

A Study on the Challenges of Implementing AI and Big Data in the Sports Industry

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Abstract

Artificial Intelligence (AI) and Big Data are increasingly being used in the sports industry for performance analysis, athlete monitoring, talent identification, injury assessment, decision-making, broadcasting, and fan engagement. Although these technologies provide opportunities for faster and more data-driven decisions, their implementation is not straightforward. Sports organizations have to deal with problems related to data quality, data integration, infrastructure, cost, availability of skilled professionals, privacy, security, ethics, and organizational acceptance. This paper studies the major challenges involved in implementing AI and Big Data in the sports industry through a qualitative review of existing academic and industry literature. The study focuses on identifying common implementation barriers rather than evaluating a particular AI model or sports organization. Existing research shows that technical performance alone is not sufficient for successful implementation. The usefulness of AI systems also depends on the quality and availability of data, appropriate infrastructure, human expertise, responsible data governance, and integration with existing sporting practices. The paper also discusses current applications and identifies areas where further research is required, particularly for smaller organizations and sports contexts with limited resources. The study concludes that successful adoption of AI and Big Data in sports requires a balanced approach involving technology, people, organizational processes, and responsible governance.

Keywords: Artificial Intelligence, Big Data, Sports Analytics, Sports Technology, Data Privacy, Data Governance, Athlete Performance

1 Introduction

The sports industry has become increasingly data-driven. Modern sports organizations collect information from match events, video systems, tracking technologies, wearable devices, fitness tests, medical records, and digital platforms. This has created large and varied datasets that can be used to support decisions related to athletes, teams, competitions, and fans. Research in sports analytics shows that machine learning and other analytical methods are increasingly being used to extract useful information from complex sports data [1].

Artificial Intelligence (AI) can help sports organizations identify patterns, make predictions, automate analysis, and support decision-making. Applications include athlete performance analysis, talent identification, injury risk assessment, tactical analysis, health monitoring, and other areas. A systematic review of AI applications across football codes identified applications ranging from athlete evaluation and event detection to injury detection and prediction [2]. The International Olympic Committee has also recognized the growing role of AI in sport and launched the Olympic AI Agenda in 2024, covering areas such as athlete performance, talent identification, broadcasting, judging, and safeguarding [3].

Big Data is closely connected with these developments. Sports data can be generated at high volume and speed from many different sources. For example, tracking systems and wearable sensors can provide detailed information about player movement and physical condition. However, the availability of large amounts of data does not automatically lead to better decisions. Researchers have noted that sports data can be complex, context-dependent, and difficult to evaluate correctly [1]. In some sports, different data sources may also need to be combined before useful analysis can be performed.

The main challenge, therefore, is not simply whether AI and Big Data can be used in sports, but whether sports organizations can implement these technologies effectively and responsibly. Implementation may require investment in infrastructure, skilled personnel, data management systems, cybersecurity, and organizational changes. In addition, athlete data can include sensitive health, biometric, location, and performance information, creating privacy and ethical concerns [4].

This study focuses on these implementation challenges. Rather than presenting AI as a solution to every problem in sports, the paper examines the practical difficulties that organizations may face when attempting to adopt AI and Big Data.

2 Research Objectives and Questions

2.1 Research Objectives

The main objectives of this study are:

1. To understand the major applications of AI and Big Data in the sports industry.
2. To identify the major technical, financial, organizational, and human challenges involved in implementation.
3. To examine privacy, security, ethical, and data governance issues related to the use of sports data.
4. To analyse how data quality, infrastructure, skills, and organizational readiness affect successful implementation.
5. To identify research gaps and discuss possible areas for future development.

2.2 Research Questions

The study addresses the following research questions:

1. What are the major applications of AI and Big Data in the sports industry?
2. What are the major challenges faced by sports organizations when implementing these technologies?
3. How do data quality, infrastructure, cost, skills, privacy, and organizational factors affect implementation?
4. What ethical and governance issues need to be considered when using AI and Big Data in sports?
5. What areas require further research to support responsible and practical adoption?

3 Research Methodology

This study follows a qualitative literature-based research approach. Existing academic research and selected industry sources were reviewed to understand the applications and implementation challenges associated with AI and Big Data in sports.

The literature was selected based on its relevance to sports analytics, artificial intelligence, big data, athlete data, sports technology, data governance, and organizational

adoption. Recent research was given particular attention, while earlier studies were included where they provided important background on the development of sports analytics and big data.

The analysis was thematic rather than statistical. Findings from the literature were grouped into recurring themes such as data-related challenges, technical and infrastructure challenges, financial and skill-related challenges, organizational adoption, and ethical and privacy concerns. This approach is appropriate for the purpose of the study because the objective is to understand and organize the different implementation barriers rather than test a specific predictive model.

The study does not claim to represent the experience of every sports organization. Sports differ in their size, available resources, data requirements, and level of technological development. Therefore, the findings are interpreted as common themes identified in the reviewed literature.

4 AI and Big Data in the Sports Industry

4.1 Applications of Artificial Intelligence

AI is being applied in several areas of sport. Machine learning can be used to identify patterns in performance data, while computer vision can support the analysis of video and player movement. AI-based approaches have also been studied for injury risk assessment, performance prediction, athlete evaluation, and event detection [2].

Common applications include:

- **Performance analysis:** analysing player and team performance using historical and real-time data.
- **Injury assessment:** using physical and performance variables to identify possible injury risks.
- **Talent identification:** supporting the identification and comparison of athletes using multiple performance indicators.
- **Tactical analysis:** studying player positions, movements, events, and team patterns.
- **Broadcasting and fan engagement:** using data and AI to support real-time statistics, content creation, and personalised experiences.

The IOC's Olympic AI Agenda illustrates the breadth of possible applications, including athlete performance, talent identification, judging and refereeing, broadcasting, safeguarding, and event operations [3].

4.2 Role of Big Data

Big Data provides the information on which many AI and analytics applications depend. Modern sports environments can generate large datasets from tracking systems, wearable devices, video, match statistics, medical information, and digital platforms. Research in elite soccer has shown how detailed tracking and physiological data can provide new opportunities for tactical analysis, while also creating challenges because of the size and complexity of the data [5].

Big Data can therefore support decision-making, but it also creates a data-management problem. Organizations need to collect, store, clean, combine, analyse, and protect the information before it can produce useful results.

5 Challenges in Implementing AI and Big Data

5.1 Data Quality and Availability

The quality of an AI system depends heavily on the data used to develop and operate it. Sports data may contain missing values, measurement errors, inconsistent formats, or information collected under different conditions. Some important sporting variables may also be difficult to measure directly. Research on sports analytics highlights the lack of objective ground truth for some performance variables and the importance of contextual factors when analysing sports data [1].

Another issue is that organizations may have access to large amounts of data but not necessarily the right data. Historical data may be incomplete, while data from different seasons, competitions, sensors, or providers may not be directly comparable. Therefore, increasing the quantity of data does not automatically increase its usefulness.

5.2 Data Integration and Interoperability

Sports organizations often use multiple technologies for tracking, video analysis, athlete monitoring, medical records, and performance management. These systems may use different formats and measurement methods. Combining information from these sources can therefore require additional technical work.

Big data research has identified integration as an important continuing challenge, particularly when organizations attempt to combine large datasets with advanced data-driven applications [6]. In sports, integration problems can also reduce the practical value of an AI system if the results cannot be connected to the workflows already used by coaches, analysts, or medical staff.

5.3 Infrastructure and Real-Time Processing

Some sports applications require information to be processed quickly. During a match or training session, data from tracking systems and sensors may need to be transmitted and analysed with low delay. This creates requirements for computing power, storage, connectivity, data pipelines, and reliable software systems.

Research on real-time AI in sports shows that models are increasingly being applied beyond purely experimental settings, but real-world implementation requires appropriate methods and feedback mechanisms for athletes and coaches [7]. Organizations with limited technical infrastructure may find these requirements difficult to meet.

5.4 Cost of Implementation

Implementation involves more than purchasing an AI software package. Organizations may need sensors, cameras, tracking systems, cloud or local computing infrastructure, data storage, software licences, cybersecurity measures, and ongoing technical support.

There can also be continuing costs for maintaining models and updating systems. These costs may create a larger barrier for smaller sports organizations than for well-funded professional teams. Recent research on digital transformation in sport organizations also identifies financial and technical barriers for smaller organizations [8].

5.5 Lack of Skilled Professionals

Effective use of AI and Big Data requires people who can understand data, technology, and the sports context. A technically accurate model may still have limited value if coaches, analysts, or other users do not understand its output or do not trust it.

The gap is therefore not only a shortage of data scientists. Sports organizations may also require professionals who can translate between technical teams and sporting staff. Bridging the gap between sports expertise and modern data analytics has been identified as an important issue in sports analytics research [1].

5.6 Privacy and Data Security

Sports organizations increasingly collect detailed information about athletes. Depending on the system, this may include health, biometric, physiological, location, and performance information. Such information can be sensitive and may create risks if collected or shared without adequate safeguards.

A 2025 systematic scoping review identified privacy and data ethics as one of the major ethical concerns in AI applications in sport. The review also highlighted issues involving fairness and bias, transparency and explainability, and accountability [4].

Consequently, organizations need clear rules concerning who can access data, how long data should be stored, why it is being collected, and how it can be shared or reused.

5.7 Ethical Issues and Bias

AI systems learn patterns from existing data. If the data is incomplete or biased, the resulting system may produce biased outcomes. This can become important in areas such as talent identification, player evaluation, recruitment, or performance comparison.

Another concern is transparency. Coaches and athletes may be less willing to rely on a recommendation if they cannot understand how it was produced. Recent research identifies fairness, bias, transparency, explainability, privacy, and accountability as recurring ethical issues in AI-based sports applications [4].

5.8 Organizational Resistance and Workflow Integration

Technology cannot be successfully implemented only by installing software. It has to fit into existing decision-making processes. Coaches, athletes, medical staff, analysts, and managers may have different expectations about how data should be used.

Research on digital transformation in sport organizations suggests that technology adoption is also an organizational and governance issue, involving leadership, organizational change, data management, and strategic alignment [8]. Therefore, resistance may arise when users feel that technology is difficult to understand, disrupts existing practices, or reduces the role of professional judgement.

6 Existing Industry Evidence

AI and Big Data are no longer limited to theoretical research. Sports organizations and governing bodies are using data-driven technologies in practical settings.

The International Olympic Committee launched its Olympic AI Agenda in 2024 and identified applications including talent identification, athlete performance, judging and refereeing, broadcasting, safeguarding, and organizing the Olympic Games [3]. This demonstrates that AI adoption can involve multiple parts of a sports ecosystem rather than only athlete performance.

Academic research also provides evidence of practical AI applications. A systematic review of AI in football codes examined 190 peer-reviewed articles and identified applications including athlete evaluation, event detection, match prediction, and injury detection and prediction. The review also identified risks involving data security, usability, data bias, and inappropriate athlete load management [2].

Research on sports analytics further shows that large amounts of data are being used to build indicators and models for athletes and teams. However, careful evaluation is

required because sports data often contain temporal dependencies, contextual differences, and other characteristics that can affect model results [1].

These examples suggest that implementation should be considered as a complete process. The existence of an AI model or a large dataset does not by itself guarantee useful or responsible decision-making.

7 Analysis and Discussion

The literature reviewed in this study suggests that implementation challenges are connected rather than isolated.

First, **data quality affects technical performance**. If data are incomplete, inconsistent, or poorly labelled, even a sophisticated AI model may produce unreliable results. Sports data also depend heavily on context, making simple comparisons difficult [1].

Second, **technical infrastructure and organizational capability must develop together**. A sports organization may purchase advanced technology but still struggle to use it if its data systems cannot communicate with each other or if employees lack the skills to interpret the outputs.

Third, **privacy and ethics are implementation issues rather than only legal issues**. Athlete data can be sensitive, and questions about consent, access, ownership, transparency, and accountability influence whether a system can be responsibly adopted [4].

Finally, **human judgement remains important**. AI can provide predictions and recommendations, but sports decisions often involve contextual information that may not be fully represented in a dataset. Current literature therefore supports approaches where AI assists rather than automatically replaces coaches, analysts, medical professionals, or other responsible decision-makers.

Overall, the main challenge is achieving alignment between technology, data, people, and organizational processes. This is why implementation should be treated as a broader organizational change rather than simply a software project.

8 Research Gaps

The existing literature provides substantial information about AI applications in sports, but several areas require further study.

First, much of the research focuses on specific applications or individual sports. More comparative research is needed across different types and sizes of sports organizations.

Second, there is a need for more research on organizations with limited financial and technical resources. Advanced AI systems may be easier to implement in large professional organizations than in smaller clubs, federations, or amateur sports environments.

Third, technical model performance is often easier to measure than organizational success. Future studies could examine whether AI systems are actually adopted by users and whether they improve real decision-making processes.

Finally, ethical and governance frameworks need to develop alongside technological adoption. Recent research has highlighted the need for sport-specific approaches to fairness, transparency, privacy, and accountability [4].

9 Future Scope

Future research can focus on developing practical frameworks that help sports organizations assess their readiness before implementing AI and Big Data. Such frameworks could consider data quality, infrastructure, financial resources, staff skills, organizational support, privacy requirements, and ethical safeguards.

There is also scope for research on smaller sports organizations and developing sporting environments, where resources may be more limited. Another useful area would be the development of standardized approaches for evaluating AI systems across sports, particularly where data and performance measures differ.

Further research could also examine human-AI collaboration in sports. Instead of focusing only on replacing human decisions, studies can investigate how AI recommendations can be presented in a way that helps coaches, athletes, analysts, and medical staff make better-informed decisions.

10 Conclusion

AI and Big Data have created new opportunities for the sports industry in areas such as performance analysis, injury assessment, talent identification, tactical analysis, broadcasting, and fan engagement. However, implementation involves challenges that extend beyond the technology itself.

The literature reviewed in this study identifies several recurring challenges, including data quality, integration, infrastructure, cost, shortage of skilled professionals, privacy, security, ethical concerns, and organizational adoption. These challenges are often interconnected. Poor data can affect model reliability, weak infrastructure can limit practical use, and lack of organizational readiness can prevent technically successful systems from being adopted.

The study therefore suggests that successful implementation of AI and Big Data in sports requires a balanced approach. Sports organizations need suitable technology, reliable data, skilled people, appropriate infrastructure, supportive organizational processes, and clear data governance. Responsible implementation should also maintain appropriate

human oversight, particularly when AI outputs can affect athletes or important sporting decisions.

Future development should therefore focus not only on creating more advanced AI models, but also on making these systems practical, understandable, secure, and suitable for the real conditions of sports organizations.

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