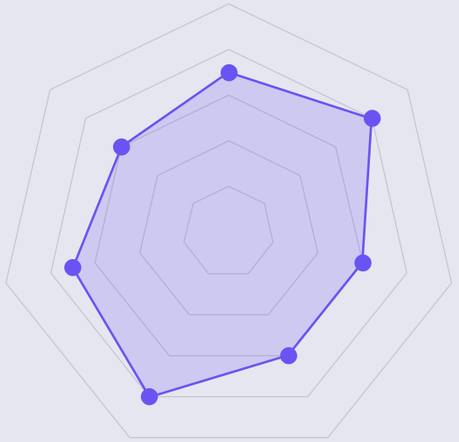
Judo is a martial art and combat sport originating from Japan that focuses on throwing or taking down the opponent, as well as techniques of strangleholds and control. Developed by Jigoro Kano in 1882, judo emphasizes efficiency and using the opponent's force against them. Judo debuted at the Tokyo 1964 Olympic Games and has become a key event, showcasing competitions known for their technique and sportsmanship, promoting values such as respect and discipline among athletes.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data and technique analysis, but full integration is still in development. Accessibility varies between competition levels and countries.

Smart Infrastructure: 6
Innovations in tatamis and lighting systems are being adopted, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 8
Data analysis is deeply integrated into all aspects of performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in judokas' preparation, though full adoption still has room to grow.

Augmented Reality: 6
AR is mainly used for technique visualization and analysis, but adoption is limited and primarily experimental.

Sensors and Wearables: 8
Sensor technology is highly advanced and widely used in clothing and protective gear for performance analysis. Such devices are common in most professional teams.

Virtual Reality: 6
VR is used in specific training sessions, but not widely adopted, though its potential for improving technique and planning is promising.

1. AI & Data

- **Technique and Strategy Analysis:** Various tools use AI to analyze judokas' movements and techniques in real-time, providing instant feedback and suggesting adjustments to optimize performance.
- **Injury Prediction:** Machine learning algorithms analyze movement patterns and training loads to predict and prevent potential injuries.

2. AR & VR

- **Training in Virtual Reality:** Using VR to simulate different combat and training scenarios, allowing judokas to practice in a controlled environment and improve their technique without the risk of injuries.
- **Technique Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, helping coaches analyze and correct techniques.

3. Sensors and Wearable Devices

- **Smart Clothing and Protective Gear:** Equipment with sensors that monitor posture, balance, and force distribution in real-time during combat, providing detailed data to improve techniques.
- **Smart Tatamis:** Combat surfaces equipped with sensors that measure force and weight distribution.

4. Platforms and Software

- **Training Management Software:** Platforms that allow planning and monitoring judo training sessions, managing workloads, and analyzing judokas' progress.
- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and combat plans in real-time, based on data obtained during training sessions and matches.

5. Infrastructure Innovations

- **Tatamis with Integrated Sensors:**
  Tatamis equipped with pressure sensors that collect data on force distribution and movement during combats.

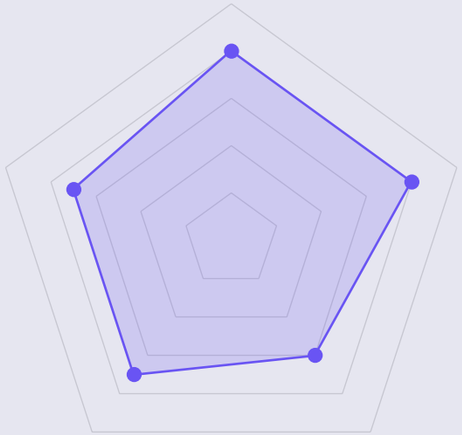
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor judokas' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Federations and clubs use data encryption, multifactor authentication, and network monitoring to prevent unauthorized access and cyberattacks. Regular cybersecurity training ensures safe practices in managing digital information and using technology for performance analysis and event management, but full implementation and universal adoption are still in progress.



Performance: 8

Tools and data analysis platforms are integrated to evaluate and optimize performance, providing precise and reliable data for decision-making, but there is still room for improvement in full implementation.

Fan Engagement: 7

Mobile applications and social media platforms are in development for fan interaction, but the implementation of AR and VR experiences is still growing.

Audiovisual: 6

Immersive experiences and AR and VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Francisco Garrigós | 2024

Current Use Cases

1. CoachLogic Platform used by judo teams **to plan and monitor training**, manage workloads, and analyze judokas' progress, optimizing training programs.

2. Athlete Analyzer a training app specifically for martial arts, including judo. It allows coaches and athletes **to analyze strengths and weaknesses**, create individualized training plans, and monitor progress through video analysis.

3. SPLYZA TEAMS, a **video analysis tool** used in a case study to analyze match videos of a university judo player. The study refuted two of the player's hypotheses and revealed a notable tendency to initiate throws from disadvantaged positions in lost matches.

4. Judo Data an **innovative company pioneering judo match analysis**. They are developing an AI system to automatically detect and record techniques, attacks, and other key performance indicators during judo matches, providing a comprehensive analysis tool for coaches, athletes, referees, and media.

5. Jabbr an **AI tool for combat sports training**. It uses an AI called DeepStrike to analyze any video input, whether professional, amateur, or combat, providing detailed statistics and personalized analysis for fighters.

6. Microsoft Kinect used as a training aid in judo, with an **augmented reality application for tachi-waza techniques.**

7. **Augmented Reality at the 2024 Portugal Grand Prix,** featured by the International Judo Federation to enhance the viewing experience.

8. Ghent University Study, **used a dummy and sensors embedded in tatamis to measure parameters** like neck injury criteria and beam criteria in different judo throwing techniques, analyzing injury risk factors.

The Next 10 Years

1. **AI will be crucial in video analysis of competitions**, providing detailed information on movements and techniques, allowing coaches to adjust strategies in real-time. Advanced algorithms will identify success patterns and areas for improvement, helping judokas perfect their skills.

2. **VR and AR will transform training**, allowing athletes to practice in simulated environments that replicate realistic combat situations. Judokas will face virtual opponents tailored to their skill levels, offering personalized and highly effective training.

3. **Sensor and wearable technology will enable constant monitoring** of athletes' health and performance. These devices will collect biometric and movement data, providing valuable information on judokas' physical condition and health status.

Wrestling

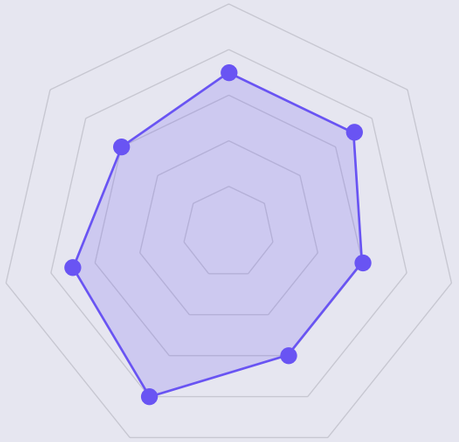
Wrestling is a combat sport practiced in a hand-to-hand manner, where two competitors try to take down or immobilize the opponent using grappling, projection, and control techniques. With historical roots dating back to ancient civilizations, wrestling has evolved into various forms, such as freestyle and Greco-Roman wrestling, each with specific rules and permitted techniques. Wrestlers must demonstrate physical strength, agility, endurance, and tactical skills to score points through takedowns or controlling the opponent on the ground, combining strategy and technique in a dynamic and physically demanding contest.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data and technique analysis, but full integration is still in development. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure: 6
Innovations in mats and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 7
Data analysis is deeply integrated into all aspects of performance and technique in wrestling, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in wrestlers' preparation, though full adoption still has room to grow.

Augmented Reality: 6
AR is mainly used for technique visualization and analysis, but adoption is limited and primarily experimental.

Sensors and Wearables: 8
Sensor technology is highly advanced and widely used in clothing and protective gear for performance analysis. Such devices are common in most professional teams.

Virtual Reality: 6
VR is used in specific training sessions, but not widely adopted, though its potential for improving technique and planning is promising.

1. AI & Data

- **Physical Preparation and Intelligent Training:** Use of generative AI to obtain personalized recommendations for nutrition, training planning, and technique analysis.
- **Competitor Study and Outcome Prediction:** Analysis of performance metrics of different wrestlers and generation of outcome probability estimates based on automatic analysis of various factors related to physical condition, style, strength, weaknesses, and opponents' previous results.

2. AR & VR

- **Immersive Training Environments:** Virtual simulation of different combat scenarios where wrestlers can practice specific techniques or movements within controlled environments.
- **Technique Analysis with AR:** Overlaying data on real-time recorded images to help coaches analyze and correct their wrestlers' technique and strategy with greater precision.

3. Sensors and Wearable Devices

- **Smart Clothing and Protective Gear:** Sports equipment integrated with connected sensors to monitor real-time factors like body temperature or heart rate of the wrestler.

4. Platforms and Software

- **Training Management Software:** Platforms that allow planning and monitoring of wrestling training sessions, helping coaches understand the wrestlers' physical condition and track performance progress.
- **Video Analysis Platforms:** Systems incorporating high-definition cameras and sophisticated software for coaches to perform detailed analyses of techniques, strategies, and tactics used by wrestlers during matches.

5. Infrastructure Innovations

- **Smart Mats:** Combat surfaces equipped with sensors that measure force and weight distribution, providing valuable information for performance analysis and technique improvement of wrestlers.

- **Energy Control Automation Systems:** IoT networks that automatically record and adjust temperature and lighting conditions of facilities during matches.

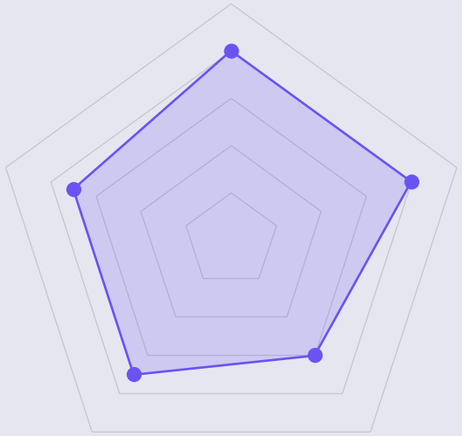
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor wrestlers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, but full implementation and universal adoption are still in progress.



Performance: 8

Data analysis platforms are integrated to evaluate and optimize performance, providing precise and reliable data for decision-making, but there is still room for improvement in full implementation.

Fan Engagement: 7

Mobile applications and social media platforms are in development to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 6

Immersive experiences and AR and VR applications are available, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Kyle Dake | 2020

Current Use Cases

1. Dartfish Applications, used in wrestling to analyze wrestlers' movements in real-time through a **camera system connected with integrated software.**

2. Wrestling IQ, tools used by **wrestling teams for planning and monitoring specialized training.**

3. Russian Researchers Study a study aimed at designing an AI program to predict wrestlers' success, improving their selection process. The authors developed an AI system specialized in wrestling to forecast Greco-Roman wrestlers' performance, analyzing data from 72 athletes across 36 different variables. **The program had only an 11% error rate in predicting wrestlers' competitive performance during subsequent trials.**

The Next 10 Years

1 **AI and Machine Learning applications will become increasingly sophisticated**, allowing highly accurate predictive analysis of results.

2 Generative AI will be a common tool in **training planning and competitor analysis.**

3 **Video analysis will continue to be researched to develop more advanced applications that connect data processing programs** with cameras equipped with computer vision, enabling coaches to study wrestlers' techniques in greater detail.

4 Augmented Reality and Virtual Reality will continue **to be adopted to enhance training and generate interactive experiences for spectators.**

5 **Smart mats and combat infrastructures will keep working on implementing IoT systems with networks of intelligent sensors** that allow recording an increasing amount of movement and execution data in wrestling.

Swimming

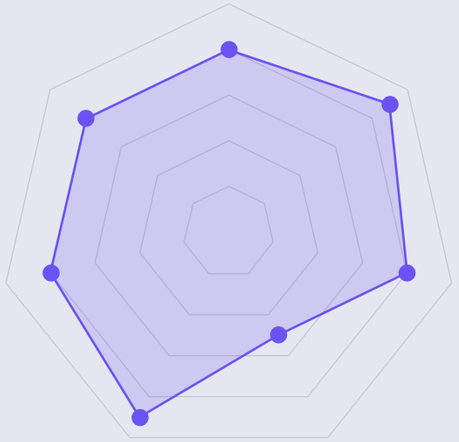
Swimming dates back to prehistoric times, but it wasn't until the 19th century that it became a popular competitive sport. The first championships started in 1837 with the establishment of the National Swimming Society of Great Britain. At that time, most swimmers used the breaststroke or a form of it. Later, a variety of styles were added to the different modalities within this discipline, which are now featured in the Olympic Games.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still developing. Accessibility to these tools varies between competition levels and countries.

Smart Infrastructure: 8
Innovations in pools and lighting systems are being adopted, but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of swimming performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in swimmer preparation, though full adoption still has room to grow.

Augmented Reality: 8
AR is already available and used for technique visualization and analysis, though there is still room for application development.

Sensors and Wearables: 9
Sensor technology is highly advanced and widely used in suits and equipment for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 5
VR is used in specific training to simulate pool scenarios, improving swimmers' decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Systems with AI-equipped cameras to analyze swimmers' movements in real-time, providing instant feedback and suggesting adjustments to optimize technique.
- **Prediction of Results:** AI algorithms that analyze data from previous competitions and compare metrics of different swimmers to predict potential performance and outcomes.
- **Training and Nutrition Plan Preparation:** Use of generative AI applications to design personalized programs based on data analysis of each swimmer and their specific needs.

2. AR & VR

- **Augmented Reality Goggles:** Equipped with motion sensors, they collect information and display it to the swimmer through one of the lenses while swimming, providing valuable data for improving training such as split times, distance, or stroke count in real-time.
- **Virtual Simulations:** Create race scenarios for swimmers to practice technique and improve stroke efficiency, biomechanics, or learn how to react to unexpected events like water entering the goggles.

3. Sensors and Wearable Devices

- **Smart Suits and Devices:** Caps, goggles, and swimsuits equipped with sensors that monitor real-time posture, workload, or stroke efficiency during races, providing detailed data to improve technique and prevent injuries.
- **Physiological Monitoring Devices:** Clothing and wearable devices that monitor heart rate, respiration, and other health indicators, helping swimmers optimize their training and recovery.

4. Platforms and Software

- **Training Management Software:** Specialized online platforms that allow planning and monitoring of swimming training, analyzing the progress achieved in training programs.
- **Live Strategy Applications:** Tools that allow coaches to adjust strategies and race plans in real-time, based on data obtained during training sessions and competitions.

5. Infrastructure Innovations

- **Smart Pools:** Facilities equipped with sensors that collect data on split times or swimmers' contact with the walls to help determine competition results more accurately.

- **AI-Controlled Safety Systems:** Camera systems with computer vision that issue alerts when they identify signs of distress or exhaustion in a swimmer, allowing medical and safety teams to intervene quickly.

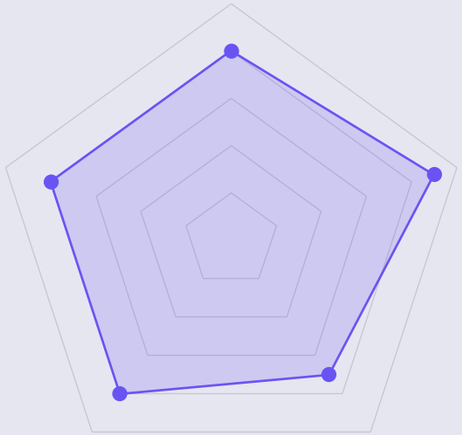
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor swimmers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9

Data analysis platforms are integrated to evaluate and optimize swimming performance, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed to interact with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Augmented reality devices are already available for training and data analysis, but the adoption of virtual reality simulations is not yet universal.

Cameron McEvoy | 2017

Current Use Cases

1. Alicia Glass, a senior sports dietitian with the U.S. Olympic and Paralympic Committee (USOPC), is currently using an **AI app called Notemeal to optimize meal plans** for about 300 athletes in the athletics and swimming disciplines.

2. The Aquahass aquatic center uses surveillance data from cameras, processed through the **Lynxight** system, to monitor swimmers in a non-invasive way. The technology helps in the **detection of possible emergencies** by automatically detecting signs of possible drowning risk.

3. The FORM swim goggles are equipped with **motion sensors and an augmented reality system that allows the swimmer to visualize training data in real time**, while swimming in the pool or open water.

4. **FINIS Swim Sense wearable devices are designed to capture swimming metrics** such as stroke count, distance, time or total pace, providing critical data to optimize swimmers' training and recovery, as well as to analyze performance in competitions.

5. SwimCloud is an application used by swimming teams to plan and monitor workouts, **analyze swimmers' performance data and measure the progress of work routines.**

The Next 10 Years

1 **AI Applications will become an essential tool** for creating personalized training and nutrition plans.

2 **Swimsuits Equipped with Motion Sensors and Wearable Devices will continue to enhance their capabilities**, allowing coaches to design more personalized and effective training programs.

3 **Video Analysis Technologies and Motion Simulation Systems will continue to provide new ways to study** and improve swimmers' techniques.

4 **Augmented Reality Goggles will become a common tool among swimmers**, regardless of their level, from elite to amateur.

5 **Underwater Cameras with Computer Vision will enable deeper biomechanical analysis**, helping swimmers refine their movements and reduce injury risk.

Artistic Swimming

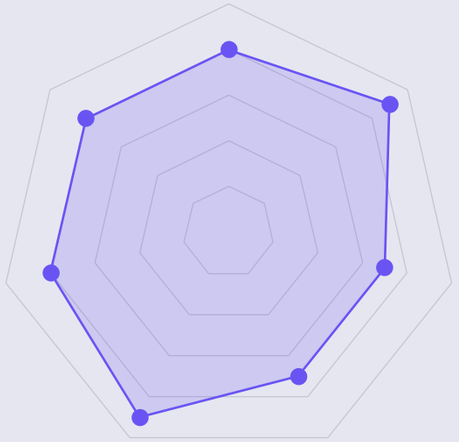
Artistic swimming, also known as synchronized swimming, is a discipline that combines swimming, ballet, and gymnastics. It originated in the early 20th century. Although the first competitions were organized for men, it later became more closely associated with female athletes, gaining international recognition through exhibitions and competitions organized in Europe and North America. Its Olympic debut occurred at the 1984 Los Angeles Games, initially with solo and duet events.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still developing.

Smart Infrastructure: 8
Innovations in pools and lighting systems are being adopted, but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of artistic swimming performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in swimmer preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is primarily used for visualization and technique analysis, but its adoption is still limited and mainly experimental.

Sensors and Wearables: 9
Sensor technology is highly advanced and widely used in suits and equipment for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training to simulate routines and conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** AI tools analyze swimmers' movements and techniques in real-time, providing instant feedback and suggesting adjustments to optimize performance.
- **Prediction of Results:** AI algorithms analyze data from previous competitions, water conditions, and other factors to predict swimmers' performance and potential outcomes.
- **AI-Designed Choreographies:** Solutions that analyze footage of past performances to extract features according to requested requirements, generating proposals for new choreography formats, detailing movements, music, and other artistic components.

2. AR & VR

- **Virtual Reality Training:** Using VR devices to simulate competition scenarios, allowing swimmers to practice in a controlled environment and experience sensations similar to those during actual competitions.
- **Routine Analysis with AR:** AR applications superimpose data and diagrams onto training videos in real-time, helping coaches analyze and correct their swimmers' techniques with greater precision.

3. Sensors and Wearable Devices

- **Smart Suits and Devices:** Equipped with sensors that monitor real-time posture, workload, and synchronization during routines, providing detailed data to improve technique and perfect choreography execution.

4. Platforms and Software

- **Training Management Software:** Specialized platforms allow for the planning and monitoring of training sessions, analyzing swimmers' progress to optimize training programs.

5. Infrastructure Innovations

- **Smart Pools:** Facilities equipped with sensors that collect data on force distribution and movement during routines, providing critical information for technique and strategy analysis.
- **Software-Controlled Dynamic Lighting:** Automated lighting systems adjust during training sessions and competitions to improve visibility and swimmers' concentration, enhance the artistic quality of choreographies, and reduce energy consumption.

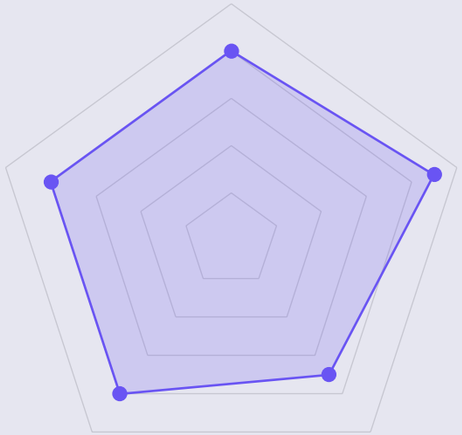
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor swimmers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9

Data analysis platforms are integrated to evaluate and optimize performance in artistic swimming, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Anna-Maria Alexandri / Eirini-Marina Alexandri | 2022

Current Use Cases

1. **Choreography AI an artificial intelligence application designed specifically for synchronized swimming**, aimed at generating and optimizing choreographies. It uses deep learning techniques to analyze videos of past performances, extracting common patterns and combining different features to synthesize new sequences that match coaches' requested criteria.

2. **SwimSync an AI application that creates synchronized swimming routines** based on the user's chosen music, theme, and difficulty level. It also provides feedback and suggestions to improve swimmers' performance and synchronization.

3. **SwimCoach Tool designed to monitor swimmers' movements,** positions, and times using a system of sensors and cameras. It provides real-time feedback and corrections while generating personalized training programs based on each swimmer's specific characteristics and needs.

4. Dartfish used in synchronized swimming to **analyze swimmers' techniques** through a system of smart cameras connected to software that processes images and issues recommendations.

5. SwimVR an AI system that **creates immersive and interactive virtual reality experiences** for visualizing and practicing synchronized swimming from anywhere. SwimVR also connects users with other swimmers, spectators, and coaches worldwide, functioning as a collaboration and engagement platform.

The Next 10 Years

1 **Generative AI will become a primary tool for training preparation**, creating hyper-personalized nutrition programs, and designing new choreographies.

2 **Motion Capture Systems and Advanced Video Analysis will enable coaches and swimmers to break down and perfect every detail of routines.** These AI-powered systems will provide precise and immediate feedback, facilitating technique corrections and synchronization improvements.

3 **Sensors Integrated into Swimwear and Wearable Devices will monitor biometric data** such as heart rate and oxygenation, optimizing training regimens and swimmers' physical condition.

4 Developments in Virtual Reality (VR) and Augmented Reality (AR) will play a crucial role. VR will allow for the **creation of simulated environments** for practicing routines anytime and anywhere, while AR will enhance the experience for swimmers, coaches, and spectators by overlaying real-time information during competitions, such as synchronization data and scores.

5 **Spectator experience will transform with immersive** broadcasts and 360-degree technology, providing unique perspectives and innovative angles during competitions.

Open Water Swimming

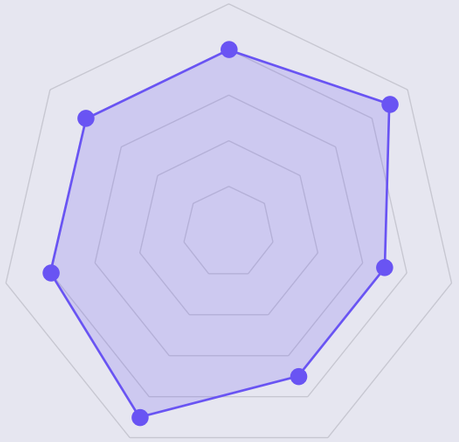
Open water swimming is a discipline conducted in natural settings such as oceans, lakes, and rivers, contrasting with pool swimming. This modality requires swimmers to adapt to various environmental conditions, including currents, waves, water temperature, and marine life. Before the inclusion of pools in the 1908 Games, in the first three editions of the modern Olympic Games, all swimming events took place in natural water surfaces. This discipline reappeared in 1991 when it was finally introduced in the FINA World Championships (now known as the World Aquatics Championships).

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, as well as training preparation, with much potential yet to be fully explored.

Smart Infrastructure: 8
Innovations in tracking devices and signaling systems are being adopted. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of open water swimming performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms : 8
Training and strategy management software is well-developed and fundamental in swimmer preparation, though there is still room for incorporating advanced features.

Augmented Reality: 7
AR devices are becoming common but still have much room for improvement and increased adoption.

Sensors and Wearables: 9
Sensor technology is highly advanced and widely used in suits and equipment for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training to simulate open water race scenarios or visualize routes, though its adoption is not universal.

1. AI & Data

- **Technique and Pace Monitoring:** Systems based on motion sensors and smart clothing connected to AI platforms analyze swimming technique, stroke frequency, and efficiency in real-time. This allows coaches to adjust and optimize swimmers' training more precisely.

- **Personalized Training Programs:** Generative AI and machine learning applications design tailored training and nutrition plans based on swimmers' performance data and physical condition.

2. AR & VR

- **Route Visualization:** VR devices allow swimmers to preview and familiarize themselves with race courses before the event, helping them plan strategies and identify critical points on the course.

- **AR Goggles:** Equipped with connected sensors, they collect performance data in real-time (pace, distance, strokes per minute, etc.) and display it to the swimmer through one of the lenses. .

3. Sensors and Wearable Devices

- **Smart Suits and Devices:** Equipped with sensors that monitor real-time posture, workload, and stroke efficiency during races, providing detailed data to improve technique and prevent injuries.

- **Physical Monitoring Devices:** Wearable clothing and devices that monitor heart rate, respiration, and other health indicators, helping swimmers optimize their training and recovery.

4. Platforms and Software

- **Training Management Software:** Platforms like SwimCloud and TeamUnify allow for planning and monitoring open water swimming training sessions, managing workloads, and analyzing swimmers' progress to optimize training programs.

- **Live Strategy Applications:** Tools that allow coaches to adjust strategies and race plans in real-time based on data obtained during training sessions and competitions.

5. Infrastructure Innovations

- **Real-Time Tracking Devices:** GPS technology and integrated sensors that allow monitoring of swimmers' exact position and performance during competitions, providing real-time data to both coaches and fans.

- **Drones:** Equipped with smart cameras, offering aerial images of swimmers from various angles, allowing for precise visualization of swimmer execution and ensuring their safety at all times.

- **Computer Vision:** Video analysis systems using AI that send alerts when they detect any risk patterns for the swimmer, whether underwater elements or gestures and movements indicating extreme exhaustion or signs of drowning.

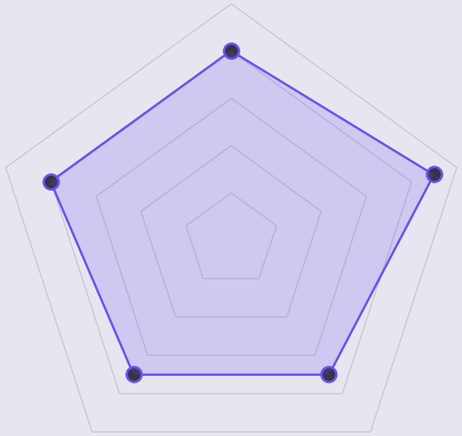
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor swimmers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9

Data analysis platforms are integrated to evaluate and optimize performance in open water swimming, providing precise and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are well-developed for interacting with fans, but there is still much room for implementing AR and VR experiences.

Audiovisual: 7

Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Taddeucci Ginevra | 2022

Current Use Cases

1. **SwimPro Tool uses cameras and software to analyze swimmers' movements in real-time**, providing instant feedback on technique and strategy, and suggesting adjustments to improve performance.

2. **SwimCloud a widely used tool by open water swimming** teams to plan and monitor training sessions.

3. **FORM Swim Goggles equipped with motion sensors** and an AR system that allows swimmers to visualize training data in real-time while swimming in pools or open water.

The Next 10 Years

1 The use of advanced AI applications will become more widespread for preparing training and nutrition plans, planning routes, and estimating results. Additionally, **AI-equipped monitoring devices will provide detailed real-time analysis of swimming technique**, stroke frequency, and other key indicators, allowing for real-time execution adjustments.

2 **AR goggles** will continue to gain popularity and improve their capabilities, becoming a staple in elite competitions. Swimmers will be able to view detailed performance data while training and competing.

3 **VR devices will also play an increasingly important role**, providing swimmers with information about routes, water conditions, and safety warnings, helping them prepare and be aware of potential environmental changes.

4 **Competition safety will be significantly enhanced with the implementation of real-time monitoring technologies.** Advanced GPS systems, drones, and high-resolution cameras equipped with AI will monitor swimmers during competitions, alerting organizers to any anomalies or emergencies.

5 Immersive broadcasts with high-definition underwater cameras and 360-degree technology, along with virtual reality, **will offer an enveloping visual experience**, allowing spectators to feel as if they are swimming alongside the competitors.

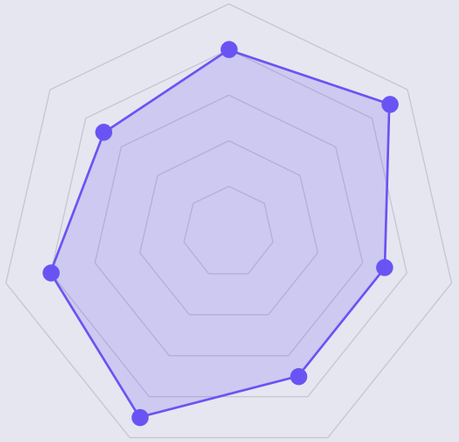
Modern Pentathlon

Modern pentathlon is an Olympic sport that combines five different disciplines: fencing, swimming (200 meters freestyle), equestrian show jumping, and a combined event of pistol shooting and cross-country running (laser-run). Created by the founder of the modern Olympic Games, the modern pentathlon tests versatility, endurance, and strategy, standing out for its unique combination of sports.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and strategies across all pentathlon disciplines, though full integration is still in development. Accessibility varies by competition level and country.

Smart Infrastructure: 8
Innovations in facilities and lighting systems are being adopted, but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.



Data Analysis: 9
Data analysis is deeply integrated into all aspects of pentathlon performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.

Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in the preparation of pentathlon athletes, though full adoption has room to grow.

Augmented Reality: 7
AR is primarily used for real-time visualization and technique analysis, but its adoption is limited and mostly experimental.

Sensors and Wearables: 9
Sensor technology is highly advanced and widely used in equipment specific to each pentathlon discipline, providing detailed data for performance analysis.

Virtual Reality: 7
VR is used in specific training to simulate competition scenarios, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Performance and Strategy Analysis:** Various tools use AI to analyze athletes' movements and strategies in real-time across all disciplines, providing instant feedback and suggesting adjustments to optimize performance.

- **Injury Prediction:** Machine learning algorithms analyze movement patterns and training loads to predict and prevent possible injuries, helping athletes maintain safe and efficient training.

2. AR & VR

- **Virtual Reality Training:** Use of VR to simulate different competition and training scenarios in all pentathlon disciplines, allowing athletes to practice in a controlled environment and improve their technique without risk of injury.

- **Technique Analysis with AR:** Applications that superimpose data and diagrams over training videos in real-time, helping coaches analyze and correct athletes' techniques more accurately.

3. Sensors and Wearable Devices

- **Multidisciplinary Devices:** Equipment with sensors that monitor posture, workload, and force distribution in real-time across the various disciplines, providing detailed data to improve technique and prevent injuries.

- **Smart Competition Platforms:** Equipment specific to each discipline (such as fencing swords, shooting guns, and horses in equestrian events) equipped with sensors that measure accuracy, speed, and force.

4. Platforms and Software

- **Training Management Software:** Various platforms allow for planning and monitoring pentathlon training sessions, managing workloads, and analyzing athletes' progress.

- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and competition plans in real-time based on data obtained during training sessions and competitions.

5. Infrastructure Innovations

- **Facilities with Integrated Sensors:** Facilities equipped with pressure sensors and other devices that collect data on force distribution and movement during competitions.

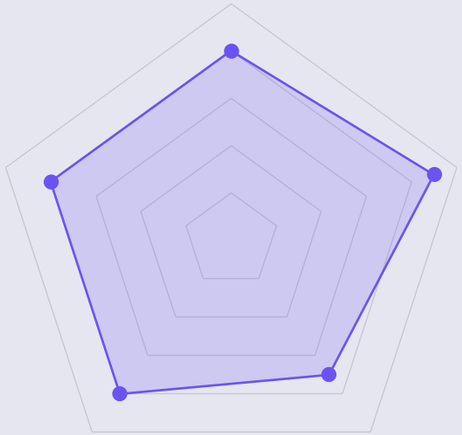
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor athletes' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity in modern pentathlon focuses on protecting personal data and securing systems used for competition and training management. Measures like data encryption, multi-factor authentication, and network monitoring are implemented to prevent unauthorized access and cyberattacks, though full implementation and universal adoption are still in progress.



Performance: 9

Data analysis platforms are integrated to evaluate and optimize performance across all pentathlon disciplines, providing precise and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

David Svoboda | 2016

Current Use Cases

1. Catapult uses **sensors in clothing and equipment** to analyze athletes' movements and strategies in real-time across all pentathlon disciplines, providing instant feedback on technique and tactics and suggesting adjustments to improve performance.

2. **Athlete Analyzer a platform used by modern pentathlon teams**, allowing for the planning and monitoring of training sessions, managing workloads, and analyzing athletes' progress.

3. **TrainHeroic a training platform that offers tools to create, manage, and track training programs for athletes and coaches.** It uses advanced technologies to monitor performance and provide real-time feedback, optimizing physical and technical preparation. In modern pentathlon, these technologies enable coaches to personalize training programs, analyze performance data, and improve training efficiency and effectiveness.

The Next 10 Years

1 The integration of artificial intelligence and machine learning will enable detailed, real-time analysis of the five disciplines, **optimizing personalized training strategies and improving accuracy in performance evaluation.** Advanced sensors and wearables will continuously monitor athletes' health and fitness.

2 **Virtual reality and augmented reality will be integrated into training and competitions.** Athletes will be able to practice in simulated environments that replicate the conditions of the tests, improving their adaptability and skills under pressure.

3 For spectators, **AR will provide real-time statistics and analysis during competitions**, making the experience more immersive and educational.

4 In addition, **Blockchain technology and advanced cybersecurity systems will ensure the integrity and transparency of competitions**, protecting athletes' personal and performance data. Performance analytics platforms will be crucial for personalizing training programs and tracking athletes' progress with pinpoint accuracy.

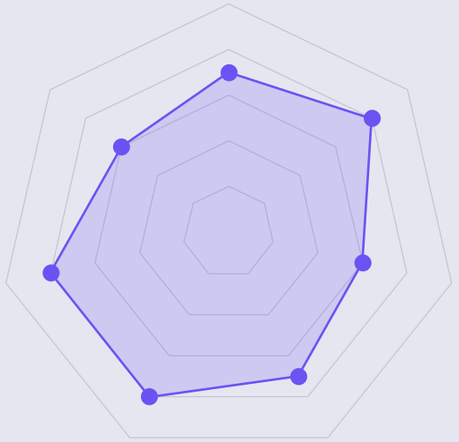
Canoe Slalom

Canoe slalom is a discipline where athletes navigate a kayak or canoe through a course of rapids and obstacles, aiming to complete the course in the shortest possible time while passing through a series of gates suspended over the water without touching them. Introduced at the Olympic Games in 1972 and reintroduced in 1992, it is a test of technical skill, speed, and precision. Competitors are evaluated based on their time and penalties incurred for mistakes during the course.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data analysis and strategies, though full integration is still in development. Accessibility varies by competition level and country.

Smart Infrastructure: 6
Innovations in slalom channels and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.



Data Analysis: 8
Data analysis is deeply integrated into all aspects of slalom performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.

Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in paddlers' preparation, though full adoption has room to grow.

Augmented Reality: 6
AR is primarily used for visualization and technique analysis, but its adoption is limited and mostly experimental.

Sensors and Wearables: 8
Sensor technology is highly advanced and widely used in paddles and boats for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training to simulate slalom scenarios, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Strategy Analysis:** Various platforms use AI to analyze paddlers' movements and techniques in real-time, suggesting adjustments to optimize performance.
- **Prediction of Water Conditions:** AI algorithms analyze meteorological and water flow data to predict river conditions, helping paddlers better prepare for competitions.

2. AR & VR

- **Virtual Reality Training:** Use of VR to simulate different slalom scenarios, allowing paddlers to practice in a controlled environment.
- **Course Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time.

3. Sensors and Wearable Devices

- **Sensors on Paddles and Boats:** Equipment with sensors that monitor posture, workload, and force distribution in real-time during slalom.
- **Physiological Monitoring Devices:** Clothing and wearables that monitor heart rate, respiration, and other health indicators.

4. Platforms and Software

- **Training Management Software:** Various platforms allow for planning and monitoring slalom training, managing workloads, and analyzing paddlers' progress.
- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and race plans in real-time based on data obtained during training sessions.

5. Infrastructure Innovations

- **Slalom Courses with Integrated Sensors:** Facilities equipped with sensors that collect data on force distribution and water flow during competitions.

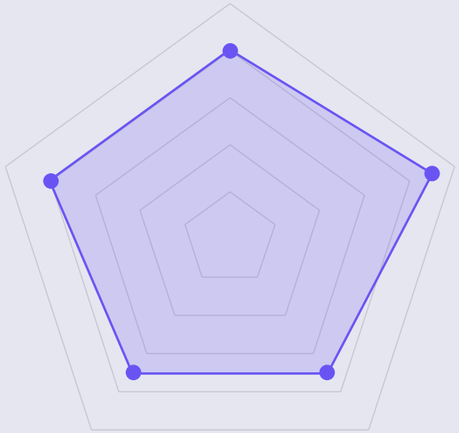
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor paddlers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Federations and clubs implement measures like data encryption, multi-factor authentication, and constant network monitoring to prevent unauthorized access and cyberattacks. Additionally, timing systems and electronic evaluation of competitions are protected to ensure the integrity and accuracy of results, though full implementation and universal adoption are still in progress.



Performance: 9

Tools like Dartfish and Kinovea, along with data analysis platforms, are integrated to evaluate and optimize slalom performance, providing precise and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are in development to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 7

Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Jiri Prskavec | 2016

Current Use Cases

1. **Massey University Study researchers evaluated the validity and reliability of using a 10 Hz GPS device to track performance in canoe slalom.** They compared GPS data with automated video tracking and found that the GPS provided accurate measurements of speed and distance during slalom runs both on land and in water.

2. **Paddlemate Sensors installed on athletes' paddles**, these sensors capture data on performance and competition conditions, including calories burned and river conditions.

3. **PCanoe a tool developed to improve dynamic balance training** in canoe slalom. It uses advanced technologies like motion sensors and force platforms to analyze and optimize athletes' stability and control over the canoe. These data allow coaches to adjust training programs and improve paddlers' technical performance.

4. Tiivii System implemented by the Galician Canoeing Federation, this automatic production technology uses **AI to record and broadcast canoeing competitions** and training sessions at Lake Verducido. It allows automatic tracking of paddlers, broadcasting all competitions and recording training sessions to improve athletes' technique.

5. **Kayak VR Mirage a VR tool designed to train slalom canoeing realistically**. It offers an audiovisual environment that simulates virtual rivers and seas with high realism, especially in water representation. The kayak control is intuitive and requires proper paddling techniques, helping develop essential skills.

The Next 10 Years

1 The **integration of sensors and monitoring devices into the kayaks and canoes** will make it possible to collect accurate data on the athletes' speed, trajectory and technique in real time. This data will be analyzed by artificial intelligence to provide instant and detailed feedback, helping coaches adjust strategies and optimize athlete performance.

2 In addition, **augmented reality (AR) and virtual reality (VR) will transform training methods**. Athletes will be able to practice in simulated environments that accurately replicate the waterways and obstacles of real competitions, improving their ability to adapt to different conditions and racing situations.

3 **AR will also be used in competitions to provide real-time information to spectators**, such as athlete speed, elapsed time, and penalties, making the viewing experience more immersive and informative.

4 **Advanced encryption and authentication measures will be implemented to guarantee the integrity** and confidentiality of the information, as well as to prevent cyberattacks that may affect the development and results of the competitions.

Sprint Canoeing

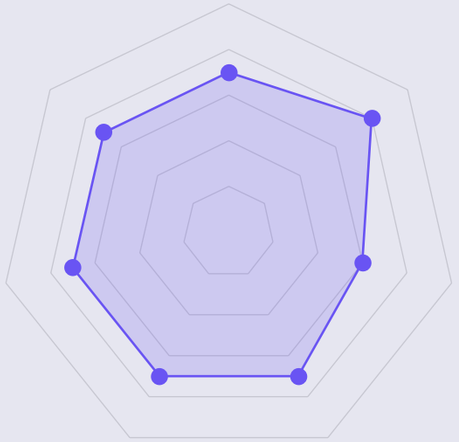
Sprint canoeing is a discipline where athletes compete in kayaks or canoes on calm waters, covering distances ranging from 200 to 1000 meters as quickly as possible. Introduced at the Olympic Games in 1936, this sport requires strength, endurance, and precise technique to achieve maximum speed. Competitors can participate in individual, double, or four-person events, known for their intensity and the technical skill required.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data analysis and strategies, though full integration is still in development. Accessibility varies by competition level and country.

Smart Infrastructure: 7
Innovations in sprint tracks and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 8
Data analysis is deeply integrated into all aspects of sprint canoeing performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in paddlers' preparation, though full adoption has room to grow.

Augmented Reality: 6
AR is primarily used for visualization and technique analysis, but its adoption is limited and mostly experimental.

Sensors and Wearables: 7
Sensor technology is highly advanced and widely used in paddles and boats for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training to simulate sprint scenarios, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Similar to slalom canoeing, various tools use AI to analyze paddlers' movements and technique in real-time, providing feedback to optimize performance.
- **Prediction of Water Conditions:** AI algorithms analyze meteorological and water flow data to predict track conditions, helping paddlers prepare better for competitions.

2. AR & VR

- **Virtual Reality Training:** Use of VR to simulate different sprint scenarios, allowing paddlers to practice in a controlled environment and improve their technique.
- **Course Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time.

3. Sensors and Wearable Devices

- **Sensors on Paddles and Boats:** Equipment with sensors that monitor posture, workload, and force distribution in real-time during sprints.
- **Physiological Monitoring Devices:** Clothing and wearables that monitor heart rate, respiration, and other health indicators.

4. Platforms and Software

- **Training Management Software:** Various platforms allow planning and monitoring of sprint canoeing training, managing workloads, and analyzing paddlers' progress.
- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and race plans in real-time based on data obtained during training sessions.

5. Infrastructure Innovations

- **Sprint Tracks with Integrated Sensors:** Facilities equipped with sensors that collect data on force distribution and water flow during competitions.

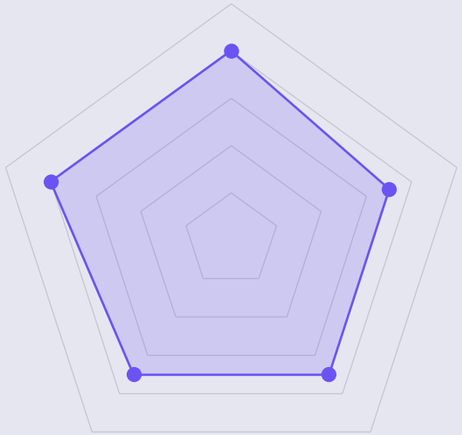
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor paddlers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Similar to slalom canoeing, federations implement measures like data encryption, multi-factor authentication, and constant network monitoring to prevent unauthorized access and cyberattacks, though full implementation and universal adoption are still in progress.



Performance: 7

Tools along with data analysis platforms are integrated to evaluate and optimize sprint performance, providing precise and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are in development to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 7

Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Sebastian Brendel | 2016

Current Use Cases

1. Cornell University Research researchers **have developed deep neural networks to detect specific events in force sensor signals** in sprint canoeing. Using convolutional neural networks (CNNs) and bidirectional recurrent neural networks (BGRUs), they automatically predict paddling cycles. This technology improves performance evaluation accuracy and facilitates detailed analysis of athletes' techniques, optimizing training and competition in sprint canoeing.

2. Chinese Scientists' Wearable Technology utilizing accelerometers and gyroscopes integrated into devices worn by athletes, this technology collects precise data on movement dynamics and applied forces during paddling. **These data are analyzed to provide real-time detailed feedback, helping optimize technique and performance.**

The Next 10 Years

1 The integration of advanced sensors and monitoring devices will enable detailed **analysis of athletes' performance in real-time.** These sensors, incorporated into the boats and athletes' equipment, will measure variables such as speed, stroke power, and movement efficiency.

2 **The AI will also be able to simulate different race conditions and strategies**, allowing athletes to prepare more effectively for various situations.

3 In addition, augmented reality (AR) and virtual reality (VR) will offer new forms of **immersive training**, where athletes will be able to practice in virtual environments that replicate realistic running conditions, improving their technique and adaptability.

4 Boat manufacturing technology will also advance, with **lighter and stronger materials that will improve speed and maneuverability.**

Rowing

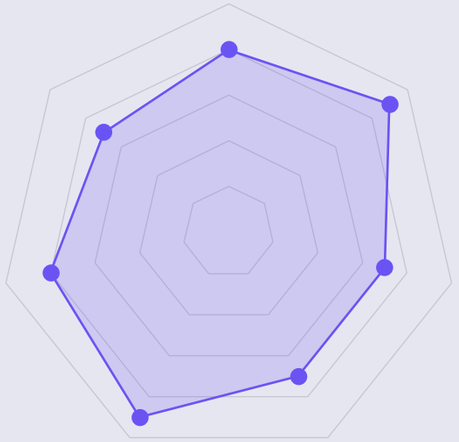
Rowing is a sport in which athletes propel a boat on water using oars. Rowers sit facing away from the direction of travel and use the strength of their arms, back, and legs to move the boat as quickly as possible. At the Olympic Games, rowing has been a prominent discipline since its inclusion in 1900. Olympic rowing competitions include various categories, both individual and team, and are valued for the combination of endurance, technique, and synchronization they require.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and strategies, though full integration is still in development. Accessibility to these tools varies by competition level and country.

Smart Infrastructure: 7
Innovations in regatta courses and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of rowing performance and technique, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in rowers' preparation, though full adoption has room to grow.

Augmented Reality: 7
AR is primarily used for visualization and technique analysis, but its adoption is limited and mostly experimental.

Sensors and Wearables: 9
Sensor technology is highly advanced and widely used in oars and boats for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training to simulate regatta scenarios, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Various tools and platforms use AI to analyze rowers' movements and technique in real-time to improve their training.
- **Water Conditions Prediction:** AI algorithms analyze meteorological and water flow data to predict river conditions, helping rowers better prepare for competitions.

2. AR & VR

- **Virtual Reality Training:** Use of VR to simulate different regatta scenarios, allowing rowers to practice in a controlled environment and improve their technique.
- **Course Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, allowing rowers to visualize courses in real-time for practice.

3. Sensors and Wearable Device

- **Sensors on Oars and Boats:** Equipment with sensors that monitor posture, workload, and force distribution in real-time during rowing.
- **Physiological Monitoring Devices:** Clothing and wearable devices that monitor heart rate, respiration, and other health indicators.

4. Platforms and Software

- **Training Management Software:** Platforms that allow planning and monitoring of rowing training, managing workloads, and analyzing rowers' progress.
- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and race plans in real-time based on data obtained during training sessions and competitions.

5. Infrastructure Innovations

- **Regatta Courses with Integrated Sensors:** Facilities equipped with sensors that collect data on force distribution and water flow during competitions, providing critical information for technique and strategy analysis.

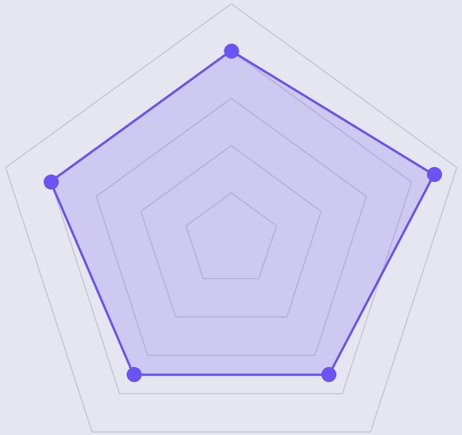
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor rowers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions in rowing, though full implementation and universal adoption are still in progress.



Performance: 9

Tools like Peach Innovations and Kinovea, along with data analysis platforms, are integrated to evaluate and optimize rowing performance, providing precise and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are in development to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 7

Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Current Use Cases

1. **Peach Innovations uses sensors, video, and software to analyze rowers' movements in real-time**, providing instant feedback on technique and strategy, and suggesting adjustments to improve performance and prevent injuries. Both coaches and athletes can use the system to quantify improvements in technique and performance and optimize equipment and platform.

2. **SpeedCoach GPS Sensors incorporated in oars and boats, equipped with technology that monitors** posture, force distribution, and technique in real-time.

3. **Polar Vantage Physiological Monitoring Devices**, monitor heart rate, respiration, and other health indicators in real-time for rowers.

4. **ASENSEI** is a training platform that uses motion recognition and **intelligent coaching** to improve rowing performance. Using sensors and computer vision technology, it captures and analyzes rowers' movements, providing real-time, personalized feedback. This technology allows for more effective and precise training, helping athletes perfect their technique and achieve their goals.

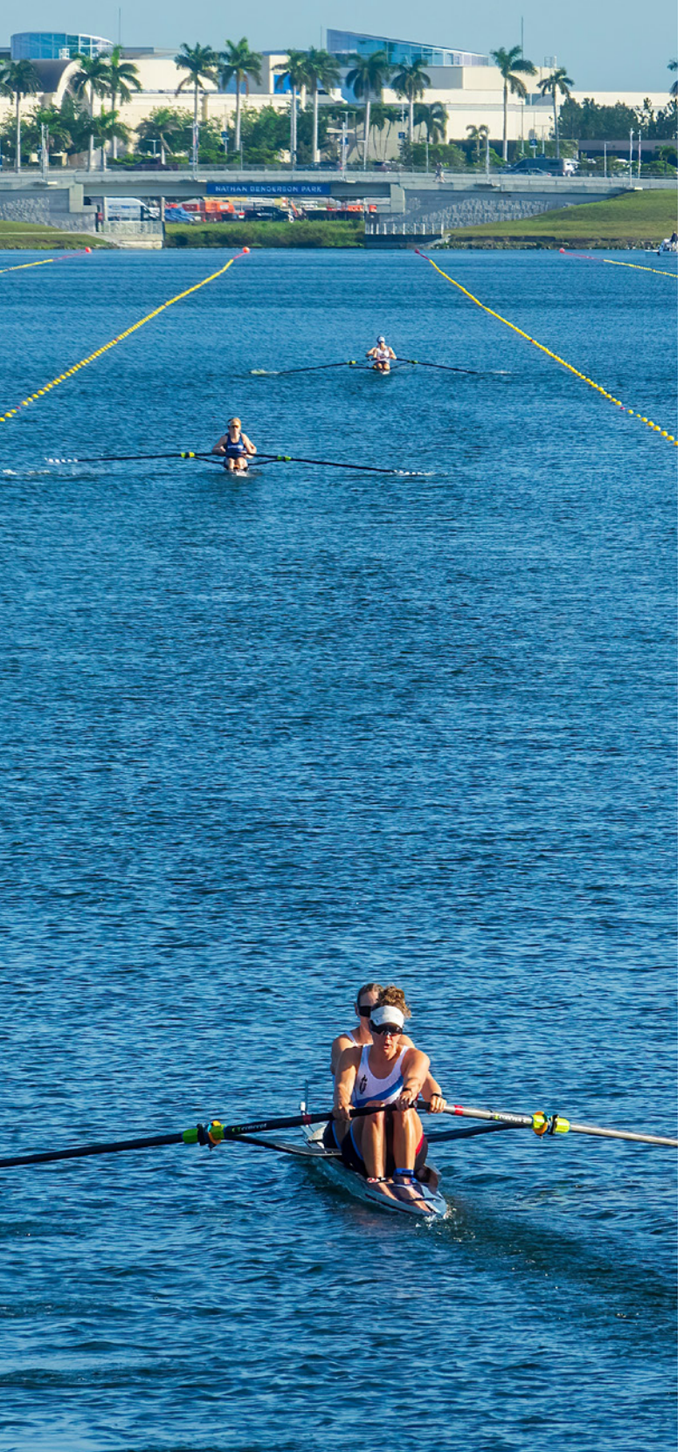
5. **Holofit, offers virtual reality workouts** for rowing machines, bikes, and ellipticals. Provides a variety of virtual worlds, bodyweight exercises without equipment, and local or online competitions. The app works with any bike and elliptical with an added cadence sensor and any rowing machine.

6. **EXR, transforms the rower into an avatar in a virtual world.** Allows users to perform specific exercises, row in different virtual landscapes, and row virtually with others.

7. **Kinomap offers a real video streaming experience**, combining its rowing machine with moving landscapes while the athlete trains. It has the world's largest geolocated video sharing platform, providing a tour guide-like experience during workouts.

8. **ErgData** is a companion app for Concept2 rowing machines that **offers features such as real-time** data tracking, workout sharing, and integration with other apps like Strava.

9. **RowerUp, provides real-time form feedback and post-training rowing technique analysis.** Offers detailed stroke information such as angles, body positioning, and length, helping athletes identify and address issues.



The Next 10 Years

1 Rowers will use wearables and advanced sensors to monitor their performance in real time. These devices will collect detailed data on paddling technique, applied force, and efficiency, **providing a thorough analysis that will help optimize every aspect of the workout.**

2 **Artificial intelligence (AI) and machine learning will be integrated to provide instant and personalized feedback**, allowing for precise adjustments during training sessions.

3 **Virtual and augmented reality will be fundamental in the preparation of athletes.** Rowers will be able to train in virtual environments that simulate realistic competition conditions, improving their adaptability and tactical skills.

4 These technologies will also offer coaches advanced tools **to design more effective training programs tailored to the specific needs of each rower.**

5 In addition, competitions will benefit from enhanced broadcasts with high-definition cameras and 360-degree capture technology, **providing an immersive viewing experience for fans.**

Rugby 7

The sport of rugby dates back to the medieval era in several European countries, but it was between 1845 and 1848 when students from a school in the English town of Rugby and the University of Cambridge established the codes of modern rugby. Rugby 7s, also known as Sevens, is a dynamic and fast-paced variant of rugby union, played with seven players per team instead of the traditional fifteen. Originating in Scotland in the late 19th century, this format has gained global popularity and was included in the Olympic Games for the first time in Rio 2016.

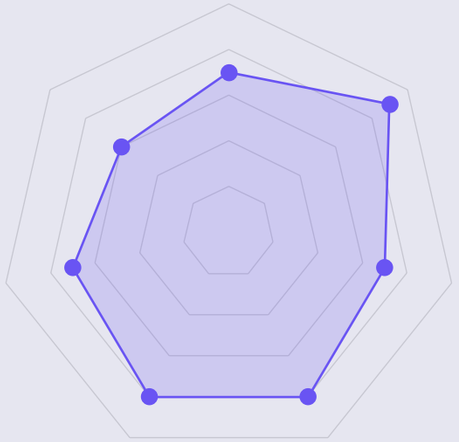
Level of Technological Implementation

Artificial Intelligence: 7

AI is widely used for data analysis and strategies, though full integration is still in development. Accessibility to these tools varies by competition level and country.

Smart Infrastructure: 6

Innovations in rugby fields and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.



Data Analysis: 9

Data analysis is deeply integrated into all aspects of performance and tactics in Rugby 7s, especially at elite levels where advanced platforms are essential for training planning and execution.

Communication Platforms: 7

Training and strategy management software is well-developed and fundamental in team preparation, though full adoption still has room to grow.

Augmented Reality: 7

AR is primarily used for visualization and strategy analysis, but its adoption is limited and mainly experimental.

Sensors and Wearables: 8

Sensor technology is highly advanced and widely used in jerseys, footwear, and balls for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 8

VR is used in specific training scenarios, with studies showing rugby as one of the sports with the highest adoption of this technology.

1. AI & Data

- **Performance and Strategy Analysis:** AI solutions analyze players' movements and strategies in real-time, providing instant feedback to coaches and suggesting tactical adjustments to optimize team performance.
- **Injury Prediction:** AI algorithms analyze movement patterns and training loads to predict and prevent potential injuries, helping players maintain safe and efficient training.
- **Training Planning:** Generative AI and machine learning applications offer personalized training and nutrition plans based on the individual needs and characteristics of each player.

2. AR & VR

- **Virtual Reality Training:** Devices simulate competition scenarios and specific plays so players can practice kicks, footwork, rucks, or scrums in specific competition situations.
- **Strategy Analysis with AR:** Applications integrated into VR glasses or headsets overlay data and tactical diagrams on images, either live or in playback, helping coaches analyze and adjust team strategies more precisely.

3. Sensors and Wearable Devices

- **Smart Clothing:** Jerseys and footwear with sensors monitor posture, workload, and force distribution in real-time during play, providing detailed data to improve technique and prevent injuries.
- **Smart Balls:** Balls equipped with sensors measure speed, rotation, and trajectory, offering valuable information for performance analysis and technique improvement.

4. Platforms and Software

- **Training Management Software:** Platforms for planning and monitoring training sessions, managing workloads, and analyzing players' progress to optimize preparation for competitions.
- **Live Strategy Applications:** Digital solutions allow coaches to adjust strategies and game plans in real-time based on data obtained during training sessions and matches.

5. Infrastructure Innovations

- **Rugby Fields with Integrated Sensors:** Fields equipped with pressure sensors collect data on force distribution and movement during matches, providing critical information for technical and strategic analysis.
- **Dynamic Software-Controlled Lighting:** IoT-based lighting systems adjust automatically during matches to improve visibility and player concentration while reducing energy consumption.

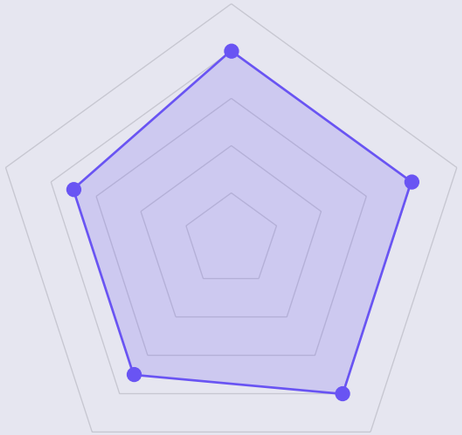
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor players' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 8

Mobile applications and connected devices to data analysis platforms are commonly used to evaluate and optimize performance, providing accurate and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 8

Immersive experiences and AR/VR applications are available but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Santiago Álvarez | 2024

Current Use Cases

1. **Catapult a rugby software that uses sensors in jerseys and footwear to analyze players' movements in real-time** and monitor strategy through AI algorithms.

2. **Hexoskin Smart Jerseys equipped with sensors** that monitor players' physical activity in real-time, providing detailed data to help coaches and athletes improve performance.

3. **Gilbert Smart Balls equipped with sensors** that monitor speed, rotation, and trajectory, providing detailed data to help players improve their technique and accuracy.

4. TeamBuildr is a platform used by Rugby 7s teams **for training planning and monitoring**.

5. French Rugby Federation, **developed an AI platform that automatically updates every performance parameter of its players**, providing the coaching staff with comprehensive real-time reports supported by video and customized dashboards.

6. University of Rennes Research, found that players behave similarly when wearing VR glasses as they do in real-world competitions, a concept known as "behavioral realism." According to this study, football, baseball, **handball, and rugby are the sports where VR is most used currently.**

The Next 10 Years

1. **AI and Machine Learning applications will increasingly be used for training planning**, analysis, and real-time game strategy adjustments.

2. **Augmented and Virtual Reality will continue to be integrated as fundamental tools for enriching training through immersive simulations** and post-game analysis.

3. **Connected Sensors and IoT Devices integration will continue to be a trend in rugby infrastructure innovation**, improving operational efficiency of facilities as well as player and spectator experience.

Diving

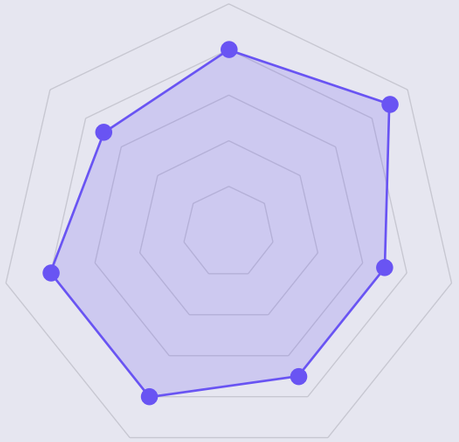
Diving, as a sport, refers to a discipline where athletes jump from platforms or springboards at various heights, performing acrobatics in the air before entering the water. It requires great precision, control, and aesthetics. Diving has been a discipline in the Olympic Games since the 1904 Games. Competitors are evaluated based on technical execution, the complexity of the acrobatics, and the entry into the water. This sport is noted for its spectacular nature and the high level of technical skill required.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and strategies, though full integration is still in development. Accessibility to these tools varies by competition level and country.

Smart Infrastructure: 7
Innovations in diving platforms and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of performance and technique in diving, especially at elite levels where advanced platforms are essential for training planning and execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in the preparation of divers, though full adoption still has room to grow.

Augmented Reality: 7
AR is primarily used for visualization and technique analysis, but its adoption is limited and mainly experimental.

Sensors and Wearables: 8
Sensor technology is highly advanced and widely used in swimsuits and diving platforms for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training scenarios to simulate diving situations, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Various tools and platforms use AI to analyze the movements and techniques of divers in real-time to enhance their training.
- **Prediction of Water Conditions:** AI algorithms analyze meteorological and pool data to predict water conditions.

2. AR & VR

- **Virtual Reality Training:** Using VR to simulate different diving scenarios, allowing divers to practice in a controlled environment and improve their technique.
- **Diving Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time.

3. Sensors and Wearable Devices

- **Sensors in Swimsuits and Diving Platforms:** Equipment with sensors that monitor posture, workload, and force distribution in real-time during the dive. Sensors can also be integrated into the diving platforms themselves.
- **Physiological Monitoring Devices:** Wearables that monitor heart rate, respiration, and other health indicators.

4. Platforms and Software

- **Training Management Software:** Platforms that allow planning and monitoring of diving training, managing workloads, and analyzing the progress of divers.
- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and diving plans in real-time, based on data obtained during training.

5. Infrastructure Innovations

- **Diving Platforms with Integrated Sensors:** Platforms equipped with sensors that collect data on force distribution and impact during dives.

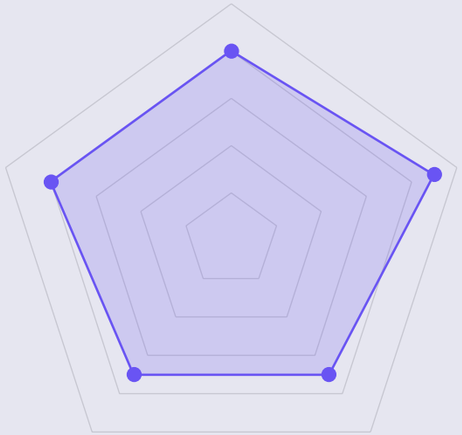
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor divers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity in diving focuses on protecting athletes' personal and performance data, as well as ensuring the integrity of scoring and competition management systems. Advanced encryption and Blockchain technologies are used to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9

Tools and data analysis platforms are integrated to evaluate and optimize performance in diving, providing accurate and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are in development to interact with fans, but the implementation of AR and VR experiences is still growing.

Audiovisual: 7

Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Wang Zongyuan | 2024

Current Use Cases

1. **Dartfish uses cameras and software to analyze divers' movements in real-time**, providing instant feedback on technique and strategy, and suggesting adjustments to improve performance and prevent injuries.

2. **Pikku Lab is an advanced 3-axis motion capture and analysis system using sensors**, videos, and AI models to measure and track athletic movements such as diving. It combines data from multiple devices to analyze acceleration, angular velocity, tilt, and rotation.

3. **Microsoft Sensor Kit is an open-source platform for analyzing** and applying machine learning to athlete sensor data. It classifies diving techniques and experience levels using sensor data.

4. **BHI380 Sensor is a programmable IMU sensor integrating AI software for tracking physical activity.** It can be incorporated into wearables to automatically track dives and other exercises, providing real-time feedback and personalized training by learning the user's movement patterns.

The Next 10 Years

1 **AI and Machine Learning will be integrated into performance analysis,** providing real-time feedback on technique and dive execution. Advanced sensors and wearables will monitor movements and body position during dives, offering detailed data to allow athletes and coaches to precisely adjust and optimize their training.

2 **Virtual and Augmented Reality will revolutionize both training and competition viewing.** Divers will be able to practice in virtual environments replicating competition conditions, improving their mental and technical preparation.

3 AR for Spectators will provide real-time information on technical and scores during competitions, **making the experience more immersive and educational.**

4 **Advanced Simulation Technology will allow divers to visualize and practice complex acrobatics** in a safe environment before executing them on the platform or springboard.

Skateboarding

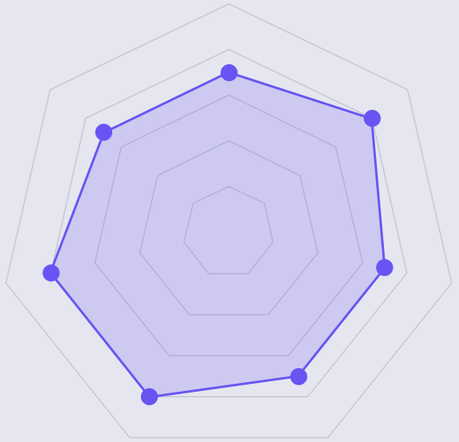
Skateboarding is an urban and culturally significant sport that focuses on the skill and creativity of skaters as they move and perform tricks on boards over urban surfaces and specially designed areas like skateparks. It developed in the United States in the 1950s when California surfers wanted something to do when the ocean waves were flat. Skateboarding made its Olympic debut at the recent Tokyo 2020 Games.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data and technique analysis, though full integration is still in development.

Smart Infrastructure: 7
Innovations in skateparks and lighting systems are being adopted but are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 8
Data analysis is deeply integrated into all aspects of skateboarding performance and technique, especially at elite levels where advanced platforms are essential for training and competition planning.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in skaters' preparation, though full adoption still has room to grow.

Augmented Reality: 7
AR is primarily used for visualization and technique analysis, but its adoption is still limited and experimental.

Sensors and Wearables: 8
Sensor technology is advancing and widely used in skateboards and other devices for performance analysis.

Virtual Reality: 7
VR is used in specific training scenarios to simulate skateboarding environments, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Digital applications that employ AI to analyze skaters' movements and techniques in real-time, based on performance data and metrics recorded by wearable devices and connected sensors.

- **Risk Prediction and Competition Planning:** AI algorithms that help skaters analyze movement patterns and terrain conditions to predict and prevent possible falls or determine the most suitable technique for each situation.

- **Custom Board Design:** AI applications that create custom board models and graphic designs based on the specific requirements requested by the user. This technology is complemented by 3D printing and additive manufacturing systems that optimize the production processes of the boards.

2. AR & VR

- **Virtual Reality Training:** Training platforms equipped with VR that allow simulating different skateboarding scenarios and practicing specific movements or techniques in controlled spaces.

- **Trick Analysis with Augmented Reality:** Applications that overlay data and diagrams on training or competition videos in real-time, helping skaters' technical teams analyze performance and perfect execution.

3. Sensors and Wearable Devices

- **Smart Skateboards:** Equipped with motion sensors, these boards record metrics in real-time and send the information to mobile applications and training platforms where all the data can be analyzed in detail.

- **Physiological Monitoring Devices:** Wearable clothing and devices that monitor important metrics such as heart rate and speed, helping skaters optimize their training and recovery.

4. Platforms and Software

- **Training Management Software:** Planning and monitoring platforms where goals can be set, calendars created, progress analyzed, and training routines optimized.

5. Innovations in Infrastructure

- **Smart Skateparks:** Facilities equipped with sensors that collect numerous data points related to speed, force distribution, and movement during skate sessions, providing critical information for technical and strategic analysis or judges' evaluations.

- **Automated Energy Management:** Lighting and climate control systems that automatically adjust during competitions to maintain suitable conditions for skateboarding while managing energy consumption.

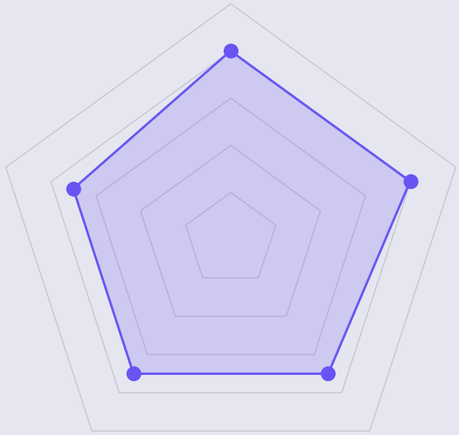
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor skaters' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 8

Mobile applications connected to data analysis platforms are integrated to evaluate and optimize skateboarding performance, providing accurate and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Nyjah Huston | 2022

Current Use Cases

1. **Smart Electric Skateboards** such as Spectra Pro or XTND, feature innovative 3D posture control systems, giving the skater greater control and stability while riding. The automatic system adjusts speed, braking, and other settings without needing to lean or change riding posture. Though their use has limitations in professional sports, they showcase how smart technology is entering the skateboarding world and the possibilities it offers.
2. **ūti Arquitectos Design Studio has used the Midjourney tool to publish designs of possible futuristic skateparks** integrated into the urban landscape of Paris.
3. **VR Skater**, one of the latest virtual reality applications in the world of immersive skateboarding experiences. **It realistically simulates multiple skate scenarios as a game, representing an advance in the e-games space.**

The Next 10 Years

1. **AI Utilization will become a common technology for competition preparation**, risk scenario analysis, and selecting the best techniques for each situation.
2. VR and AR will continue to develop, **bringing significant changes in how competitions and training are experienced from both the skater's and the spectator's perspectives.**
3. **Infrastructure** investments will continue to improve professional competition infrastructures, with significant advancements in **IoT sensor networks and energy control through smart home systems.**

Surfing

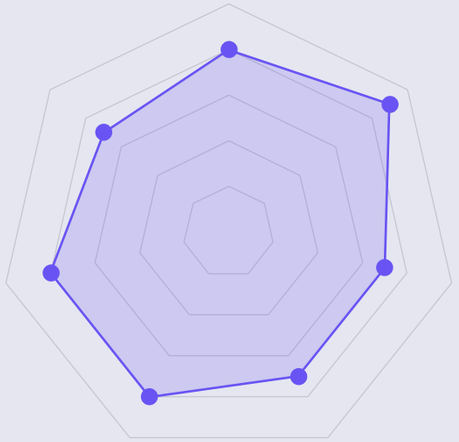
Surfing is a water sport that involves riding waves using a specialized board known as a surfboard. Originating in the Polynesian islands and popularized in Western culture in the 20th century, surfing has evolved into both a recreational and competitive activity practiced on beaches worldwide. Besides being a physically demanding sport that requires strength, balance, and athletic skills, it is also valued for its connection to nature and its ability to provide moments of pure adrenaline and freedom in the ocean.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for comparative data analysis and ocean condition prediction, though full integration is still in development.

Smart Infrastructure: 7
Innovations in computer vision and surveillance systems are in development, but not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of surfing performance and technique, especially at elite levels where advanced platforms are essential for training and competition planning.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in surfers' preparation, though there is still room for growth.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is still limited and experimental.

Sensors and Wearables: 8
Sensor technology is very advanced and widely used in surfboards and other devices for performance analysis.

Virtual Reality: 7
VR is used in specific training scenarios to simulate surfing conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** AI tools integrated into programs or mobile applications automatically analyze surfers' movements and techniques, providing recommendations on execution and technique improvements.
- **Ocean Condition Prediction:** AI algorithms analyze meteorological and ocean data to predict the conditions surfers will face, helping them plan the best strategies and be prepared for various situations.
- **Smart Manufacturing:** AI applications create surfboard designs based on individual surfer or team preferences and manufacture them on-demand using 3D printing systems.

2. AR & VR

- **Virtual Reality Training:** Platforms with integrated VR devices simulate different surfing conditions and scenarios, allowing surfers to improve their technique in controlled environments.
- **Maneuver Analysis with AR:** Applications overlay data and diagrams on training and competition videos in real-time, helping coaches and surfers analyze and correct technique with greater precision.

3. Sensors and Wearable Devices

- **Smart Surfboards:** Equipped with sensors that monitor posture, workload, force distribution, and balance in real-time during maneuvers, providing valuable information for post-performance analysis and technique improvement.
- **Physiological Monitoring Devices:** Smart swimsuits and wearable devices monitor heart rate, respiration, body temperature, and other health indicators, helping surfers optimize their training and recovery.
- **Artificial Waves:** Structures designed to generate and reproduce surfable waves in locations where natural conditions do not permit, incorporating smart sensors to measure and control conditions like height, speed, and water temperature.

4. Platforms and Software

- **Training Management Software:** Online platforms that share technical and performance data to monitor training progress and determine the necessary workloads for each surfer.

5. Infraestructura Inteligente

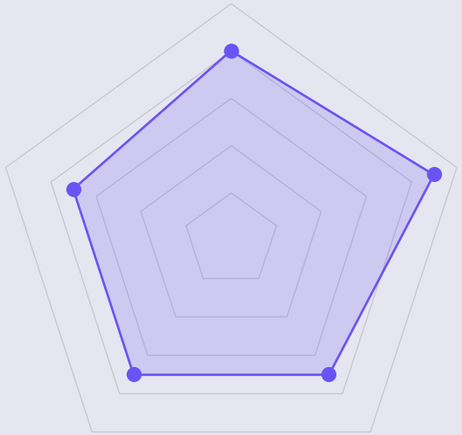
- **Smart Surveillance Systems:** Consisting of underwater cameras and drones equipped with computer vision, these systems interpret real-time images and send automatic alerts when a potential risk situation requires emergency intervention to protect surfer safety.

- **Computer Vision for Image Transmission:** Smart cameras installed on surfboards or drones record maneuvers from impossible angles and generate automatic highlights of the most spectacular moments, enhancing viewer experience and providing useful materials for technique analysis.

Use of Technologies by Category

E-Health: 8
Wearable devices and mobile applications help monitor surfers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7
Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9
Digital tools and mobile applications, along with data analysis platforms, are integrated to evaluate and optimize surfing performance, providing accurate and reliable data for decision-making.

Fan Engagement: 7
Mobile applications and social media platforms are well-developed for interacting with fans, though the implementation of AR and VR experiences is still emerging.

Audiovisual: 7
Immersive experiences and AR/VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

John John Florence | 2013

Current Use Cases

1. **TRACE is a surfing data monitoring program** that collects information recorded by connected sensors on surfboards, allowing surfers to evaluate and analyze all performance metrics of each session.

2. **Surfcoach Manager is an online work platform designed specifically for high-performance surf instructors or coaches**, including various tools to collect physical, technical, tactical, psychological, and competition data in surfing.

3. Artificial Wave Installations, facilities like Kelly Slater's Surf Ranch in the United States are equipped with **sensors that collect data** on the force distribution and movement of waves, allowing control of their operation and data collection for surfers.

4. **Samsung Galaxy Surfboard is a new connected surfboard** that allows data to be sent in real-time to coaches or a community of fans, providing other useful information like weather forecasts or wind direction.

5. **Red Bull and PPS Collaboration, creating a solution for surfers using touch detection technology**, providing a deep analysis of the pressure used on the board during specific movements.

6. **Westpac Little Ripper Lifesaver is a safety drone for surfers built by the University of Technology Sydney**, including a communication system that allows rescue teams to react quickly and effectively, even detecting sharks in real-time.

The Next 10 Years

1 **Advanced AI will continue to be incorporated into digital training management and data analysis platforms**, allowing surfers and their trainers to obtain comprehensive ocean condition forecasts and design personalized training plans based on previous performance patterns and metrics.

2 **AI-Driven Customization will facilitate the personalization** of surfboard designs and aesthetics and enable efficient on-demand production through 3D printing technologies.

3 **VR and AR will play a crucial role**, allowing surfers to train and simulate increasingly specific conditions from any location, even on dry land, refining their technique with much greater precision.

4 **Computer Vision and Safety Drones will experience significant advances**, becoming fundamental allies for the safe organization of open sea events and enhancing the spectator experience.

5 **Artificial Wave Technology will see significant improvements**, including more advanced systems that create more realistic, consistent, and adjustable waves, better r**eplicating ocean conditions** and perfecting data collection and analytics through sensors.

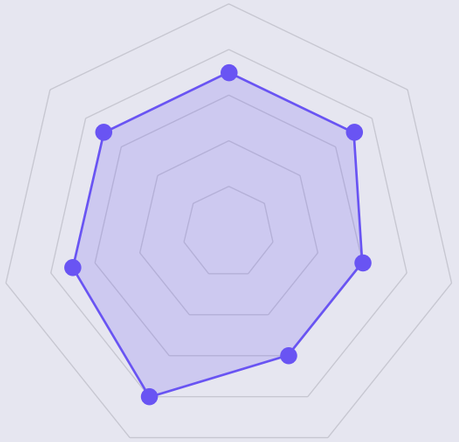
Taekwondo

Taekwondo is a Korean martial art that combines combat techniques with kicks and punches, known for its spectacular high kicks. Taekwondo was introduced as an official Olympic sport at the Sydney 2000 Games. Competitors compete in different weight categories and are evaluated based on the precision and effectiveness of their attack and defense techniques, as well as their ability to accumulate points through valid strikes to the opponent's body and head.

Level of Technological Implementation

Artificial Intelligence: 7
AI is widely used for data and technique analysis, though full integration is still in development. Access to these tools varies by competition levels and countries.

Smart Infrastructure: 7
Innovations in dojos and lighting systems are being adopted, but are not yet universal. Investment in smart infrastructure is ongoing, especially at high-level competitions.



Data Analysis: 7
Data analysis is integrated into all aspects of taekwondo performance and technique, especially at elite levels, where advanced platforms are essential for training and competition planning.

Communication Platforms: 7
Training and strategy management software is well-developed and fundamental in preparing taekwondo athletes, though there is still room for growth.

Augmented Reality: 6
AR is mainly used for visualization and technique analysis, but its adoption is limited and mainly experimental.

Sensors and Wearables: 8
Sensor technology is advanced and widely used in protectors and training mats for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 6
VR is used in specific training scenarios to simulate combat conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Various tools use AI to analyze athletes' movements and techniques during their training.
- **Injury Prediction:** AI algorithms analyze movement patterns and training loads to predict and prevent possible injuries.

2. AR & VR

- **Virtual Reality Training:** Use of VR to simulate different combat and training scenarios, allowing taekwondo athletes to practice in a controlled environment.
- **Technique Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, helping coaches analyze and correct technique.

3. Sensors and Wearable Devices

- **Smart Protectors and Clothing:** Equipment with sensors that monitor posture, force, and impact of strikes in real-time during combat.
- **Smart Training Mats:** Training surfaces equipped with sensors that measure force and weight distribution.

4. Platforms and Software

- **Training Management Software:** Various platforms allow planning and monitoring taekwondo training sessions, managing workloads, and analyzing athletes' progress.
- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and combat plans in real-time based on data obtained during training sessions and competitions.

5. Infrastructure Innovations

- **Dojo with Integrated Sensors:** Facilities equipped with pressure sensors that collect data on force distribution and movement during combats.

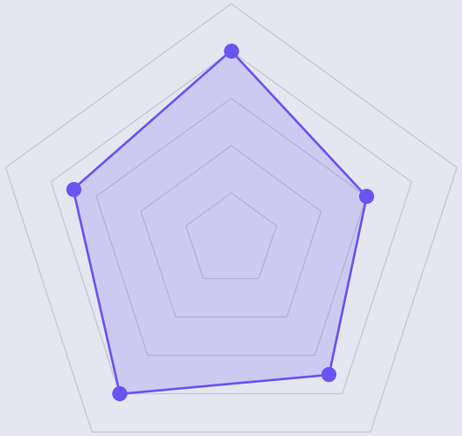
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor taekwondo athletes' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress and may take several years to fully materialize.



Performance: 6

Various tools, along with data analysis platforms, are integrated to evaluate and optimize performance in taekwondo, providing precise and reliable data for decision-making. However, they are still in development for this specific use case.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Simone Alessio | 2022

Current Use Cases

1. Researchers at Sejong University in South Korea have developed a system that includes the use of **advanced sensors and AI algorithms** to analyze taekwondo athletes' performance. Sensors are integrated into suits and protectors, capturing data that provides instant and detailed feedback on training and postures.

2. **Daedo Smart Protectors**, including vests, helmets, and socks, are equipped with sensors that monitor posture, force distribution, and technique of athletes practicing the sport. These protectors are widely used by professional taekwondo athletes.

3. An article published in the International Journal of Computer Science in Sport highlighted the potential benefits of immersive technologies in taekwondo training. Studies have shown that **VR and AR can significantly enhance athletes' cognitive and perceptual abilities**, leading to better performance in real-world competitions.

The Next 10 Years

1. **Advanced Sensors in suits and protectors** will measure the force and precision of strikes, helping coaches and athletes optimize performance. These suits will also incorporate AI to predict movements in the sport.

2. **Virtual and Augmented Reality** will revolutionize training, allowing athletes to practice in simulated environments that replicate realistic combat conditions. AR will also be used in competitions to provide real-time information to spectators about scores and techniques used.

3. **Wearable Devices will collect data** on heart rate, stress levels, and other performance indicators, providing insights for tailored training programs and improving overall athletic performance.

Tennis

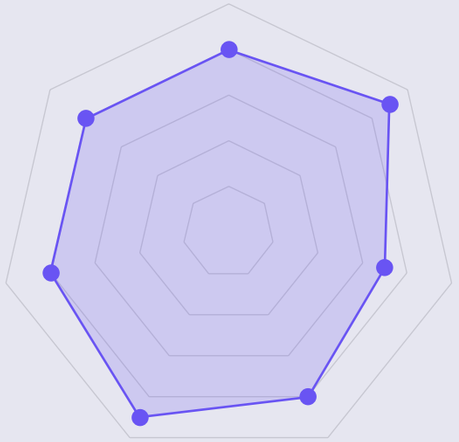
Modern tennis developed in 19th century England and was first included in the Olympic Games in 1896 during the inaugural Modern Games in Athens. After a hiatus, it was reestablished as an official sport in Seoul 1988 and has since been an integral part of the Olympics. Tennis is a racquet sport that combines physical skills such as speed, endurance, and coordination with tactical strategies, making it a highly complete and globally popular discipline.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though its full integration is still in development.

Smart Infrastructure: 8
Innovations in tennis courts and lighting systems are being adopted, though adoption is not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of tennis performance and technique, especially at elite levels, where advanced platforms are essential for training and match planning.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in preparing tennis players, though there is still room for full adoption.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its capabilities still have room f or development in tennis.

Sensors and Wearables: 9
Sensor technology is very advanced and widely used in racquets and other devices for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 8
VR is used in specific training scenarios to simulate match conditions, improving decision-making and player technique, though there is still room for improvement.

1. AI & Data

- **Technique and Performance Analysis:** Solutions that employ AI algorithms to analyze players' movements and techniques in real-time and monitor performance indicators during matches. This helps players and coaches better understand their strengths and weaknesses and adapt strategies more precisely.

- **Result Prediction:** AI algorithms that analyze data from previous matches, physical parameters, and other factors to predict player performance and potential outcomes.

2. AR & VR

- **Virtual Reality Training:** Using VR devices to simulate different match scenarios, creating immersive experiences that allow players to improve their technique in controlled environments.

- **Game Analysis with AR:** Applications that overlay real-time graphics and statistics on match footage, providing information on shot speeds, ball trajectories, and player positioning.

3. Sensors and Wearable Devices

- **Smart Racquets:** Equipped with sensors that record and transmit real-time data on stroke position and force distribution, providing details to better analyze plays and improve technique.

- **Physiological Monitoring Devices:** Clothing and wearables that monitor heart rate, respiration, and other health indicators, helping tennis players optimize their training and recovery.

4. Platforms and Software

- **Training Management Software:** Digital platforms designed specifically to help tennis players and coaches plan and monitor training sessions. They incorporate data analysis systems and performance metrics.

- **Live Strategy Applications:** Tools that allow coaches to adjust strategies and game plans in real-time based on data obtained during training sessions and matches.

5. Infrastructure Innovations

- **Tennis Courts with Integrated Sensors:** Facilities equipped with contact and motion sensors that collect real-time data during matches, providing critical information for technique and strategy analysis, as well as for judges' evaluations.

- **Computer Vision Platforms:** Smart camera systems that connect with data platforms and monitor gameplay, associating data on speed, distance covered, ball positions, and strokes with metrics like accuracy/error percentages, physical activity, and various statistics.

- **Software-Controlled Dynamic Lighting:** Lighting systems that automatically adjust during matches for better visibility and efficient energy management.

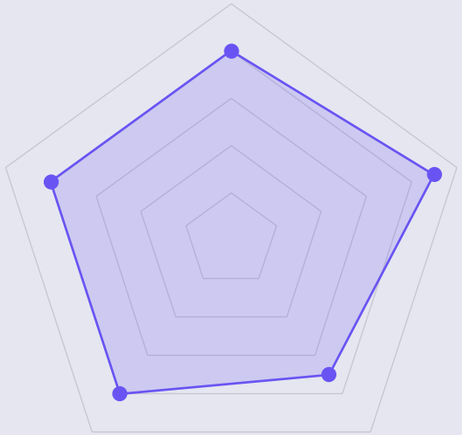
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor tennis players' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9

Mobile applications connected to data analysis platforms are integrated to evaluate and optimize tennis performance, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, though their use is still limited to specialized contexts.

Carlos Alcaraz | 2024

Current Use Cases

1. **Hawk-Eye is a visual tracking system that uses high-speed cameras and advanced software to review ball trajectories** and precisely determine if a ball has landed inside or outside the court boundaries. It is widely used in tennis to help referees make controversial calls and allow players to challenge line calls.

2. **Babolat Play Smart Racquets incorporate imperceptible sensors in the handle that collect data during training or matches.** This data can be viewed through a mobile app, offering statistics on shot power, spin, speed, force, etc.

3. **Tennis Analytics, one of the most popular digital tools in tennis training management.** This platform provides reports and match videos for players and coaches with a data-driven approach that helps tennis players monitor progress and optimize results.

4. **IBM Power Index is an AI-based index developed by IBM to enhance the fan experience** at one of the world's oldest tennis tournaments, Wimbledon. The Power Index uses generative AI models created with Watsonx (IBM's AI) to analyze player performance match by match and predict outcomes, combining advanced statistical analysis of match data with sentiment analysis from media commentary to identify players with the highest potential.

5. **Thread Matrix is a system developed by Signify Group that uses an AI algorithm to detect patterns of inappropriate behavior on social media** and alert human moderators to take actions such as blocking users or removing hateful content. This system has been implemented at Wimbledon to protect its tennis players from online harassment.

The Next 10 Years

1 Artificial Intelligence is poised to revolutionize tennis through advanced performance **analysis and game strategy.** Using machine learning algorithms, AI systems can analyze vast amounts of match data, identifying patterns and trends that help players and coaches develop more effective tactics and predict outcomes.

2 **Analysis AI allows detailed analysis of opponents**, giving players a competitive edge when preparing for matches. It can also assist in real-time decision-making during play, suggesting tactical adjustments based on ongoing performance.

3 VR and AR will continue to transform training and viewing experiences. **Simulated matches and training in controlled environments** will continue to set trends, and AR applications will enhance both coaches' and spectators' experiences, providing a richer, more detailed view of the game.

4 **Computer Vision will improve, allowing key plays to be recreated automatically,** enabling coaches and players to review and analyze each point with millimeter precision.

5 **IoT sensors in tennis infrastructure and connected** devices will continue to enhance player performance and facility management.

Table Tennis

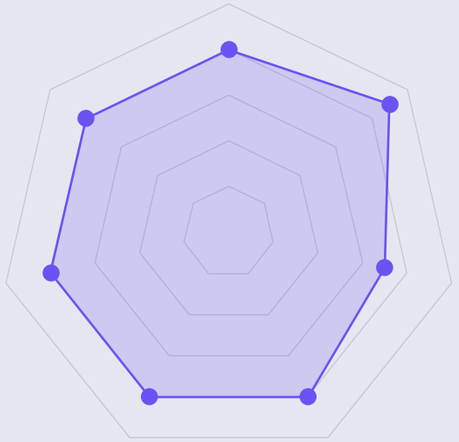
Also known as ping-pong, table tennis is a racquet sport that began as an after-dinner entertainment among English upper-class families, using any objects they could find as equipment. It requires a combination of technique, skill, and speed. Over time, it evolved, and in 1926 competitions were organized in Berlin and London, leading to the first World Championships held in London that same year. Extremely popular in Asia, it was incorporated into the Olympic Games in Seoul 1988.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still in development. Accessibility to these tools varies across competition levels and countries.

Smart Infrastructure: 8
Innovations in table tennis tables and lighting systems are being adopted, though they are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of performance and technique in table tennis, especially at elite levels, where advanced platforms are essential for training and match execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in preparing players, though there is still room for full adoption.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is limited and mainly experimental.

Sensors and Wearables: 8
Sensor technology is very advanced and widely used in paddles and other devices for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 8
VR is used in specific training scenarios to simulate match conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Real-time Video Analysis:** AI tools that automatically analyze images in real-time or playback, interpreting players' techniques and classifying the best plays or providing recommendations to improve performance. These tools offer detailed data on the speed, angle, and spin of shots, as well as on movement patterns and strategies employed.

- **Result Prediction:** AI algorithms that analyze past match data, performance metrics, and other factors to predict potential outcomes for players.

2. AR & VR

- **Virtual Reality Training:** VR platforms that simulate match scenarios, allowing players to practice in controlled environments and improve their technique by playing against remote opponents.

- **Game Analysis with AR:** Applications that overlay data and diagrams on match videos in real-time, helping coaches analyze and correct their players' techniques with greater precision.

3. Sensors and Wearable Devices

- **Smart Paddles:** Equipped with contact and motion sensors that record detailed data on the force and technique of strokes, allowing for real-time or post-game analysis.

- **Physiological Monitoring Devices:** Clothing and wearables that monitor heart rate, respiration, and other health indicators, helping players optimize their training and recovery.

4. Platforms and Software

- **Training Management Software:** Specialized platforms that allow for planning and monitoring table tennis training sessions, analyzing players' progress, and optimizing training programs.

- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and game plans in real-time, based on data obtained during training sessions and matches.

5. Infrastructure Innovations

- **Tables with Integrated Sensors:** Facilities equipped with pressure and motion sensors that collect data during matches, providing critical information for technique and strategy analysis.

- **Computer Vision Systems for Referees:** Cameras equipped with AI that help referees determine points with total precision, minimizing the risk of human error.

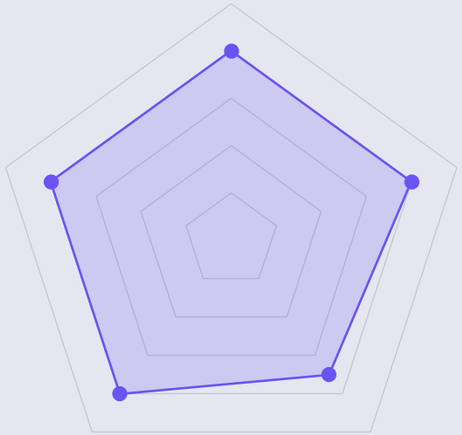
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor players' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 8

Mobile applications connected with data analysis platforms are integrated to evaluate and optimize performance in table tennis, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Fan Zhendong | 2015

Current Use Cases

1. **Stupa Analytics is an application that uses cameras and AI software to analyze players' movements in real-time**, used in table tennis to enhance training and prepare for competitions.

2. **Choreiking Smart Paddles, incorporate IoT speed sensors** that allow analysis of swing speed, direction, and angle during a stroke.

3. **Table Tennis Edge is a digital mental training platform used in table tennis to refine technique**, improve ball returns, understand spins, and anticipate shot directions faster. It uses the analysis of body signals from top Olympic players.

4. **Betterplay.ai is a web application specializing in video analysis for table tennis.** Used by players, coaches, and fans to upload complete match and training videos and receive summarized and highlighted versions.

The Next 10 Years

1 **AI and Machine Learning Systems will integrate more deeply into training**, providing real-time detailed analyses of player performance. These systems will collect data on shot speed and angle and offer personalized recommendations to improve technique and strategy.

2 **Virtual Simulations coaches will have access to more precise virtual simulations** to design practice sessions dynamically adapted to each player's progress and needs.

3 High-Speed Camera Systems and Integrated Sensors in tables and balls **will enable precise detection of contact points**, eliminating disputes and human errors in decisions. The implementation of AR technology will provide referees and line judges with real-time information on plays, facilitating faster and more accurate decisions.

Shooting

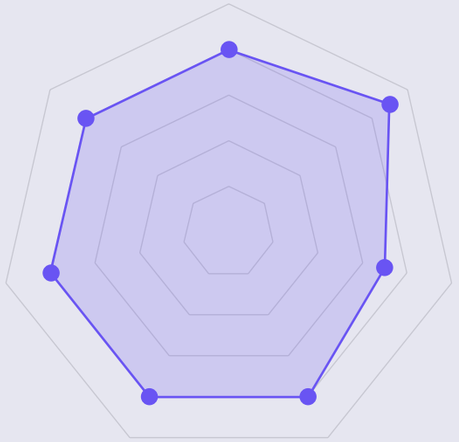
Shooting as a sport involves the use of firearms or air guns to shoot at static or moving targets with precision. It includes various disciplines such as target shooting, skeet, and trap shooting. In the Olympic Games, shooting has been part of the program since the first modern Games in 1896. Olympic shooting events are divided into three main categories: rifle, pistol, and shotgun, and are evaluated based on precision, speed, and consistency of shots.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still in development. Accessibility varies by competition level and country.

Smart Infrastructure: 8
Innovations in shooting ranges and lighting systems are being adopted, though they are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of shooting performance and technique, especially at elite levels, where advanced platforms are essential for training and competition execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in shooter preparation, though there is still room for full adoption.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is limited and mainly experimental.

Sensors and Wearables: 8
Sensor technology is very advanced and widely used in guns and other devices for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 8
VR is used in specific training scenarios to simulate shooting conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Some tools use AI to analyze shooters' movements and techniques in real-time.
- **Result Prediction:** AI algorithms analyze training sessions and competition data, environmental conditions, and other factors to predict shooters' performance and potential outcomes.

2. AR & VR

- **Virtual Reality Training:** VR is used to simulate different shooting scenarios, allowing shooters to practice in a controlled environment.
- **Shot Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, helping shooters analyze and improve their technique.

3. Sensors and Wearable Devices

- **Smart Guns:** Equipped with sensors that monitor posture, workload, and shot accuracy in real-time, providing detailed data to improve technique and prevent errors.

4. Platforms and Software

- **Training Management Software:** Various platforms allow for planning and monitoring shooting training and analyzing shooters' progress.
- **Live Strategy Applications:** Tools that enable coaches to adjust shooting strategies and plans in real-time.

5. Infrastructure Innovations

- **Shooting Ranges with Integrated Sensors:** Facilities equipped with sensors that collect data on accuracy and movement during shots, providing critical information for technique and strategy analysis.

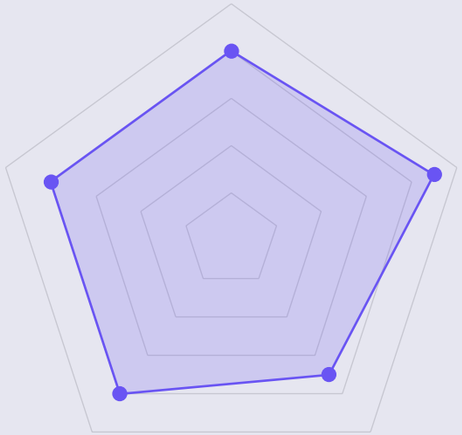
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor shooters' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity in shooting sports focuses on protecting athletes' personal data and the integrity of systems used for managing competitions and training, though full implementation and universal adoption are still in progress.



Performance: 9

Various tools, along with data analysis platforms, are integrated to evaluate and optimize shooting performance, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Jedrzejewski Camille | 2023

Current Use Cases

1. **SCATT is a training system for precision shooting sports** that uses high-precision optical sensors mounted on guns to record all barrel movements while aiming at the target. The technology provides real-time visual feedback on the sighting path and shot, allowing shooters to analyze and improve their technique. SCATT is compatible with mobile and desktop devices, facilitating training anywhere without the need for live ammunition.

2. MantisX is a training system for shooting that uses **advanced sensors to analyze gun movement and provide real-time feedback**. It attaches to pistols, rifles, or shotguns and collects precise data on shooting technique, identifying areas for improvement. The technology includes mobile applications that visualize data and offer personalized recommendations to optimize shooter performance.

3. **Virtual-Shot a mobile virtual shooting simulation system** that turns a phone into a portable shooting simulator. It uses the phone's sensors and microphone to detect dry fire from real guns, airsoft guns, and paintball guns.

4. **Thales is a company that has launched an AI-based tactical training and simulation solution that records events and parameters** such as shots, weapon data, videos, and positions during training sessions. Using AI algorithms, it generates indicators, dashboards, and real-time reports to provide objective data collection and behavior analysis for instructors and trainees.

5. **Ace is a shooting experience that combines a realistic mobile device with virtual reality.** It allows users to practice their shooting skills without the costs and limitations of a physical shooting range. Ace offers a variety of scenarios, mini-games, and multiplayer modes to enhance visual processing, transitions, and overall shooting performance.

6. **GAIM is a virtual shooting training platform that uses realistic training guns**, precise ballistics, and fully immersive software scenarios to improve muscle memory, speed, and accuracy. It offers pistol, hunting, and clay shooting simulators that can be used anywhere and anytime. GAIM works with Meta Quest VR headsets and includes a wooden rifle accessory.

7. Additionally, GAIM is developing a **Bluetooth dry fire** magazine that connects to the VR controller, allowing users to practice with their own pistol. They are also creating trigger packs for AR-15 rifles that work similarly.

The Next 10 Years

1 **Movement Analysis and Advanced Sensors will integrate even more deeply into training, providing real-time data on each shot.** These systems will use AI to analyze shooters' techniques, identify areas for improvement, and offer instant, personalized feedback.

2 Virtual and Augmented Reality will become essential tools for training. Shooters will be able to practice in **virtual environments that simulate realistic competition conditions,** from various shooting scenarios to different weather conditions.

3 **Biometric Monitoring Technology** will allow constant tracking of shooters' health and physical condition.

4 **Enhanced Cybersecurity Measures will be implemented to protect shooters' sensitive data** and the integrity of scoring and competition management systems**.**

5 **Improved Competition Broadcasts** using high-definition cameras and capture technology will offer spectators an immersive viewing experience.

Archery

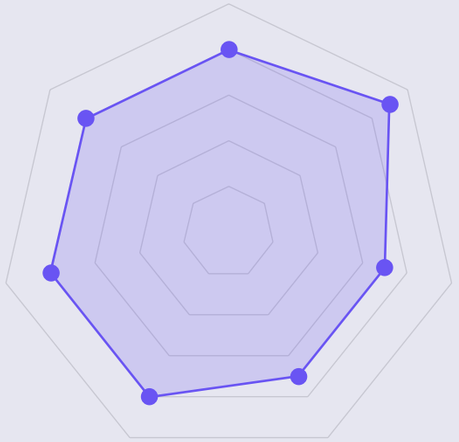
Archery is a sport where participants use a bow to shoot arrows at a fixed target from a specified distance. Precision and consistency in hitting the center of the target are essential for high scores. This sport combines physical skills such as strength and coordination with concentration and mental control. In the Olympic Games, archery has been a discipline since 1900, with individual and team competitions for both men and women. Archers compete at different distances and in various modalities, showcasing their technique and precision.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though full integration is still in development. Accessibility varies by competition level and country.

Smart Infrastructure: 8
Innovations in archery fields and lighting systems are being adopted, though they are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of archery performance and technique, especially at elite levels, where advanced platforms are essential for training and competition execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in archers' preparation, though there is still room for full adoption.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is limited and mainly experimental.

Sensors and Wearables: 8
Sensor technology is very advanced and widely used in bows and other devices for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training scenarios to simulate shooting conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Various applications use AI to analyze archers' movements and techniques in real-time.
- **Result Prediction:** AI algorithms analyze training and competition data, environmental conditions, and other factors to predict archers' performance and potential results.

2. AR & VR

- **Virtual Reality Training:** Use of VR to simulate different shooting conditions and competition scenarios, allowing archers to practice in a controlled environment.
- **Technique Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time, helping coaches analyze and correct athletes' techniques.

3. Sensors and Wearable Devices

- **Smart Bows:** Equipped with sensors that monitor posture, workload, and shot accuracy in real-time.
- **Physiological Monitoring Devices:** Clothing and wearable devices that monitor heart rate, breathing, and other health indicators.

4. Platforms and Software

- **Training Management Software:** Various platforms allow for planning and monitoring archery training, managing workloads, and analyzing archers' progress.
- **Live Strategy Applications:** Tools that enable coaches to adjust shooting strategies and plans in real-time.

5. Infrastructure Innovations

- **Archery Fields with Integrated Sensors:** Facilities equipped with sensors that collect data on accuracy and movement during shots. .

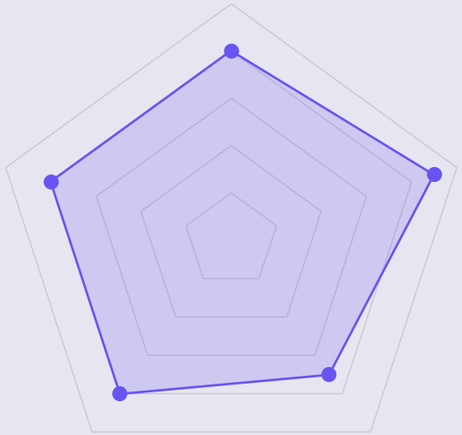
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor archers' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9

Tools like Archery Analytics and Kinovea, along with data analysis platforms, are integrated to evaluate and optimize archery performance, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Marcus D'Almeida | 2024

Current Use Cases

1. **Archery Analytics' RyngDyng, an advanced tool for measuring arrow positions and automatic scoring in archery competitions.** It uses high-precision technology like cameras and sensors to document and analyze archers' performance, facilitating technical improvements and providing real-time data during tournaments. This technology is standard in international competitions organized by the World Archery Federation, enhancing the experience for both athletes and spectators.

2. Archery Pro by SideQuest provides **highly realistic virtual reality archery simulations.** Users can practice target shooting, compete in archery competitions, and develop their archery skills in a fully immersive VR environment.

3. **Meta Store's Archery, offers virtual reality experiences focused** on archery, providing a virtual archery range to practice aiming and develop skills.

4. **MantisX X8**, a smart sensor used as a warm-up tool that attaches to the bow and tracks all movements while shooting, providing insights on how to improve shots. It sends real-time data via Bluetooth to a smartphone or tablet for analysis.

5. Artemis, used by archery teams, this platform offers a video game-like archery experience through virtual reality devices. **Artemis models a physical bow that can be held and drawn like a real one, but without a physical arrow.**

6. **AI-Powered Archery Trainer by High University uses computer vision and LSTM neural networks to evaluate an archer's form and technique.** The system can detect the position of the archer's head and hand in a video and classify different types of shots with over 95% accuracy, providing real-time feedback on form without needing wearable sensors.

7. **Visual Archery, a computer vision application that can automatically score archery targets** by analyzing photographs of the target face, eliminating the need for manual scorekeeping and allowing archers to focus on training.

8. **Archery Vision uses AI to automatically detect and reproduce an archer's shots,** providing enhanced video analysis tools for independent practice.

The Next 10 Years

1 **The archers will use AI-based motion analysis systems that will provide real-time feedback** on the technique and accuracy of each shot.

2 **Advanced sensors built into the bows and arrows** will capture detailed data on speed, trajectory and impact, allowing fine-tuning of each shot to optimize performance.

3 **Virtual reality and augmented reality will transform training methods.** Archers will be able to practice in virtual environments that simulate realistic competition conditions.

4 AR will also be applied in competitions, **offering spectators an immersive experience** where they can see real-time analysis and the trajectory of the arrows.

5 **Data encryption and multi-factor authentication** will ensure that all information related to tournament performance and management is handled securely, preventing any kind of manipulation or fraud.

Triathlon

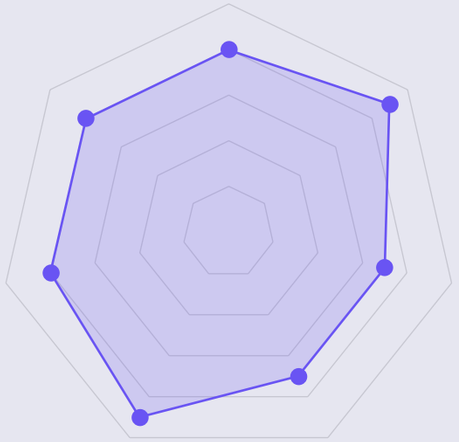
Triathlon is a multisport race that combines three disciplines: swimming, cycling, and running, performed consecutively in that order. Participants must complete a specific course in each discipline, with the total time including transitions between the different phases of the event. Triathlon was first included in the Olympic Games in Sydney 2000 and has since been a regular event in the Olympic program. The format used in the Olympic Games is the standard or Olympic distance.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, although its full integration is still under development. Accessibility to these tools varies by competition level and country.

Smart Infrastructure: 8
Innovations in pools, tracks, and smart bikes are being adopted, though they are not yet universal. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of triathlon performance and technique, especially at elite levels, where advanced platforms are essential for training and competition execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in triathletes' preparation, though there is still room for full adoption.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is limited and primarily experimental.

Sensors and Wearables: 9
Sensor technology is very advanced and widely used in wearables and clothing for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training scenarios to simulate running, swimming, and cycling conditions, improving decision-making and technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** Various tools use AI to analyze the movements and technique of triathletes, providing instant feedback and suggesting adjustments to optimize performance.
- **Performance Prediction:** AI algorithms analyze training and previous competition data, environmental conditions, and other factors to predict the performance and potential results of triathletes.

2. AR & VR

- **Virtual Reality Training:** Use of VR to simulate different conditions for running, swimming, and cycling.
- **Technique Analysis with AR:** Applications that overlay data and diagrams on training videos in real-time.

3. Sensors and Wearable Devices

- **Advanced Wearables:** Devices that monitor posture, workload, heart rate, and other performance indicators in real-time.
- **Smart Clothing:** Apparel equipped with sensors to monitor the triathlete's physiology, such as body temperature, sweat, and respiration.

4. Platforms and Software

- **Training Management Software:** Various platforms for planning and monitoring triathlon training, managing workloads, and analyzing triathletes' progress.
- **Live Strategy Applications:** Tools that allow coaches to adjust strategies and race plans in real-time.

5. Infrastructure Innovations

- **Smart Pools and Tracks:** Facilities equipped with sensors that collect data on force distribution and movement during swimming and running training.
- **Smart Bikes:** Equipped with sensors to monitor pedal efficiency, cadence, and other indicators in real-time.

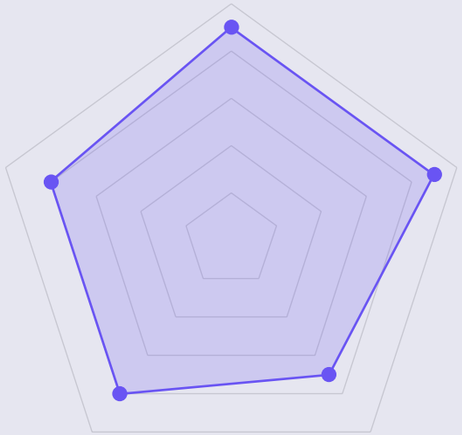
Use of Technologies by Category

E-Health: 9

Wearable devices and mobile applications help monitor triathletes' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity in triathlon is a priority, with advanced encryption and Blockchain technologies implemented to protect sensitive data and transactions. These measures ensure athletes' personal and performance information is safe from unauthorized access and tampering. However, full implementation and universal adoption of these technologies are still in progress.



Performance: 9

Tools along with data analysis platforms are integrated to evaluate and optimize performance in triathlon, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Alex Yee | 2019

Current Use Cases

1. **TrainingPeaks is an advanced platform for triathlon training** that uses technologies like data analysis, real-time monitoring, and integration with wearable devices. It offers personalized training plans, performance tracking tools, and the ability to sync data from devices like Garmin and Apple Watch. This allows athletes and coaches to optimize training programs, improve efficiency, and achieve specific goals.

2. Final Surge, another triathlon training platform **offering advanced tools for planning, tracking, and analyzing workouts.** It uses auto-sync technology with popular devices like Garmin and Strava, giving athletes and coaches detailed performance data. The platform offers training calendars, personalized plans, and effective communication between coaches and athletes, facilitating a structured and efficient approach to achieving performance goals.

3. **2PEAK is an AI-based training platform** that plans triathlon, cycling, and running sessions tailored to each athlete's data and goals. The algorithm analyzes training load and recovery, dynamically adjusting the training plan after each session.

4. Stryd is a technology for triathlon training that uses **a portable sensor attached to running shoes** that communicates with a running watch. This system measures running power in watts, providing precise data on exercise intensity in real-time. Stryd helps athletes maintain optimal pace during training and competitions, adjusting speed according to terrain and wind conditions, offering personalized training plans and detailed performance analysis.

5. Garmin offers advanced technologies for triathlon training, integrating devices like multisport watches, bike computers, and heart rate sensors. **These devices provide real-time performance data**, including speed, distance, heart rate, cadence, and power. Garmin Connect allows for planning, analyzing, and sharing workouts, offering a detailed and personalized view of an athlete's progress. Advanced features include GPS navigation, topographic maps, and personalized training plans, all designed to optimize triathlon performance.

6. **Rouvy provides an augmented reality experience** with video routes of real-world courses worldwide. It allows training in a more realistic environment than 3D simulations.

The Next 10 Years

1. **Advanced Wearables will measure biometric parameters in real-time**, providing detailed data on heart rate, oxygen levels, and heart rate variability. AI will analyze this data to offer instant, personalized feedback, optimizing training strategies.

2. **AR and VR will transform training sessions.** Athletes will practice in virtual environments simulating realistic race conditions, improving adaptability and efficiency.

3. I**nnovations in materials and design of equipment** like bikes and wetsuits will reduce water and wind resistance, increasing speed and efficiency. Advanced navigation systems integrated into multisport watches and smart swimming goggles will guide athletes throughout the course, optimizing strategy and pace management.

4. **Online Training Platforms will integrate even more with monitoring devices**, allowing coaches to adjust training plans in real-time based on athletes' current performance.

Volleyball

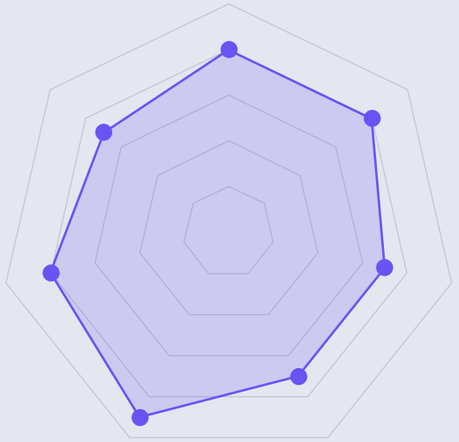
Volleyball was invented in 1895 by William G. Morgan in Holyoke, Massachusetts, as a less physically demanding alternative to basketball. Since its inclusion in the Olympic Games in 1964, it has evolved into one of the most popular and widely played team sports globally. Coordination, agility, and teamwork are essential in this sport, which also requires refined technique and good physical condition.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, although its full integration is still under development.

Smart Infrastructure: 7
Innovations in volleyball courts and lighting systems are being adopted, though not yet universally. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 8
Data analysis is deeply integrated into all aspects of volleyball performance and technique, especially at elite levels where advanced platforms are essential for training and competition execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in players' preparation, though there is still room for full adoption.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is limited and primarily experimental.

Sensors and Wearables: 9
Sensor technology is very advanced and widely used in clothing and equipment for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training scenarios to simulate match conditions, improving decision-making and player technique, though its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** AI software connected with cameras, sensors, and data platforms to analyze players' movements and techniques.
- **Strategy Planning:** Generative AI solutions analyze data on players' physical and performance parameters and those of opponents to propose personalized training plans or strategies for upcoming competitions.
- **Result Prediction:** AI algorithms analyze historical data, court conditions, and opponents' performance parameters to predict potential team outcomes.
- **Material Design:** Generative AI solutions create designs for custom sportswear and equipment based on user preferences, which can then be manufactured on-demand through 3D printing processes.

2. AR & VR

- **Virtual Reality Training:** Using VR devices to simulate match scenarios and specific plays, allowing players to study their position, strategy, and movements to be prepared and respond to those situations in real competition.
- **Game Analysis with AR:** Applications that overlay statistics on match videos in real-time, helping coaches analyze and correct players' techniques with greater precision.

3. Sensors and Wearable Devices

- **Smart Balls:** Equipped with pressure and motion sensors, they collect data that can be used to analyze details such as height, position, and speed.
- **Smart Clothing and Equipment:** Equipped with sensors that record real-time heart rate, posture, body temperature, and other physical parameters, allowing technique refinement and injury prevention.
- **Physiological Monitoring Devices:** Equipped with sensors that record bodily parameters such as heart rate, respiration, and other health indicators, enabling the monitoring of players' physical condition and health.

4. Platforms and Software

- **Training Management Software:** Specialized platforms for planning and monitoring volleyball training, managing workloads, and analyzing player progress, optimizing training programs.

- **Live Strategy Applications:** Connected platforms that allow coaches to adjust strategies and game plans in real-time, based on data obtained during training sessions and recorded during competitions.

5. Infrastructure Innovations

- **Volleyball Courts with Integrated Sensors:** Facilities equipped with sensors and IoT networks that collect data on the speed, force, and movement of balls and players during matches, providing critical information for technique analysis and strategy development.

- **Software-Controlled Lighting and Energy Management Systems:** Domotic systems based on IoT networks connected with AI programs that automatically adjust lighting or court temperature to ensure proper visibility and reduce energy consumption.

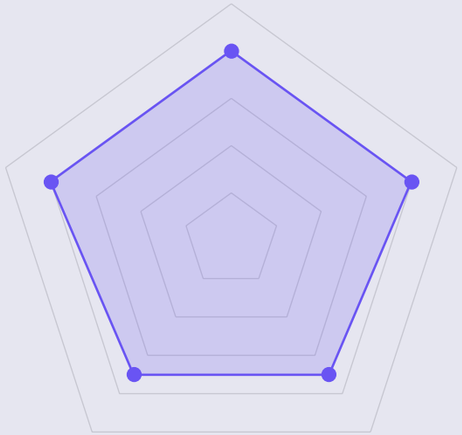
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor players' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 8

Mobile applications and data analysis platforms are integrated to evaluate and optimize volleyball performance, providing precise and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Bjelica Ana | 2022

Current Use Cases

1. **Data Volley** is a mobile application that allows importing match data for later analysis. It is used by both players and technical staff to examine and review the game from different perspectives, analyzing performance and strategy metrics in real-time.

2. **VolleyMetrics is Hudl application specializing in volleyball training management.** It provides coaches and technical staff with interactive match analysis and offers advanced data analytics tools, player recruitment, and video sharing.

3. **Highline Volleyball VR a virtual reality sports game specializing in volleyball that creates immersive experiences,** allowing both beginner and professional athletes to improve their skills from anywhere in a controlled virtual environment.

The Next 10 Years

1 The introduction of advanced technologies such as **data analytics and artificial intelligence** will enable a considerable improvement in player preparation and performance. Coaches will be able to use video analysis tools and real-time data to identify patterns, weaknesses and areas for improvement, leading to more sophisticated and customized game strategies according to each team's characteristics.

2 The **use of sensors and monitoring devices** in players' equipment will continue to be refined and will provide increasingly complex analyses with recommendations for improving their fitness and performance.

3 **Generative artificial intelligence will become a crucial tool** for training and competition preparation, as well as for predicting results and selecting players.

4 **We will continue to see advancements in virtual and augmented reality platforms**, offering new forms of remote training and allowing teams to interact with their fans through immersive experiences.

Beach Volleyball

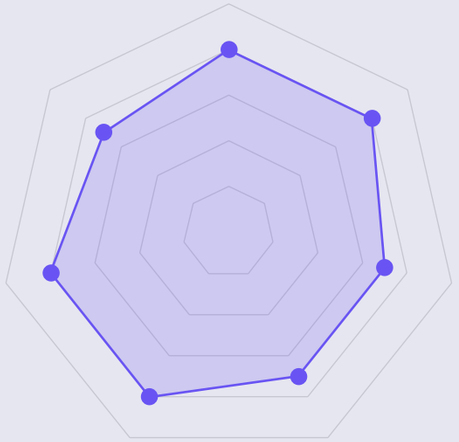
A variant of volleyball played on sand first appeared on the beaches of Santa Monica, California, in 1920, making its official Olympic debut at the Atlanta 1996 Games after being a demonstration sport at the Barcelona 1992 Olympics. This discipline requires a combination of physical and strategic skills, including jumping, speed, endurance, and specific game tactics to adapt to changing environmental conditions, such as wind and sand texture.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though its full integration is still under development.

Smart Infrastructure: 7
Innovations in beach volleyball courts and lighting systems are being adopted, though not yet universally. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 8
Data analysis is deeply integrated into all aspects of beach volleyball performance and technique, especially at elite levels where advanced platforms are essential for training and competition execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in player preparation, though there is still room for full adoption.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is still in the emerging phase.

Sensors and Wearables: 8
Sensor technology is very advanced and widely used in clothing and equipment for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training scenarios to simulate match conditions on the sand, improving decision-making and player technique, though its adoption is not universal.

1. AI & Data

- **Performance Analysis and Planning:** Using AI algorithms to analyze metrics related to players' physical condition, previous results, and other factors to plan personalized training and define strategies for upcoming competitions.

- **Result Prediction:** AI algorithms that analyze previous match data, opponent performance, environmental conditions, and other factors that may influence the final outcome.

- **Computer Vision for Player Tracking:** Cameras equipped with AI algorithms that can track player movements on the court, capturing data on their speed, agility, and positioning.

2. AR & VR

- **Virtual Reality Training:** Devices and VR applications simulate different match scenarios on the sand, providing immersive experiences for players.

- **Game Analysis with AR:** Applications that overlay data and statistics on match videos or real-time images, helping coaches analyze and correct player technique, position, or strategy with greater precision.

3. Sensors and Wearable Devices

- **Smart Balls:** Incorporating pressure and motion sensors to record useful data for match analysis and technique improvement.

- **Smart Clothing and Equipment:** Sportswear equipped with sensors and wearables that monitor physical patterns during play, such as heart rate, body temperature, and respiration.

4. Platforms and Software

- **Training Management Software:** Digital platforms that allow planning and monitoring of beach volleyball training, helping coaches schedule sessions and analyze player progress.

- **Live Strategy Applications:** Solutions that enable coaches to adjust strategies and game plans in real-time, based on data obtained during previous sessions and matches.

5. Infrastructure Innovations

- **Courts with Integrated Sensors:** IoT devices located within the facilities to collect data on ball and player movements and positions, providing useful information for referee evaluations and post-match analysis.

- **Computer Vision for Officiating Support:** Camera systems equipped with AI to help referees determine the exact position of balls and players, reducing the risk of human error in officiating.

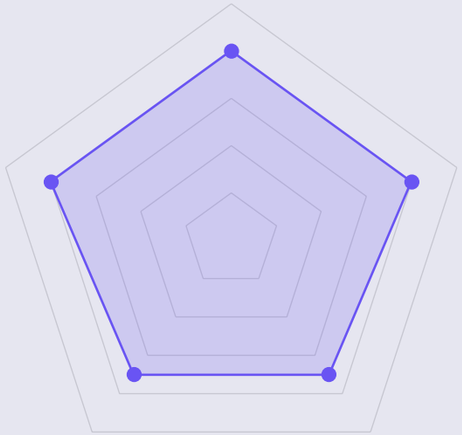
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor player health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 8

Specialized data analysis applications are integrated to evaluate and optimize beach volleyball performance, providing precise and reliable data for decision-making.

Fan Engagement: 7

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Christian Sandlie Sørum | 2023

Current Use Cases

1. **SportEasy is an application specialized in managing beach volleyball teams** at both professional and amateur levels. It is designed to help coaches with team organization and internal communication, allowing for easy planning and communication of training schedules to players and technical staff.

2. Puerta de Hierro Beach Volleyball Center, this facility, part of the Madrid Volleyball Federation, has incorporated technology developed by **Tiivii and Cinfo that uses AI to recognize specific** beach volleyball plays and automatically switch between cameras during broadcasts.

3. **Highline Volleyball VR is a virtual reality sports game featuring immersive scenarios to improve volleyball skills.** It includes three beach and Olympic volleyball environments: Sunny Beach, Six Coconut Beach, and Paris Stadium.

The Next 10 Years

1 **Widespread Use of AI will be widely used to analyze real-time data, improving team strategy and physical preparation.** Coaches will use advanced algorithms to study game patterns, identify opponent weaknesses, and adjust tactics on the fly. Players will receive instant feedback on their performance, helping them improve specific skills more efficiently.

2 **Enhanced Virtual Training will continue to improve, allowing players to practice in simulated environments that replicate specific game conditions**, such as wind direction or sand texture, without needing to be physically on the beach.

3 **Smart infrastructures and computer vision will also play a crucial role**. Beach volleyball courts will be equipped with advanced sensors and cameras that provide detailed information about the game, such as ball speed and trajectory, player positioning, and environmental conditions, helping referees, coaches, players, and spectators to obtain a much more precise and detailed analysis of the matches.

Sailing

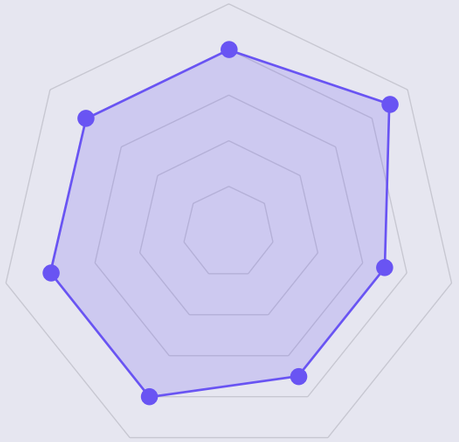
Sailing is a water sport that involves navigating a vessel propelled by the wind using sails. Sailors, known as yachtsmen, must maneuver their boats to complete a course marked by buoys in the shortest possible time, using navigation techniques and tactical strategies. In the Olympic Games, sailing has been a prominent discipline since its inclusion in 1900, featuring multiple classes of boats, such as Laser, 470, and 49er, which vary in size and complexity, highlighting the technical skill and strategy of the competitors.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though its full integration is still under development. Accessibility to these tools varies across competition levels and countries.

Smart Infrastructure: 8
Innovations in boats and lighting systems are being adopted, though not yet universally. Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of sailing performance and strategy, especially at elite levels, where advanced platforms are essential for race planning and execution.



Communication Platforms: 8
Race management and strategy software is well-developed and fundamental in sailors' preparation, though there is still room for full adoption.

Augmented Reality: 7
AR is primarily used for strategy visualization and analysis, but its adoption is limited and mainly experimental.

Sensors and Wearables: 8
Sensor technology is very advanced and widely used in sails and hulls for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training scenarios to simulate sailing conditions, improving decision-making and sailors' technique, though its adoption is not universal.

1. AI & Data

- **Performance and Strategy Analysis:** Various tools use AI to analyze the movements and techniques of sailors in real time.
- **Prediction of Sea and Wind Conditions:** AI algorithms analyze meteorological and sea data to predict wind and water conditions.

2. AR & VR

- **Virtual Reality Training:** Using VR to simulate different sailing conditions, allowing sailors to practice in a controlled environment and improve their technique without the risk of injury.
- **Race Analysis with AR:** Applications that overlay data and diagrams on training videos in real time.

3. Sensors and Wearable Devices

- **Sensors in Sails and Hulls:** Equipped with sensors that monitor the speed, direction, and force of the wind, as well as the sailor's posture and movements in real time.
- **Physiological Monitoring Devices:** Wearables that monitor heart rate, respiration, and other health indicators, helping sailors optimize their training and recovery.

4. Platforms and Software

- **Race Management Software:** Platforms that allow planning and monitoring of races, managing workloads, and analyzing sailors' progress.
- **Live Strategy Applications:** Tools that enable coaches to adjust strategies and sailing plans in real time.

5. Infraestructura Inteligente

- **Smart Boats:** Vessels equipped with sensors that collect data on force distribution, wind direction, and boat movement.

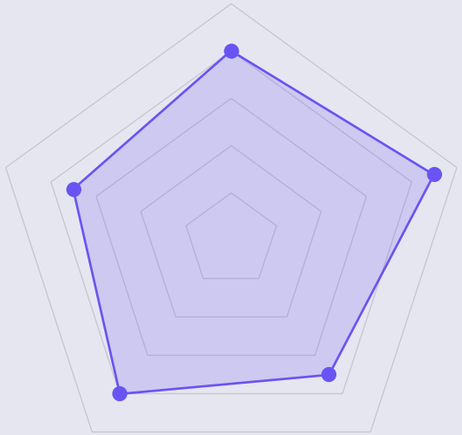
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor sailors' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 7

Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions. These measures ensure that athletes' personal information and performance data are protected against unauthorized access and tampering. However, the full implementation and universal adoption of these technologies are still in progress and expected to provide a higher level of security.



Performance: 9

Tools and data analysis platforms are integrated to evaluate and optimize sailing performance, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 7

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Jordi Xammar / Nora Brugman | 2024

Current Use Cases

1. **SailGrib is a training platform for sailing athletes that uses various technologies to optimize navigation.** It offers applications that integrate weather forecasts, tide calculations, and optimized routing through advanced algorithms. Users can download GRIB files from multiple sources, view nautical charts, and use AIS and NMEA data for precise navigation. Additionally, it includes anchor alarms and specific tools for race starts, providing a comprehensive and accessible solution for sailors of all levels.

2. **B&G Sensors in sails and hulls that monitor wind speed, direction, and force, as well as sailors' posture** and movements in real time.

3. **RaceQs is a platform that allows recording races using GPS or a smartphone and then replaying them in 3D to evaluate athletes' performance.** The collected data includes trajectory, speed, and tactics used during the race. The 3D replays facilitate detailed analysis of decisions made on the water, providing a valuable tool for improving navigation skills and strategies.

4. **SailGP's AR Feature, an augmented reality feature in the SailGP** app that allows spectators and athletes to view high-tech F50 catamarans in 360 degrees. This feature includes live statistics, boat tracking, and other interactive elements to enhance the viewing experience.

5. **MarineVerse is virtual reality sports application** that allows users to experience sailing realistically and immersively. The application enables users to connect with other sailors, compete against them in real time, and learn from experienced sailors.

The Next 10 Years

1 Boats will be constructed with **lighter and more durable materials,** such as advanced carbon fibers, improving speed and durability.

2 **Navigation systems will integrate artificial intelligence to optimize routes in real time,** adjusting to weather and sea conditions with unprecedented precision.

3 **Augmented reality will be integrated into sailors' goggles and devices,** providing crucial information about wind speed, direction, and competition positions directly in their field of view. This will enable competitors to make informed decisions quickly, enhancing strategy and safety on the water.

4 **Sensors and monitoring devices will collect detailed data** on boat performance and sailors' techniques, allowing for deep and personalized performance analysis.

5 Live broadcasting systems will benefit from these innovations, **offering immersive viewing experiences for fans** with real-time graphics and detailed analyses.

Water Polo

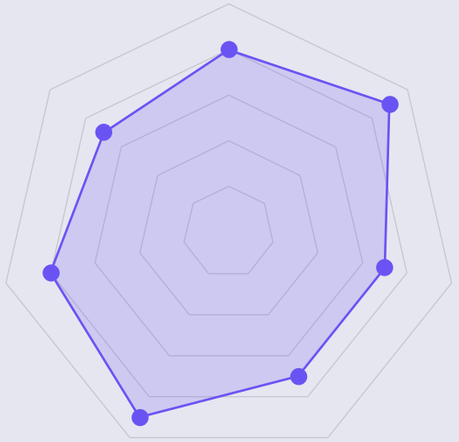
Water polo is a water sport that originated in England and Scotland in the late 19th century, inspired by a mix of rugby and soccer played in the water. In 1870, the London Swimming Association drafted the rules for the sport to be played in indoor pools. This discipline requires a combination of cardiovascular endurance, strength, swimming skills, and coordination to handle the ball and make accurate shots on goal. Water polo debuted as an Olympic sport at the Paris Games in 1900, making it one of the oldest team sports in the Olympic program.

Level of Technological Implementation

Artificial Intelligence: 8
AI is widely used for data analysis and predictions, though its full integration still has room for development.

Smart Infrastructure: 7
Investment in smart infrastructure is ongoing, especially in high-level competitions.

Data Analysis: 9
Data analysis is deeply integrated into all aspects of water polo performance and technique, especially at elite levels, where advanced platforms are essential for training planning and execution.



Communication Platforms: 8
Training and strategy management software is well-developed and fundamental in player preparation, though there is still room for feature improvement.

Augmented Reality: 7
AR is mainly used for visualization and technique analysis, but its adoption is still limited and mainly experimental.

Sensors and Wearable Devices: 9
Sensor technology is very advanced and widely used in clothing and equipment for performance analysis. Devices like these are common in most professional teams.

Virtual Reality: 7
VR is used in specific training scenarios to simulate game conditions in the pool, improving decision-making and players' technique, although its adoption is not universal.

1. AI & Data

- **Technique and Performance Analysis:** AI algorithms can track data such as player positions, speed, shot direction, and goals scored. These data can then be used to identify areas for improvement.

- **Team Strategy Planning:** AI algorithms analyze past game data to identify trends and play patterns, helping teams understand their strengths and weaknesses and how to counter opponents.

- **Predicting Outcomes:** AI algorithms analyze player and team performance metrics combined with historical results and other factors to predict potential outcomes.

2. AR & VR

- **Training and Simulation:** VR allows players and coaches to simulate game situations in a controlled environment. Players can practice tactics, improve decision-making, perfect movements and shooting biomechanics, and react to different scenarios without needing to be in the pool.

- **Performance Analysis with AR:** Applications that overlay real-time information and data during training and competitions. Coaches can use AR devices to view performance statistics, such as shot speed, water positioning, and movement efficiency, facilitating detailed analysis and immediate error correction.

3. Sensors and Wearable Devices

- **Technique Analysis:** Motion sensors and accelerometers in wearables can record and analyze swimming patterns and specific movements during the game. This information is valuable for correcting technique, improving movement efficiency, and preventing injuries.

- **Physical Performance Monitoring:** Wearables like smartwatches and bracelets can track health and performance indicators in real time, such as heart rate, body temperature, and metabolic activity. This allows coaches to adjust training intensity according to each player's physical condition.

4. Platforms and Software

- **Training Planning:** Connected platforms that allow coaches to design and distribute personalized training plans for each team member. Players can follow these plans on their mobile devices, record their progress, share data, and receive real-time adjustments based on their performance.

- **Video Analysis and Strategies:** Tools that allow coaches and players to analyze game and training recordings. These platforms facilitate detailed review of tactics, movements, and errors, enabling teams to adjust their strategies based on visual and collaborative analysis.

5. Infraestructura Inteligente

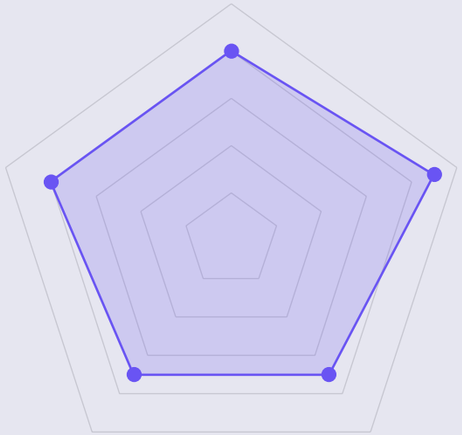
- **Smart Pools:** Equipped with advanced IoT technology, motion sensors, and data monitoring systems for precise tracking of player performance. These pools can measure speed, pace, and movement efficiency, providing real-time data for analysis and immediate adjustments.

- **Underwater Cameras:** Equipped with computer vision systems for detailed visualization of underwater movements and automatic selection of highlight footage or identification of movement patterns.

Use of Technologies by Category

E-Health: 8
Wearable devices and mobile applications help monitor players' health and personalize treatment plans, though adoption is not universal at all competition levels.

Cybertech: 8
Cybersecurity is a priority with advanced encryption and Blockchain technologies to protect data and transactions, though full implementation and universal adoption are still in progress.



Performance: 9
Data analysis platforms are integrated to evaluate and optimize performance in water polo, providing precise and reliable data for decision-making.

Fan Engagement: 7
Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing, though there is still room for further development and adoption.

Audiovisual: 7
Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Harai Balazs | 2017

Current Use Cases

1. Hudl, performance analysis platforms like Hudl are commonly used in water polo teams **to analyze and share video footage**, plan game strategies, and share metrics and training analysis.

2. MyPlay is a startup that **developed an advanced camera system using AI to automatically track live game broadcasts.** The AI algorithm zooms and pans automatically to follow the game action, creating a television-like broadcast experience without the need for camera operators. This system is already being implemented in several sports, including water polo clubs.

3. **REPS is a virtual reality sports training platform** that has partnered with well-known Olympic water polo players like Tony Azevedo and Maggie Steffens to create personalized immersive content and specific virtual training solutions for water polo.

The Next 10 Years

1 **Advanced AI Analysis will enable much deeper and more detailed performance analysis**, using advanced algorithms to identify game patterns, predict opponents' moves, and optimize team strategies. Coaches will be able to make more informed decisions based on precise and real-time data, improving player preparation and performance. Additionally, AI will facilitate personalized training plans, adapting them to each player's individual needs to maximize their potential.

2 **Virtual and augmented reality will play a crucial role in the evolution of water polo training**, allowing players and coaches to immerse themselves in game simulations, plan and modify strategies, or improve shooting techniques and skills. This will not only reduce the risk of injuries but also allow for more intensive and specific practice.

3 **Intelligent pools and computer vision will continue to revolutionize performance monitoring and management in water polo.** Pools equipped with advanced sensors will track movements, measure speed, and analyze players' techniques with increasing precision, while computer vision will allow for automatic evaluation of plays and identification of technical errors, providing instant feedback.

Paralympic Sports

Paralympic sports are disciplines adapted for athletes with physical, visual, and intellectual disabilities and are held at the Paralympic Games, not the Olympic Games. In the 2024 Paralympic Games, to be held in Paris, athletes will compete in sports such as athletics, swimming, cycling, wheelchair fencing, powerlifting, wheelchair basketball, wheelchair rugby, and many others.

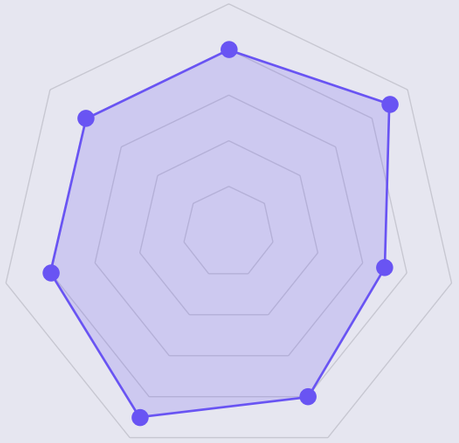
Level of Technological Implementation

Artificial Intelligence: 8

AI is widely used for data analysis and predictions, though its full integration is still in development. Accessibility to these tools varies by competition level and country.

Smart Infrastructure: 8

Innovations in adapted sports facilities and centers are already developed but not yet universal, and athletes still need to seek specific facilities for their needs. Investment in smart infrastructure is ongoing, especially at high-level competitions.



Data Analysis: 9

Data analysis is deeply integrated into all aspects of performance and strategy in Paralympic sports, especially at elite levels where advanced platforms are essential for planning and executing training and competitions.

Communication Platforms: 8

Training and strategy management software is well-developed and fundamental in player preparation, though there is still room for growth in adoption.

Augmented Reality: 7

AR is mainly used for visualization and technique analysis, but its adoption is still limited and primarily experimental.

Sensors and Wearable Devices: 9

Sensor technology is very advanced and widely used in equipment and prosthetics for performance analysis of athletes with disabilities. Such devices are common in most Paralympic teams.

Virtual Reality: 8

VR is used in specific training scenarios for athletes with disabilities to simulate competition scenarios, improving decision-making and technique. While not universally adopted, it is widely used in Paralympic sports.

1. AI & Data

- **Technique and Performance Analysis:** AI algorithms can track data from Paralympic athletes to improve their performance and training. These data can then be used to identify areas where athletes can improve.

- **Smart Assistive Technologies:** Use sensors connected with AI algorithms to adapt to athletes' movements, providing more natural and efficient support in adaptive sports equipment. Wheelchairs, prosthetics, and other sports equipment can be optimized with AI to enhance maneuverability and response, enabling athletes to reach their full potential.

2. AR & VR

- **Adapted Virtual Simulation:** VR allows Paralympic athletes to train in immersive environments that simulate real competition situations. This is especially useful for those with mobility limitations, as they can practice tactics and skills without needing a large physical space. Additionally, it helps in improving the biomechanics and movement efficiency of prosthetics.

- **Immersive Visibility Experiences:** VR simulations allow spectators to experience the features of adaptive sports firsthand. These educational tools aim to generate interest among fans by showcasing the skills and challenges that athletes face in Paralympic disciplines.

3. Sensors and Wearable Devices

- **Smart Prosthetics and Devices:** Prosthetics for athletes with motor disabilities equipped with sensors that monitor workload and force distribution in real time during games. Sensors can also be implemented in wearables to guide athletes with visual impairments.

- **Wheelchairs:** Wheelchairs used in multiple Paralympic sports can incorporate sensors that, like prosthetics, monitor training and performance.

- **Physiological Monitoring Devices:** Wearables and smart clothing that monitor heart rate, respiration, and other health indicators, helping athletes with disabilities—who may be more prone to injuries or accidents—prevent incidents during competitions.

4. Platforms and Software

- **Training Management Software:** Various platforms allow planning and monitoring of training for athletes with disabilities, managing workloads, and analyzing progress to optimize training programs and improve the physical well-being of Paralympic athletes. They also help athletes find sports centers adapted to their needs and learn new training techniques.

- **Live Strategy Applications:** Tools that allow coaches to adjust strategies and game plans in real-time, adapting them to each Paralympic discipline based on data obtained during training sessions and matches.

- **Computer Vision Platforms:** Cameras equipped with AI that capture and analyze the biomechanics of Paralympic athletes automatically, providing precise data on posture, speed, coordination, and movement efficiency. These platforms optimize specific techniques for each adapted discipline and serve as safety systems, issuing alerts when a risky movement or pattern occurs to enable early intervention.

5. Infrastructure Innovations

- **Adapted Smart Facilities:** Tracks, pools, and other sports facilities equipped with special lanes, tactile guides, sensors, and specific surfaces to enhance the safety and performance of athletes with visual and physical disabilities.

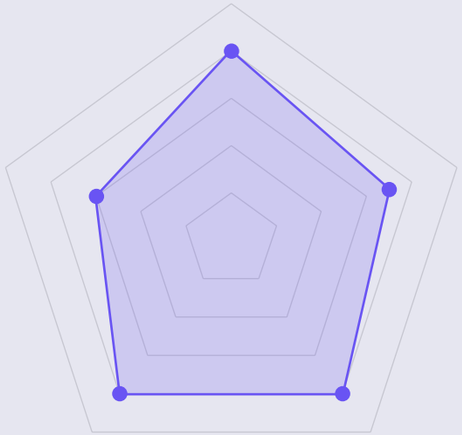
Use of Technologies by Category

E-Health: 8

Wearable devices and mobile applications help monitor athletes' health and personalize treatment plans, though adoption is not universal at all levels of Paralympic competition.

Cybertech: 6

Cybersecurity in Paralympic sports is implemented using advanced encryption and Blockchain technologies to protect athletes' personal data and training strategies, though this field is still developing.



Performance: 7

Data analysis tools and platforms are integrated to evaluate and optimize performance in Paralympic sports, providing precise and reliable data for decision-making.

Fan Engagement: 8

Mobile applications and social media platforms are well-developed for interacting with fans, and the implementation of AR and VR experiences is growing.

Audiovisual: 8

Immersive experiences and AR and VR applications are available for training and analysis, but their use is not uniform across all competitions, being more common in high-profile events and specialized training.

Asier García Pereiro | 2021

Current Use Cases

1. American researchers have created a **VR physical navigation simulator as a rehabilitation tool for athletes with motor disabilities.** Technologies applied include a motion platform to simulate navigation conditions and an immersive virtual environment that replicates the experience of being on the water. This simulator helps users improve motor skills, balance, and coordination.

2. **Samsung has made the Unnoise mobile app available to the Spanish Paralympic team for their preparation for the Paris Paralympic Games.** The tool allows users to customize decibel tolerance levels and automatically reduce sounds that exceed a preset limit, improving concentration and well-being during auditory distortion events common in crowded sports events.

3. Developed by Irontec for GaituzSport Fundazioa**, Kiprest is a mobile and web app that facilitates access to sports for people with disabilities.** The app provides information, coordination, and communication, allowing users to find sports centers, access recommended activities based on their disability, and communicate with sports technicians.

4. **Accessercise, founded by British Para-Powerlifting world champion Ali Jawad, Accessercise is a fitness app designed for people with disabilities.** It uses AI to offer personalized training plans and tailored guidance. The app includes a directory of gyms rated by accessibility, a social center to connect with other users, tools to create and record personalized workouts, set fitness goals, schedule workouts in the calendar, and a library of adapted exercises.

5. Developed by Imperial College London, **Ghost is a training device for visually impaired swimmers.** Worn on the wrist and elbow, it emits sounds and vibrations to alert the athlete when they perform a movement correctly. It also provides information on the movements of top Olympic athletes, helping swimmers improve their technique.

6. **Biostrength by Technogym uses AI and advanced technology to adapt and guide athletes with disabilities during strength sessions.** The Biostrength REV line includes equipment with six types of resistance and sensors that collect precise data for training with millimeter precision. Skillrun and Skillup offer cardio and strength training with biomechanical and asymmetry analysis, especially effective for athletes with disabilities and those in wheelchairs.

7. **ParalympicsGB Mindscape, an immersive digital experience launched for Paris 2024,** designed to allow users to learn about and experience the accessibility challenges faced by athletes with disabilities.

8. **International Paralympic Committee (IPC) using VR to provide insights into the experiences of Paralympic athletes**, these tools aim to foster empathy and raise awareness of Paralympic sports among spectators.

9. Innovative Prosthetics include Ottobock's 1E95 foot used in sports like basketball and volleyball, the 1E91 Runner foot for sprinters and long jumpers, and the 3S80 knee prosthesis designed to withstand the stresses of running and jumping, used by athletes like Martina Caironi. **These AI-assisted prosthetics, made with advanced materials like carbon fiber, have significantly improved the performance and quality of life for Paralympic athletes.**

10. New Zealand Paralympic skier Adam Hall **used VR technology as part of his training for the Beijing 2022 Winter Paralympic Games**, helping him secure a podium finish in the super combined event.

The Next 10 Years

1. **Revolution in Prosthetics will be a revolution in the design and functionality of prosthetics and assistive devices.** Advances in materials and AI integration will lead to lighter, more durable, and adaptive prosthetics that not only replicate human limb functions but may even enhance them, offering athletes greater speed, agility, and precision.

2. **Virtual and augmented reality will play crucial roles in training and preparing Paralympic athletes.** These virtual environments will allow athletes to simulate competitions and train in scenarios that closely replicate actual event conditions.

3. **Sensors and wearable devices will provide real-time data on athletes' performance**, allowing instant and personalized adjustments to training routines.

4. Advances in neurotechnology, **such as brain-computer interfaces (BCIs), will allow athletes with severe disabilities to control devices and prosthetics directly with their thoughts.**

5. **Digital platforms and social media will continue to increase the visibility and inclusion of Paralympic sports.** Live streaming, data analysis, and real-time fan interaction will allow Paralympic sports to reach an even larger global audience.

Conclusions

The research conducted in this report reveals a fascinating and promising future for innovation in Olympic sports. As we move into the next decade, **the impact of technological disruptions will be especially driven by advancements in artificial intelligence**, the enhancement and adoption of immersive experiences, and the improvement of smart infrastructure and equipment.

Together, these innovative technologies will make **data analytics a core component of sports preparation**, significantly influencing competition outcomes.

In the future, winning an Olympic medal will transcend athletes' physical and mental abilities, increasingly relying on the technical and coaching teams' ability to effectively apply **advanced technologies to maximize athletes' potential.**

However, these innovations will not only redefine how sports are practiced but will also **create new opportunities for improving athlete safety, enhancing spectator experiences, and efficiently managing sports events.**

New Athlete, Coach, and Spectator Experience

One of the most significant aspects of digital transformation in Olympic sports is its **impact on athlete performance**. AI and connected sensors enable the real-time collection and analysis of biomechanical, physiological, and technical data through multiple devices installed in infrastructures and smart sports equipment and materials.

This information helps coaches and athletes plan and optimize training, predict outcomes, and prevent injuries. It will also become crucial for developing more precise and personalized competitive strategies, allowing game tactics to be planned based on the automatic analysis of numerous performance metrics and physical parameters, or modified in real-time during competitions.

In this regard, **virtual and augmented reality platforms** will continue to improve their capabilities, offering increasingly realistic and specific immersive environments for each discipline, becoming key tools for enhancing technical skills in sports training.

These platforms will also continue **to transform the spectator experience**, increasing athlete-fan interaction and enhancing spectator participation in the Games. Augmented reality broadcasts will offer panoramic views and real-time data on athlete performance, enriching event narratives and providing a more interactive and immersive experience.

This trend, along with the incorporation of computer vision systems, drones, and underwater cameras, will completely change how we perceive the broadcasting of the Games today.

Security and Smart Management

Athlete and spectator safety is a fundamental priority at any sports event, and the Paris 2024 Games will mark a turning point in this regard.

Technologies such as **computer vision and advanced image detection systems using artificial intelligence allow for the automatic monitoring** of large crowds or extensive areas of sports facilities to ensure safety and assist human professionals.

Similarly, the algorithms used by these new camera systems **can identify movement and position patterns with millimetric precision**, issuing alerts whenever a health risk situation for an athlete may arise, or helping referees conduct fairer officiating with less exposure to human error.

Moreover, **smart infrastructures** equipped with IoT sensor networks and automated facility management systems **will continue to enhance the operational efficiency of events**, allowing significant energy resource savings and contributing to more responsible and sustainable sports practices.

Challenges and Future Tasks

Despite the evident benefits, the widespread adoption of these disruptive technologies also presents significant challenges for Olympic sports.

The rise of artificial intelligence and advanced data analytics tools raises ethical concerns about athlete information privacy, cybersecurity risks, and fairness in competition and equal access to these technologies.

All these debates will need to be comprehensively addressed in the coming years, and **it will be crucial to develop robust regulatory frameworks and ethical standards** that guide the responsible and fair use of these tools at all levels of sport.

In the next 10 years, we will witness the **convergence of sports and technology resulting in a new Olympic experience where innovation and sportsmanship merge**, creating previously unknown synergies.

To successfully achieve **this promising future**, investments in research and development must be a priority for sports organizations, clubs, public entities, and private companies.

Through joint efforts, these advances will be driven forward, **ensuring that the Olympic sport continues to be a symbol of excellence,** achievement, health, and global unity, even in the digital age.

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