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TENDENCIES IN THE IMPLEMENTATION OF SMART TECHNOLOGIES IN THE SPORTS INDUSTRY

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Abstract. The combination of sport, business and artificial intelligence, in the context of high social interest, business interests and intelligent technologies, opens perspectives for a considerable expansion of the sports industry. At the same time, the dynamic of the market demands the implementation of artificial intelligence (AI). It is being successfully used in several key aspects - fans' involvement, which generates major revenues in the industry; injury prevention and avoidance; improving sports performances (through in-depth analysis); improving sports equipment and providing equitable refereeing, all of which directly and indirectly influence the development of business models and cash flows in the industry. This report presents the tendencies of implementing intelligent technologies in the management and operation of sports organisations. Intelligent technologies were considered in both the sport performance and business management strands of organisations as well. The main directions of intelligent technology implementation in sport organizations are based and delineated on an empirical study and secondary data analysis and synthesis.

Keywords: Sport technology; Technology innovation; Artificial Intelligence; Sport Business

JEL: *L83, 031, Z21*

1. Introduction

In modern society, sport occupies an important role not only as means of entertainment and health maintenance, but also as a mighty social and economic phenomenon. Sporting events unite people from different cultural and social backgrounds, encouraging and fostering a sense of community and mutual understanding. Globally, worldwide, sport is a key factor in promoting healthy lifestyles and physical activity, which are essential to address a range of health challenges in modern society. The sports industry represents a significant economic sector with annual revenues of billions of dollars. It is estimatedthat the world's sports market will reacharound $471 billion in 2021 andthat it willreach $707 billion by 2026with

an annualcompound growth rate (CAGR) of 7.2% (Yogendra & Sumant, 2024). This significant growth highlights the importance of the sports industry to the global economy, which is responsible for creating a large number of jobs and driving a range of innovations.

In the face of high public interest and competition, sports organisations are constantly looking for ways to improve their efficiency and increase their revenues. Over the past few years, artificial intelligence (AI) has been rapidly entering the sports industry, providing new opportunities for optimization and innovation (Barlow & Sriskandarajah, 2019). AI (artificial intelligence) is transforming sports score analytics, predicting sports achievements, helping to improve athletes' physical fitness through injury prevention analytics, and contributing to building strategies to drive fan involvement and marketing activity and business processes across the organization (Barlow & Sriskandarajah, 2019; Ratten, 2020). The use of artificial intelligence - based technologies is transforming the way sports organizations operate and make decisions, giving them a competitive advantage in the marketplace (Khanna, 2023). In addition, AI plays a key role in the development of new sports technologies and equipment that further enhance athlete performance and safety (Porubay, 2024). Along with these benefits, the implementation of AI in management decisions requires adaptation of the organizational structure and new skills of employees, which represents a significant challenge for sports organizations (Stoycheva & Vitliemov, 2024). As a result of these innovations, sports organizations are not only optimizing their operations, but also establishing new standards for success in the industry. The growth of AI in the sports industry reflects the combination of high public interest, business interests, and innovative technology.

As a result of these innovations, sports organisations are not only optimising their operations, but also setting new standards for success in the industry. The growth in the use of AI in the sports industry reflects the combination of high public interest, business interest and innovative technology. It is expected that this process will continue to accelerate, with AI taking an increasingly central place in the strategies of sports organisations worldwide. The market for AI in the sports industry is expected to grow at a significant rate in the coming years, reaching a value of over $3.5 billion by 2027 year (Mordor Intelligence, 2024). Further analysis shows that AI is not only improving sports performance, but also fan involvement and creating new business models that lead to significant financial benefits for sports organisations (Cabral, 2024).

The aim of this report is to explore and analyse the tendencies in the implementation of intelligent technologies in the sports industry, in particular in the following main areas

The role of artificial intelligence in the sports industry in the following areas: **Fan involvement**: the use of AI to increase fan involvement, which generates

significant revenue for the industry; **Injury prevention and avoidance**: the use of methods and new technologies that predict and prevent injuries thanks to big data analytics; **Improving sports achievement:** the use of in-depth analytics and AI to improve sports form or opponent analysis resulting in improved sports achievments and safety; **Improving sports equipment:** the development of sports equipment through AI is also directly linked to improving sports achievements and safety; **Ensuring equitqble refereeing:** equitqble refereeing technologies that provide more accurate and equitqble decisions.

Tendencies and perspectives: **Analysis of current tendencies and key technologies in the sports industry:** Main areas of implementation of inteligent technologies; **Future prospects and challenges:** Opportunities for the development of AI in the sports industry and potential challenges that sports organizations may face.

The main research question that is posed in the development is: **What are the main areas of application of intelligent technologies in the sports industry, and from there what is the motivation and what challenges and barriers do sports organizations face when implementing them?**

To answer it the following parts sequentially examine the background of the role of AI in the sports industry; Research methodology; The results of the research and the Conclusion.

2. Background of AI's Role in the Sports Industry

Artificial Intelligence (AI) is gaining significant popularity in the sports industry, but its implementation in various aspects, is just beginning. This section of the paper looks at the main ways in which AI is changing sport. Profitability is one of the key performance indicators (KPI) for any business, and intelligent technology is becoming an invaluable asset to help sports organisations increase efficiency, optimise the bottom line and improve fan engagement.

2.1. Involvement of fans

The intelligent technologies allow sports organizations to analyse vast amounts of data from social media and other digital platforms, which improves the understanding of fans and their preferences (Wang, et al. 2024). For example, by using machine-learning algorithms, organizations can personalize their content and marketing campaigns, leading to a higher level of involvement and loyalty from fans (Ratten, 2020). This is essential for sustainable revenue growth, as data analysis allows sports' clubs to anticipate fan tendencies and preferences. With the growing importance of personalization in marketing strategies, sports clubs are looking not only to understand their fans better, but also to turn this data into engaging experiences. Thanks to AI, sports clubs can collect, analyse and interpret data, enabling them to offer personalized and interactive experiences to their fans (Ivich, 2023). This includes the use of chatbots, personalized content, as well as virtual and aug-

mented realities. Through these innovative technologies, sports clubs can better connect with their fans, providing them with personalized experiences that meet their needs and interests. In this context, chatbots are one of the most popular applications of AI in the sports industry. They can provide immediate answers to fans' questions; facilitate the purchase of tickets, the sale of merchandise and other club-related services. Clubs such as Manchester United and Barcelona use chatbots that provide personalized match information, player statistics and other relevant data (Ivich, 2023). While chatbots facilitate direct communication and access to information, they also contribute to the overall personalization of the fan experience. In addition, intelligent technologies use algorithms to analyse fan data, creating personalized content that is relevant to each individual fan. This includes personalized news, videos and social media posts. Clubs such as Paris Saint-Germain are using AI-based platforms to distribute effective content and improve social media involvement with fans[1]. Being able to immerse themselves in the world of their favourited club through virtual reality creates greater involvement and satisfaction for fans. An example of this is the application launched by FIFA during the Qatar 2022 year FIFA World Cup, which enables fans to watch video replays from different camera angles on their phones, as well as receive relevant live statistics (Ivich, 2023). Using virtual reality not only engages fans, but also provides important data about their behaviour and preferences. Sports organizations are using AI to gather feedback from fans and adapt their involvement strategies. For example, surveys and focus groups allow clubs to understand fan preferences and expectations, leading to better adapted and effective involvement strategies (Ratten, 2020). From the collected data, it can be concluded that the use of AI in the sports industry not only improves fan involvement, but also provides valuable information about fan needs, builds strong relationships and increases revenue. However, it should be noted that the essence of the sport remains in the game and the emotional connection with the fans, which intelligent technology only helps to strengthen the processes.

2.2. Injury prevention and prevention

The role of intelligent technology in the prevention and avoidance of sports injuries is growing significantly. Both machine learning algorithms and the analysis of large datasources allow the intelligent technologies to predict injury hazards and offer preventive solutions (Ratten, 2020). These technologies use real-time monitoring of athletes' physical condition and workload training, which one is of a key position to minimizing the risk of injury, which also leads to maintaining a certain level of athletic performance (Barlow & Sriskandarajah, 2019). The researches shows that AI algorithms can analyse biomechanical data of athletes and can identify movement abnormalities that can lead to injuries (Naraine & Wanless, 2020).

[1] Sports Fan Involvement: What It Is, Examples, Ideas, & Tips. *Greenfly Blog*. https://www.greenfly.com/blog/social-media-in-sports

2.3. Improving athletic performance

AI also holds a key role in improving athletic performance through the analysis of a large amount of datasource collected during different trainings and competitions. Thus, patterns and tendencies can be identified which help the athletes to optimize their training regimes and strategies in competition mode. The intelligent technologies can identify the strengths and weaknesses of both individual athletes and teams by analysing large amounts of data (Barlow & Sriskandarajah, 2019).

An example of this is the analysis of video recordings from trainings and competitions to provide selective feedback about the technique and tactics of athletes and sports teams. This datasource can be used for optimizing training processes and strategies in the competitive process as well (Mallen, 2019). The researches show that AI-based systems can improve training performance by providing personalized recommendations for each athlete or team (Păun, 2023).

Besides the sporting achievements, intelligent technologies can also be used to enhance the efficiency of employees. For example, the methodology for intelligent personal effectiveness (IM), promotes the use of stress monitoring and individualized solutions that improve productivity and promote corporate social responsibility (Biolcheva & Valchev, 2023).

2.4. Improvement of sports equipment

Artificial intelligence has made a significant contribution in the improvement of sports equipment by providing new opportunities to optimize the design and materials were used. Through the usage of machine learning and optimization algorithms, manufacturers can create more efficient and safer products (Ratten, 2020). For example, AI technologies are being used to analyse the materials and design of sports equipment, leading to innovations in the creation of athletic footwear that minimize the risk of injury (Naraine & Wanless, 2020). Furthermore, sensors integrated into sports equipment allow for real-time data collection that can be analysed using AI to improve athlete performance (Sulimov, 2024). This data collected in real-time provides valuable information about athletes' performance and allows AI to suggest personalized improvements.

Improving sports equipment through AI has a direct influence on sports scores. More efficient and safer equipment allows athletes to perform themselves at a high level. For example - shoe optimization can improve athletes' stability and speed, which is critical for achieving high scores in sports such as athletics, soccer, and many other sports (Barlow & Sriskandarajah, 2019). This technological intervention sets the prerequisites for higher performance and minimizing the risk of injury. The advanced equipment allows athletes to train more intensely and for longer periods of time without the risk of injury. This leads to improved physical endurance and skill, which is essential for success in a competitive mode (Ratten, 2020). This can show us the rate of significance the role of AI could be in the development of sports equipment, which accounts for between 15 and 20% of all intelligent technology in sports (Wang et. al., 2024).

2.5. Ensuring equitable refereeing

Artificial intelligence plays a critical role in maintaining equitable and accurate judging in sporting events (Ratten, 2020). By using AI to analyse video records and other competition datasource, referees can make more objective and accurate decisions (UEFA, 2024). For example, AI-powered video replay systems can automatically identify mistakes and errors and significantly reduce the risk of human errors. (Ratten, 2020).

The use of AI technology in judging significantly increases the accuracy and objectivity of decisions. These systems provide the judges with additional information and different perspectives that reduce the risk of human mistakes and questionable decisions.

The use of AI in this aspect of sport not only improves the quality of competitions, but also increases the satisfaction of fans who can ensure that decisions were made objectively and accurately. This leads to a higher level of trust and involvement from fans, which is in a key position to the success of sports organisations.

3. Methodology of the Research

This report uses a combined datasource collecting and analysing methodology, including both primary and secondary sources of information.

Primary datasource: The primary method of primary datasource collection was through an online questionnaire created and distributed with the help and utilization of Google Forms. The questionnaire itself was targeted at representatives of sports clubs, federations, leagues, and other organisations related to the sports industry, including marketing agencies, sports tourism organisers and management agencies. The respondents themselves included both Bulgarian and European participants, mainly from football clubs and organisations – 20 organisations in total. The survey was conducted during the third quarter of 2024 year.

The survey is structured to collect quantitative and qualitative data, with questions focused on the implementation of artificial intelligence (AI) in various aspects of the sports industry. The questions asked address the priority areas for AI implementation, the benefits and challenges associated with this, as well as the current status and future plans for AI integration in sports organisations.

Secondary datasource: Secondary datasource was collected through a review of existing scholarly literature, reports, and articles that address the role and influence of AI in the sports industry. Sources from reputable publications and datasource were analysed to provide a more extensive context and to support the conclusions drawn from the results of the questionnaire.

Data Analysis: The datasource, collected through the questionnaire, was analysed by using descriptive statistics and qualitative analysis in order to identify key positioned tendencies and models in AI implementation. The secondary datasource helped to deepen the analysis and to compare the results with previous research in the field.

4. Research Results

4.1. Primary datasource – empirical study (questionnaire survey)

The results of the research are based on the summarised data from the empirical study and the analysis of the key positioned aspects related to the implementation of AI in sport organisations. The answers are grouped by type of organisation followed by an analysis of the key areas for AI implementation. An analysis of the motivations and barriers to AI adoption is presented, as well as future plans for the integration of these technologies.

4.1.1. Classifing the answers arranged in groups by type of organisation

Sports clubs represented 40% accounted of the respondents, with the majority having implemented smart technology (5 clubs had implemented 3 had not). There were three main areas where clubs considered that intelligent technologies should be used – the most important being increasing fan involvement (87.5% of clubs), improving sporting performance (75%) and injury prevention (62%). The motivation for implementing smart technology is related to increasing revenue (87.5% of clubs), optimising of the governance (75%) and improving the sport achievement (62.5%). The lack of experienced staff is a major issue in implementing intelligent technologies, with 62.5% of clubs are identifying this as a significant barrier.

Sports federations and sports leagues can be united under a single denominator as they inherently administrate sports competitions and sports clubs as well. The difference is that sports leagues are more about developing business models for management. In this relation, the 2 sports federations participating in the study indicated that they have implemented AI technologies but focus on improving sports equipment and equitable refereeing. Meanwhile, of the 4 sports leagues participating in the study, 2 have and 2 have not implemented AI technologies, but all four indicated that a primary focus would be fan involvement, which are a generator of financial cash flows. Improving sporting achievements and equitable refereeing are also part of the priority areas with 75% and 50% of the answers respectively.

Lack of expert staff and inadequate technology infrastructure are major challenges to technology adoption implementation. 30% of the total number of respondents represent other sports organisations that are inherently part of the industry – management agencies, travel agencies, sports-related marketing agencies, sports equipment manufacturers and developers. For them also the main focus is fan involvement at 83.3% and additionally they are focused on improving sport achievement and injury prevention at 66.75%. The main motivations are increasing revenue, optimizing management and increasing the fan basis.

4.1.2. Analysis of key positioned areas for AI implementation

Fan involvement was the most frequently mentioned area for AI implementation across all organisation types, with 80% of them are identifying this area as a priority. Improving sporting performance came in second place at 60% of organisations, and injury prevention was the third place area at 35%.

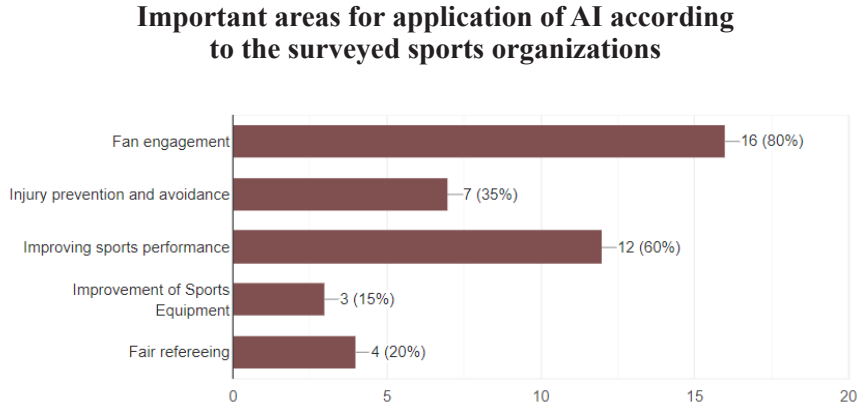

Figure 1. How sports organizations have answered the question: Which areas of AI implementation do you consider most important for your organization?

4.1.3. Motivation and barriers to AI implementation

The primary motivation for management optimization - 14 out of 20 organizations identified this motivation and 13 out of 20 organizations focused on increasing revenue. A smaller percentage of motivation was based on improving sporting achievements and increasing the fan base - 9 out of 20 organisations. The most frequently identified barriers mention financial limitations and lack of expert staff, as well as insufficient technology infrastructure.

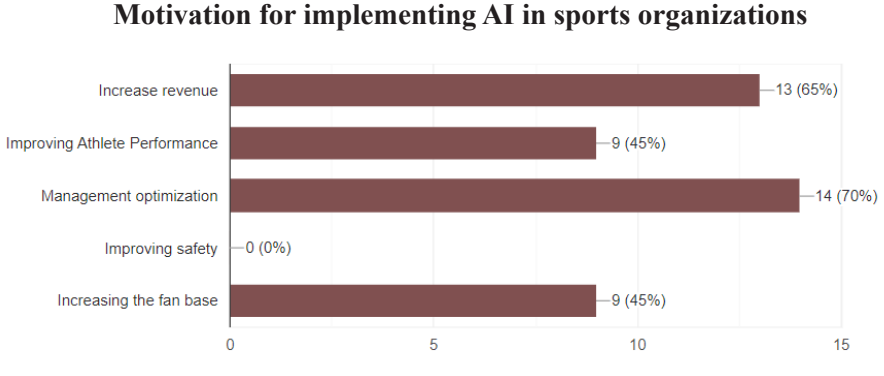

Figure 2. How sports organizations have answered the question: What is the main motivation for implementing AI in your organization?

4.1.4. Future plans for AI implementation

Many organizations declare that they plan to implement new AI technologies or expand existing ones. Only 2 out of 20 organisations do not plan to implement AI technologies in their operations at all. The concerns about the implementations are mostly related to the technological failures (70% of the answers), data protection (40%) and impact on workplaces (30%) are correlated. It can be concluded that organizations still do not trust enough in technology and its reliability.

Main concerns about implementing AI in the sports industry?

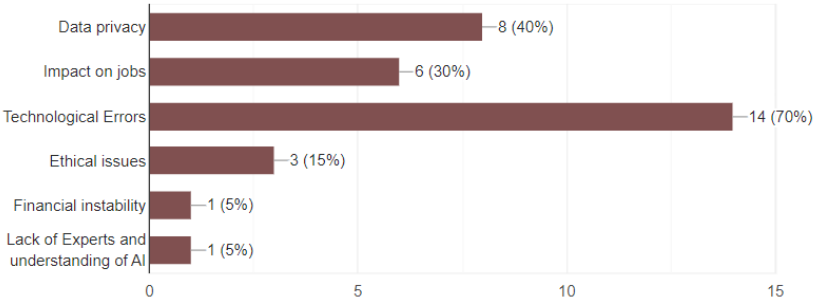

Figure 3. How sports organizations have answered the question: What are your main concerns about implementing AI in the sports industry?

4.2. Secondary data sources

The analysis of secondary datasource turns out that the main application areas of Artificial Intelligence (AI) in the sports industry are related to fan involvement, improving sports performance, injury prevention, improving sports equipment and ensuring equitable refereeing. These areas are consistent with theoretical expectations about the potential of AI in sport as outlined in the research literature.

Comparison with the results of the empirical study reveals some discrepancies between the theoretical concepts and the practical application of AI in sport organizations. While fan involvement and sport performance improvement are emerging as key positioned areas of interest both theoretically and in practice, other different areas such as injury prevention and sport equipment improvement are remaining less prominent in real-world implementations.

These differences highlight the importance of overcoming barriers to AI implementation, such as lack of experienced staff and financial constraints, which limit the full potential of these technologies in the sports industry.

While AI is establishing itself as a key positioned contributor to innovation and efficiency in sport, the need for a strategic approach and support to overcome practical challenges is essential for the future development of the industry.

5. Conclusion

The research question that guided this paper is: What are the main areas of implementation of Artificial Intelligence (AI) in the sports industry, what are their motivations, and what challenges and barriers do sports organisations face in implementing them?

Analysis of primary and secondary data reveals that AI is being implemented in several key positioned areas that are essential to the modernisation and development of sports organisations.

First, fan involvement is the most frequently mentioned area of implementation for AI, with 80% of organizations surveyed identifying it as a priority. Technology allows sports clubs and leagues to personalize content and communication with fans, leading to greater loyalty and increased revenue. This area has also been covered broadly in academic reports and articles in recent years.

Secondly, improving sports performance is the second most important area where 75% of the people surveyed see a key positioned basic implementation of AI. By analysing large volumes of datasource and using machine learning algorithms, AI assists sports teams in optimising training regimes and preventing injuries, which area in turn falls into the focus of 45% of organisations

Based on the analysis of the data collected, it is recommended that sports organizations focus on the following areas:

– Investing in AI related to fan involvement - developing personalized, data-driven marketing strategies can significantly increase the fan base and improve the financial performance of organizations.

– Supporting AI initiatives in sports performance - sports clubs and federations should continue to integrate AI technologies into the training process to optimise sporting performance and reduce the risk of injury.

– Major barriers to AI deployment need to be addressed, including lack of experienced staff and financial constraints. This can be done by collaborating with technology companies and investing in training existing staff.

In conclusion, AI provides significant opportunities to transform the sports industry. Despite the challenges present, AI is establishing itself as a key tool for achieving sustainable growth and innovation in the sports industry. The continued development and deployment of these technologies will play an important role in the future of sports organisations, while providing new opportunities to engage fans and improve sporting performance. This provides the author with a foundation to continue working on the topic and furthering his research by also focusing it on clarifying the direct and indirect effects, both from a financial perspective and a reputational one.

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