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Ethical challenges using technology in sport competitions

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Abstract

Purpose: Technologies such as artificial intelligence or tools such as AR and VR can potentially improve performance in sports. However, not all athletes, coaches, or sports clubs can access these resources. In addition, ethical issues related to data protection need to be considered. This research aims to evaluate the main challenges and potential drawbacks of using innovative technologies in sports, which may have an influence on their measures and the utility of innovative technologies.

Design/methodology/approach: Considering Ethics in Sports, Ethical Measures, and Tech Benefits, to evaluate the main challenges and potential drawbacks of tech introduction in sports, which may influence their measures and the utility of innovative technologies, quantitative descriptive research was developed, and statistical analysis was carried out.

Findings: This research found that ethical technologies in sports influence ethical measures, but technologies` utility influences ethical measures. It is necessary to broaden knowledge of the complex and dynamic relationships associated with the use of technology, to understand better the advantages and possible disadvantages associated with it, to promote the involvement of the different stakeholders, and to promote long-term engagement–the main consequences of introducing technology into sports influence both the measures and the usefulness of innovative technologies.

Research limitations/implications: This study has many limitations, namely that it includes self-reported data and has a cross-sectional design, which may cause a conscious or unconscious bias.

Practical implications: Ethical aspects of the use of technology, such as justice and equity, need to be considered.

Social implications: It is well known that some technologies and tools, such as artificial intelligence, augmented reality (AR), or virtual reality (VR), can improve performance in sports. However, not all athletes, coaches, or sports clubs have access to these types of resources, which raises an ethical question regarding parity or fairness in competitions.

Originality/value: This research finds challenges and potential drawbacks of introducing technology into sports, which influence the measures and the usefulness of innovative technologies.

Keywords: Technology in sports, Innovative technologies, Virtual reality (VR), Augmented reality (AR)

Jel Codes: M00; M53

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1. Introduction

The use of AI has been widely recognized in several fields of research, such as medicine, businesses, entertainment, and sports (Soni, Sharma, Singh & Kapoor, 2020; Marr & Ward, 2019). The multiple philosophical and practical challenges, both current and future, arise from artificial intelligence (Kulkarni, Mantere, Vaara, van den Broek, Pachidi, Glaser et al., 2024). Despite such importance, the study of AI in sports is still in its infancy, particularly regarding AI ethics (Resseguier & Ufert, 2023). On the one hand, using of technologies such as artificial intelligence or tools like AR and VR can help improve performance in various professional activities, such as sports. On the other hand, in terms of ethics and fairness, both in competitions and in the way technologies are used, not all athletes, coaches, or sports clubs have access to this type of resource.

Decision-making comes in many forms: from historical reviews of match and training demands, through daily real-time decision support, to proactive planning for the future (West, Clubb, Torres-Ronda, Howells, Leng, Vescovi et al., 2021). However, the following questions arise: can the introduction of the use of technologies in sports, such as artificial intelligence or AR/VR, influence performance? And would these influence competitions fairly? What is the role of ethics in the use of this type of resource?

The sports industry increasingly relies on accurate, precise, and timely information for long-term planning and data management. Information technology has transformed sports events, improved training performance, and reached more fans. The internet provides access to sports education and achievements, making travel unnecessary. The development of information and communication technologies (ICT) in sports is crucial for advancing sports and achieving success. Some studies examine digital and engineering innovations in sports, including adaptive equipment, wearable devices, analytics tools, and virtual platforms. Organizations must identify barriers to utilizing ICT and develop targeted programs to enhance productivity and efficiency (Qi, Sajadi, Baghaei, Rezaei & Li, 2024).

Faced with these questions, this research has set itself the principal objective. The research aims to evaluate the main challenges and potential drawbacks of using innovative technologies in sports, which may have an influence on their measures and the utility of innovative tecnologies.

The study was carried out in Romania due to several intersecting factors. First, Romania presents a compelling case study of a country where technological innovation in sport is still emerging, and ethical challenges are particularly pronounced due to limited access to advanced tech (e.g., VAR, AI tools). This makes it a revealing environment for analyzing tech-ethics tensions, unlike in countries with fully embedded systems. Unlike some Western European contexts, Romania lacks comprehensive ethical governance structures surrounding tech in sports, offering a fertile ground to observe how stakeholders perceive and navigate these issues. The researchers had direct access to professional networks within Romanian football, mainly through the National University of Physical Education and Sport and the Romanian Football Federation. This ensured high-quality, context- specific data collection.

A descriptive quantitative study was carried out through a questionnaire. The questionnaire aimed to evaluate the main challenges and potential drawbacks of using innovative technologies in sports from an ethical perspective and the measures that might prevent the overuse of technology. The instrument was designed to be applied online by Google Forms and was applied especially to coaches of Romanian. Thus, it is suggested to focus on maximizing performance. This survey was inspired by research that combines quantitative and qualitative methods to provide a comprehensive understanding of how these technologies enhance operations in the sports industry. The study uses a quantitative survey of 21 sports organizations to examine their adoption rates and perceived impacts on performance, injury reduction, and operations improvement (Qi et al., 2024).

Even so, other authors (Sampedro - Advanced Olympic Research Grant Programme) affirm there is a gap in the literature regarding representative studies that map the knowledge and viewpoints of players, coaches, and referees regarding the growing application of artificial intelligence in sports is another significant shortcoming (Sanpedro, 2023).

These suggestions can potentially improve understanding of the dynamic relationships between these variables, particularly between the overuse of technology and its benefits, and promote long-term commitment through successful measures.

Based on three dimensions of variables, the Ethics of the use of technology in sports, the measures to avoid the excessive use of technology, and the Technological Benefits related to the usefulness of innovative technologies, this research chose to apply a questionnaire to sports professionals and coaches.

The structure of this paper presents the fundamentals of ethics of using technology in sports by explaining the important references about ethics of using technology in sports and ethical measures. Afterwards, the paper presents the methodology of the research, as well as results, discussion, and main conclusions. Finally, the study's limitations and suggestions for future research are presented.

2. Theoretical Ethical Perspectives on Technology in Sport

To deepen the ethical analysis beyond operational concerns, this study integrates three foundational ethical frameworks – distributive justice, deontological ethics, and virtue ethics – illuminating the normative dimensions of technology use in sports.

From the perspective of distributive justice, particularly Rawlsian theory, fairness requires that any advantage (such as access to performance-enhancing technologies) be structured to benefit the least advantaged. The unequal availability of technologies like AI-assisted coaching, virtual reality (VR), or biometric tracking in Romanian football –and less-resourced contexts more broadly– risks exacerbating competitive inequality (Laukyte, 2020). If innovation reinforces already-existing hierarchies between clubs or nations, the ethical foundation of fair competition is undermined.

Secondly, deontological ethics emphasizes duties and moral rules, particularly the responsibility to treat individuals as ends, not merely means. This is highly relevant to data ethics, where technologies gather and process personal and sensitive biometric information. The ethical application requires robust consent procedures, privacy safeguards, and transparency – obligations that should not be bypassed even when the utility for performance improvement is high (Karkazis & Fishman, 2017; Dhiman, Juneja, Mohafez, El-Bayoumy, Sharma, Hadizadeh et al., 2022).

Third, virtue ethics, which focuses on individuals' character and moral development, provides a lens to assess how technological over-reliance might reshape core values in sports. Overdependence on VAR, wearables, or algorithmic decision-making may diminish the development of critical virtues such as resilience, judgment, and responsibility among athletes, referees, and coaches (Williams & Manley, 2016; Galily, 2024). It also risks eroding spectators' sense of the game's authenticity – a concern that transcends utility and touches on meaning.

By embedding these normative perspectives into the empirical findings, we move beyond a checklist approach to ethics and engage with more profound moral questions about what kind of sporting future we are designing. Ethical decision-making in sports must manage risk and reflect on the values we prioritize – from fairness and autonomy to excellence and human dignity.

3. Ethical & Sport

Monitoring athletes is crucial for modern sports scientists (West et al., 2021). However, the use of human enhancement technologies in sports must include ethical conduct (Miah, 2020). In addition, the development and publication of codes of conduct were considered relevant (Resseguier & Ufert, 2023), but they need to keep up with the dynamics of behaviors, i.e. they need structural revisions (Waddington, Scott-Bell & Malcolm, 2017).

Another important point is to give users control (Kerr, Kidd & Donnelly, 2020) over their data, allowing them to make choices about information collection, privacy, and digital footprint (Karkazis & Fishman, 2017; James, Weinstein & Mendoza, 2019) (Control). In this sense, it is suggested to continually monitor technological advances and their social implications. Codes of conduct were considered relevant (Resseguier & Ufert, 2023), but they need to keep up with the dynamics of behaviors, i.e., they need structural revisions (Waddington et al., 2017).

3.1. The Ethical Use of Innovative Technologies in Sport

Regarding the ethics of using technology in sports, it is necessary to develop some guidance. The objective is to help people with decisions that may maximize the performance of athletes who play sports and promote the well-being and success of the team (West et al., 2021). In this sense, it becomes possible to assess how technology can be accessible to all participants without compromising aspects related to fairness (Serrano-Durá, Molina & Martínez-Baena, 2021; Grady, 2023) (DataProtect).

Another concern relates to the secure storage of sensitive information and the responsible handling of data (Sun, Han, Li, Wang, Chang & Wu, 2022; Grady, 2023) (Stock). It is also necessary to find a balance because an excessive dependence on technology can undermine the integrity and authenticity of sports competitions (Serrano-Durá et al., 2021; Williams & Manley, 2016; Lazareva & Brigadnova, 2020) (Balance).

The use of video assistant referee (VAR) technology in association football is an example of how technology can be used to aid decision-making (Spitz, Wagemans, Memmert, Williams & Helsen, 2021), and more recently, VAR has been used in other sports also (Armenteros, Benítez & Betancor, 2019). VAR provides information that aids decision-making. It should, therefore, be used as an auxiliary tool (Galily, 2024).

Aiming to ensure fair competition, the potential for errors, biases, or technology manipulations should be minimized to ensure the integrity of the game (TechTest). Video assistant referees (VAR) aim to help the referee when in doubt without interfering with the game's pace (Nuhrat, 2023; Spitz et al., 2021).

On one side, rules, regulations, and standards for using technology in sports must be clear to ensure the playing field is level for all participants (Hardes, 2017; Karale, 2021) (Rules). Conversely, technology should not be responsible for barriers to participation for athletes with limitations or disabilities (Wei, Zhang, Lyulyov & Pimonenko, 2023; Sand, Schmidt, Pillmayer & Scherle, 2023; Bossey, 2020; Ballas, Buultjens, Murphy & Jackson, 2022) (Handicap). Prioritizing athlete safety and well-being is essential. In this sense, it is crucial to evaluate the benefits of new technologies and potential risks (Lee, Ahn & Lee, 2023; Kim, 2013; McCaughtry, Oliver, Dillon & Martin, 2008; Miah, 2020) (Health). Table 1 presents the main challenges and potential drawbacks of technologies in sports.

Sub Items	Abbreviation	Description
Data protect	DataProtect	The ethical use of technology in sports aims to help maximize performance, promote well-being, and increase team success (West et al., 2021), while maintaining fairness (Serrano-Durá et al., 2021; Grady, 2023)
Stock	Stock	The secure storage of sensitive information (Sun et al., 2022; Grady, 2023)
Balance	Balance	Integrity and authenticity of the competitions should be provided (Serrano-Durá et al., 2021; Williams & Manley, 2016; Lazareva & Brigadnova, 2020) (Balance).
Technology tests	TechTest	The use of technology such as the video assistant referee (VAR) (Spitz et al., 2021; Armenteros et al., 2019) can increase assertiveness in case of doubt (Nuhrat, 2023; Spitz et al., 2021).
Limitations (rules)	LimitExcess	VAR should be used as an auxiliary tool (Galily, 2024)
Health	Health	Benefits and potential risks of new technologies (Lee et al., 2023, Kim, 2013; McCaughtry et al., 2008; Miah, 2020)
Handicap	Handicap	Technology cannot be considered a barrier, particularly for athletes with special needs (Wei et al., 2023; Sand et al., 2023; Bossey, 2020; Ballas et al., 2022)
Rules	Rules	Rules and regulations should ensure fairness in competitions (Hardes, 2017; Karale, 2021).

Table 1. Indicators associated with Ethics of using innovative technologies in Sport

In other words, the Ethics of using innovative technologies in sports includes data protection, storage of sensitive information, balance, testing technologies, implementing rules, including athletes with limitations or disabilities, and promoting healthy benefits, as well as avoiding risks.

3.2. Theoretical Dimensions to Measure the Ethical Use of Innovative Technologies in Sports

The Ethics of using technology in sports could explore four modes: coercive, persuasive, decisive, and seductive. The invisibility of seductive mediation of technology, where both sources and means are invisible, has specific implications for organization studies (Greenwood & Cox, 2023).

Educating people involves learning about the potential risks and developing some ethical considerations associated with using technology (Snegireva, Derman, Patricios & Welman, 2020; Guo & Li, 2021; Devecioglu, Sahan, Tekin & Yildiz, 2012; Zhang, 2017; Miah, 2020) (Edu). It is becoming crucial to develop ethical guidelines and regulations for developing, implementing, and making use of technology (Hardes, 2017; Karale, 2021) (Guidelines), and encouraging technology companies to adopt responsible practices that prioritize the users' well-being (Han & Liao, 2022; Sato, Tsuda, Ellison & Hodge, 2020; McCullough & Trail, 2023; Macassa, McGrath, Tomaselli & Buttigieg, 2021) (Company).

It is considered necessary to develop audits and evaluations of technological systems and their algorithms to identify and rectify any ethical issues or even prejudices that may occur (Han & Liao, 2022; Sato et al., 2020; Djaddang & Lysandra, 2022; Fülöp, Cordoș & Măgdaș, 2020) (Audit). It is also considered necessary to develop and enforce ethical standards for using artificial intelligence (AI) systems and algorithms (Liu & Jin, 2023; Karkazis & Fishman, 2017; Laukyte, 2020) (Supervise).

Another critical point is to give users control (Kerr et al., 2020) over their data, allowing them to make choices about information collection, privacy, and digital footprint (Karkazis & Fishman, 2017; James et al., 2019) (Control). In this sense, it is suggested that technological advances and their social implications be monitored continually.

Collaboration between technology developers, policymakers, researchers, and civil society organizations (Kerr et al., 2020) must be assessed in an integrated manner (Laktić & Pezdevšek-Malovrh, 2018; Hantrais & Lenihan, 2021), as must the consequences of such collaboration (Duarte, Culver & Paquette, 2020; Ekholm & Holmlid, 2020) (Collaboration).

Furthermore, it is important to highlight the relevance of initiatives that educate individuals (Opstoel, Chapelle, Prins, De Meester, Haerens, van Tartwijk et al., 2020) about having good technological habits (Blake, Vaughan, Bartle, Yarker, Munir, Marwaha et al., 2022), which promote well-being in the digital environment and encourage the conscious and balanced use of technology (Blake et al., 2022; Huda, 2019) (Health Custom), addressing the negative or unethical consequences of technology (Liu & Jin, 2023; Karale, 2021) (Consequences). Table 2 presents indicators to evaluate Ethics.

Sub items	Abbreviation	Description
Education	Edu	Learning addresses ethical considerations and potential risks of technology (Snegireva et al., 2020; Guo & Li, 2021; Devecioglu et al., 2012; Zhang, 2017; Miah, 2020)
Guidelines	Guidelines	It is crucial to regulate the use of technology (Hardes, 2017; Karale, 2021).
Company	Company	Companies should prioritize the well-being of users (Han & Liao, 2022; Sato et al., 2020; McCullough & Trail, 2023; Macassa et al., 2021)
Auditing	Audit	Audits and evaluations of technological systems help to identify and rectify the process (Han & Liao, 2022; Sato et al., 2020; Djaddang & Lysandra, 2022; Fülöp et al., 2020)
Supervising	Supervise	The supervision of artificial intelligence (AI) systems and algorithms are crucial for ethics (Liu & Jin, 2023; Karkazis & Fishman, 2017; Laukyte, 2020)
Controlling	Control	Empowering users means giving them control (Kerr et al., 2020), which favors decisions and ensures privacy (Karkazis & Fishman, 2017; James et al., 2019)
Collaboration	Collaboration	Collaboration allows greater integration (Laktić & Pezdevšek-Malovrh, 2018; Hantrais & Lenihan, 2021), better policies (Kerr et al., 2020), and better impact (Duarte et al., 2020; Ekholm & Holmlid, 2020)
Health Custom	Health Custom	Initiatives should educate individuals (Opstoel et al., 2020) and promote good technological habits (Blake et al., 2022)
Consequences	Consequences	The positive impact is well-being and balance in the digital environment (Blake et al., 2022; Huda, 2019)

Table 2. Indicators to measure the ethical use of technology in sport

Thus, the Ethical measures in sports include educating, guiding, involving companies, auditing, supervising, controlling, collaborating, having good technological habits, and evaluating the consequences. Considering that there are challenges and potential drawbacks of introducing technology into sports which may influence ethical measures that must be taken to prevent the overuse of technology can lead to various negative and unethical issues, the first hypothesis is:

H1. The challenges and potential drawbacks of tech immersion in sports influence ethical measures.

To evaluate the ethical use of innovative technology in sports, this research chooses to explore the benefits and utilities of the use of new technologies in sports competitions.

3.3. Benefits and Utilities of Using Innovative Technologies in Sport

Analyzing performance with sensors and portable devices such as VR/AR (Aghilidehkordi, 2020) used in athletes' training (So, Crystal, Jihye & Chang, 2018; Schack, Junior & Essig, 2020) (VR/ARsim) should be evaluated in the use of technologies in sport (Johnston, Judice, García, Mühlen, Skovgaard, Stang et al., 2021; Frevel, Beiderbeck & Schmidt, 2022) (Perform_senz). Besides, some tracking devices can provide real-time feedback (Johnston et al., 2021; McCaughtry et al., 2008; Bodemer, 2023) (Feedback). In addition, AI and data analysis can be used to train, coach, and design strategies (Apuzzo, 1996; Guo & Li, 2021; Sampedro, 2021) (AI strategy).

Athletes can use health monitoring systems during training and competitions (Johnston et al., 2021; McCaughtry et al., 2008; Montull, Slapšinskaitė-Dackevičienė, Kiely, Hristovski & Balagué, 2022; Clarsen, Steffen, Berge, Bendiksen, Fossan, Fredriksen et al., 2021) (Monitor). It could help to prevent injuries (Karkazis & Fishman, 2017). Finally, video recording and biomechanical analysis are used to correct the individual technique (Guo & Li, 2021; Lucarno, Zago, Buckthorpe, Grassi, Tosarelli, Smith et al., 2021) (VideoBio). Table 3 presents indicators of the utility of innovative technologies.

Sub items	Abbreviation	Description
Perform analysis	Perform_senz	Perform analysis with sensors and wearable devices
VR/AR	VR/ARsim	Accept the/AR use in athletes' training
Real-time feedback	Feedback	Track devices to provide real-time feedback
Design training strategies	Ai strategy	Ai and data analysis are used to design training strategies.
Using video and biomechanical analysis	VideoBio	Use video recording and biomechanical analysis to correct the individual techniques
Monitor	Monitor	Monitoring the athlete's health during training and competitions, to prevent injuries.

Table 3. Indicators of benefits and utilities obtained using new technologies in sport

Benefits of improved utility obtained from using technologies include performance, using VR/AR, providing real-time feedback, AI strategy, video recording, biomechanical analysis, and monitoring systems. Considering that there are challenges and potential drawbacks of introducing technology into sports with significant contributions in this field, which may influence how to utilize these innovative technologies to ensure meaningful contributions in the field of sports, the second hypothesis is:

H2. The challenges and potential drawbacks of tech immersion in sports influence the utility of innovative technologies.

The resumes of these variables and respective indicators of using innovative technologies in sports are presented in Table 4.

Variable	Indicators	Description
Ethics of using innovative technologies in sports (challenges and potential drawbacks of tech introduction in sport)	Dataprotect	Assess how technology can be made accessible to all participants to maintain fairness.
	Stock	Securely store and responsibly handle sensitive information.
	Balance	Overreliance on technology may undermine the integrity and authenticity of sports competitions.
	Techtest	The potential for errors, biases, or manipulation in technology should be minimized to ensure the integrity of the game.
	Limit_excess	To enhance fairness, var should not excessively interrupt the flow and rhythm of the game or undermine the authority of officials.
	Health	Prioritizes athletes' safety and well-being by thoroughly evaluating new technologies' potential risks and benefits.
	Handicap	Ensuring that technology doesn't unintentionally create barriers to the participation of athletes who may have limitations or disabilities
	Rules	Clear rules, regulations, and standards for the use of technology in sports, ensuring a level playing field for all participants.
Ethical measures (measures to prevent the overuse of technology can lead to various negative and unethical issues)	Edu	Educate people about the potential risks and ethical considerations associated with technology
	Guidelines	Guide ethical guidelines and regulations for the development, deployment, and use of technology
	Company	Encourage technology companies to adopt responsible design practices that prioritize user well-being and ethical considerations.
	Audit	Audit and assess the technology systems and algorithms to identify and rectify any ethical issues or biases.
	Supervise	Develop and enforce ethical standards for artificial intelligence (AI) systems and algorithms
	Control	Give users control over their data and enable them to make informed choices about their privacy and digital footprint
	Collaboration	Develop collaboration with technology developers, policymakers, researchers, and civil society organizations
	Health custom	Initiating education for individuals on healthy technology habits

	Consequences	Address the negative and unethical consequences of technology
Tech utility (the utility of innovative technologies with significant contributions in the field of sports is)	Perform_senz	Perform analysis with sensors and wearable devices
	VR/ARsim	Accept VAR/AR use in athletes' training
	Feedback	Track devices to provide real-time feedback
	Ai strategy	AI and data analysis are used to design training strategies.
	VideoBio	Use video recording and biomechanical analysis to correct the individual techniques
	Monitor	Monitoring the athlete's health during training and competitions, to prevent injuries.

Table 4. Variable dimensions and respective indicators of using the innovative tecnologies in sports

Based on three dimensions of variables, Ethics of using technology in Sports, which is related to the use of innovative technologies in sports, Ethical Measures are related to measures to prevent the overuse of Technology, which can lead to various negative and unethical issues, and Tech Benefits that is related to the utility of innovative technologies with significant contributions in the field of sports is, this research chose to develop an instrument to be applied to sports professionals and coaches.

3.4. Conceptual Foundation of the Adaptive Capacity Index

Adaptive capacity, as conceptualized in this study, refers to the ability of sports institutions and professionals to respond ethically, effectively, and sustainably to the increasing integration of innovative technologies. This concept draws from broader frameworks in resilience theory (Folke, Carpenter, Walker, Scheffer, Chapin & Rockström, 2010), organizational learning (Argyris & Schön, 1996), and adaptive governance (Chaffin, Gosnell & Cosens, 2014), which emphasize flexibility, feedback, and stakeholder inclusion in dynamic systems.

In the context of sports technology, adaptive capacity involves aligning ethical awareness, regulatory mechanisms, and practical utility in the face of rapid digital transformation. This triadic structure mirrors similar models used in environmental governance and public health, where ethical, procedural, and functional capacities are balanced to enhance systemic resilience (Engle, 2011; Gupta, Termeer, Klostermann, Meijerink, van den Brink, Jong et al., 2010).

The study focuses on three dimensions in the sport-tech ecosystem: ethical tech use (Laukyte, 2020; Resseguier & Ufert, 2023), ethical measures (Chaffin et al., 2014; Hardes, 2017), and tech utility (OECD, 2022; Kulkarni et al., 2024). The indicators are grouped based on theoretical grounding from multidisciplinary literature and empirical relevance, particularly in the Romanian sports context. The study aims to evaluate static perceptions and capture how sports professionals can anticipate, absorb, and reshape ethical and technological challenges over time, addressing institutional fragility and uneven access to digital tools (Qi et al., 2024).

4. Methods

From an ethical perspective, the research aims to evaluate the main challenges and potential drawbacks of using innovative technologies in sports, which may influence the measures that the athletes and trainers might apply to get the most out of the utility of technology in sports and the utility of innovative technologies. A descriptive statistical analysis was developed. In this sense, the research presents the instrument and explains the sample and data analysis.

4.1. Developing the Research Instrument

Considering those three dimensions of variables, Ethics of using technology in sports, Ethical Measures, and Tech Benefits, to evaluate the main challenges and potential drawbacks of tech introduction in sports, which may influence on their measures and the utility of innovative technologies, this research developed the questionnaire with four sections. The questionnaire aimed to evaluate the main challenges and potential drawbacks of using innovative technologies in sports from an ethical perspective. In the first part, the questionnaire aimed to assess the main challenges and potential drawbacks of using innovative technologies in sports (Ethics of using technology in sports). The second part of the questionnaire aimed to evaluate Ethical measures that might prevent the overuse of technology, which can lead to multiples negative and unethical matters (measures to prevent the overuse of technology can lead to various negative and unethical issues). The third part of the questionnaire evaluated the utility of innovative technologies with significant contributions in sports (Tech utility). The last section contains socio-demographic information.

Each section corresponds to a theoretical dimension with its respective indicators. These indicators are sub-items that specify a category. It is important to highlight that the instrument was designed to be applied online using Google Forms. The link to the survey was sent via WhatsApp.

The survey was inspired by a study exploring digital technology adoption in 21 sports organizations, focusing on performance, injuries, operations, and fan experience. It found that analytics, wearables, management information systems, and fan engagement platforms significantly enhance organizational performance. Emerging technologies like augmented reality and AI coaching have potential, but implementation challenges include financial considerations, skills gaps, resistance to change, and ethical risks (Qi et al., 2024). The questionnaire was created based on the literature review. A pre-test was carried out.

4.2. Universe and Sample

Soccer is probably the most lucrative sport and, for this reason, the one with the most resources and investment. New technologies are expensive resources. Not all sports have access to most of these innovative technologies, such as Video Arbitrage, for example. For this reason, the survey was developed to be applied especially to soccer coaches.

Considering the relevance of the Romanian National Football Federation, the respondents identified were those involved in soccer and professors (trainers of the new generations of coaches) from the National University of Physical Education and Sport in Bucharest and the University of Cluj-Napoca. The questionnaire was applied between September and January 2023.

The universe is limited and is a non-probabilistic sample, which justifies the sample size. Nevertheless, this sample size is statistically sufficient to support the conclusions, although it is necessary to safeguard its coverage.

The reliability and quality of the study were ensured by the rationale, but above all by the coherence between the research plan and the results. The fact that this is a cross-sectional study, which limits inferences, does not call the study's reliability into question, as there is consistency between the sample (respondents associated with the sport with the most access to new technologies - soccer) and the results.

4.3. Data Analysis

The data was examined using partial least squares structural equation modeling (PLS-SEM). This statistical method makes it possible to analyze the influences of many variables. Structural equation modeling is a reliable statistical analysis that allows for the simultaneous analysis of several direct and indirect relationships between variables through a structural model.

Regarding data analysis, this study used SmartPLS software to provide a path analysis. This path analysis allows researchers to test the model's hypotheses and assess the significance of interactions (influences of these variables). In addition to this analysis, the relationship between variables was evaluated using Confirmatory Factor Analysis. It is important to highlight that the questionnaire was answered voluntarily, and permission to use the data was sought from all respondents. All the respondents agreed to use their answers. Otherwise, the questionnaire would be submitted before being completed. The data was treated anonymously.

5. Results

The results obtained 230 collected answers, but only 213 were validated and included in the analysis. Faced with a limited universe and increased difficulties in collecting responses, a sufficient sample was considered representative to develop the analysis. The statistical analysis excluded incomplete answers. Regarding the descriptive statistics for socio-demographic variables, the distribution of respondents in the different age groups is balanced, with the respondents being more representative of the study's ages from 19 to 25 years old (36.15 %). The same repartition is observed regarding the profession. The coaches/trainers have a slightly higher representation (28.27 %). Due to it being a convenience sample and because most soccer managers are men, most respondents are men (80.75 %), which may justify the lower representation of women in women's football professional practice. Regarding education, most of the respondents have higher education degrees (50.23 %) or master's degrees (35.21 %). Finally, regarding the location zone, the majority is from a rural zone (77.46 %).

5.1. Normalization

Each indicator in the questionnaire was scored on a standardized Likert scale (from -2 to +2), ensuring that the data were normalized before model testing.

Applying parametric tests because most variables were measured on a Likert scale. The mean of these variables was greater than 1.2, meaning a very high value, because a Likert scale with five steps (-2 totally disagree; -1 disagree; 0 neutral; 1 agree; 2 totally agree) was used.

Standard deviations are low, and the sample is homogeneous. This means the respondents agree with the ethical measures of applying technology in sports.

Skewness helps to ensure the distribution validation, and Kurtosis indicates the tailed data in relation to a normal distribution. These values were included in the interval [-1.96; 1.96], which means that it is acceptable. These results of Skewness and Kurtosis were presented in Table 5 to ensure and validate statistical assumptions despite the Standard error of Skewness (0.17) and Kurtosis (0.33) being low, meaning that calculations are accurate.

Variables / sub-items	N	Mean	Median	Mode	Std. Deviation	Skewness (*)	Kurtosis (*)
Perform_senz	213	1.63	2	2	.60	-1.38	.86
VR/ARsim	213	1.37	2	2	.71	-.68	-.77
Feedback	213	1.57	2	2	.62	-1.17	.28
AIstrategy	213	1.34	1	2	.73	-.62	-.90
VideoBio	213	1.62	2	2	.60	-1.33	.74
Monitor	213	1.55	2	2	.64	-1.11	.12
DataProtect	213	1.21	1	1	.73	-.34	-1.06
Stock	213	1.34	1	2	.69	-.56	-.77
Balance	213	1.26	1	2	.74	-.46	-1.04
TechTest	213	1.31	1	2	.73	-.55	-.96
LimitExcess	213	1.29	1	2	.73	-.50	-.99
Health	213	1.21	1	2	.75	-.36	-1.14
Handicap	213	1.14	1	1	.74	-.23	-1.14
Rules	213	1.30	1	2	.74	-.54	-.98
Edu	213	1.21	1	1	.72	-.33	-1.04
Guidelines	213	1.25	1	2	.73	-.42	-1.02
Company	213	1.24	1	1	.73	-.40	-1.04
Audit	213	1.22	1	1	.73	-.36	-1.05
Supervise	213	1.13	1	2	.79	-.23	-1.38
Collaboration	213	1.19	1	1	.74	-.33	-1.13
Control	213	1.28	1	2	.73	-.49	-.99
DigitalWellbeing	213	1.18	1	2	.77	-.32	-1.24
Health Custom	213	1.24	1	2	.76	-.44	-1.16
Progress	213	1.24	1	2	.75	-.43	-1.13
Consequences	213	1.23	1	2	.73	-.40	-1.06
Age	213	2.19	2	1	1.12	.41	-1.22
Gender	213	1.19	1	1	.40	1.57	.47
Profession	213	2.47	3	3	1.26	-.33	-1.10
Education	213	2.33	2	2	.72	.10	-.21
Zone	213	1.23	1	1	.42	1.32	-.25

(*) Significance: [-1.96; 1.96]

Table 5. Skewness, Kurtosis, and other descriptive statistics analysis. (SPSS analysis (reprinted on 18 January 2024))

5.2. Weighting and Aggregation

Indicators were modeled as **reflective indicators**, and the latent constructs were analyzed through the PLS algorithm, which estimates outer weights and path coefficients using a series of regression equations (Lohmöller, 1989). This method ensures that weights are data-driven and not arbitrarily assigned.

This study emphasizes the following key variables: TechUtility, EthicTech, and Ethic Measures. The research looked at the questionnaire components, creating questions to gauge the variables and determine how important they are in relation to one another. The questions were created by summing up all the replies (across the total score) and comparing each response option. The survey is reliable and consistent in this instance.

As these are simultaneous relationships of influence, the correlational analysis was considered assertive (Hair, Hult, Ringle & Sarstedt, 2017; Ringle, Wende & Becker, 2015). PLS-SEM statistical robustness is present in the literature (e.g., Hair et al., 2017; Ringle et al., 2015). All variables were analyzed as reflective, and the results emphasize that if the technology is used in sports following ethical principles, it has a positive impact and utility in sports. This assumption was proved by a high path coefficient (EthicTech TechUtility: 0.552).

The ethical use of technologies influences their usefulness. Likewise, the use of technologies influences the ethical measures of this. The technology used in sports under ethical principles requires meeting specific measures to avoid overuse. This second assumption was proved by a high path coefficient (EthicTech Ethic Measures: 0.813), as might be observed in Figure 1.

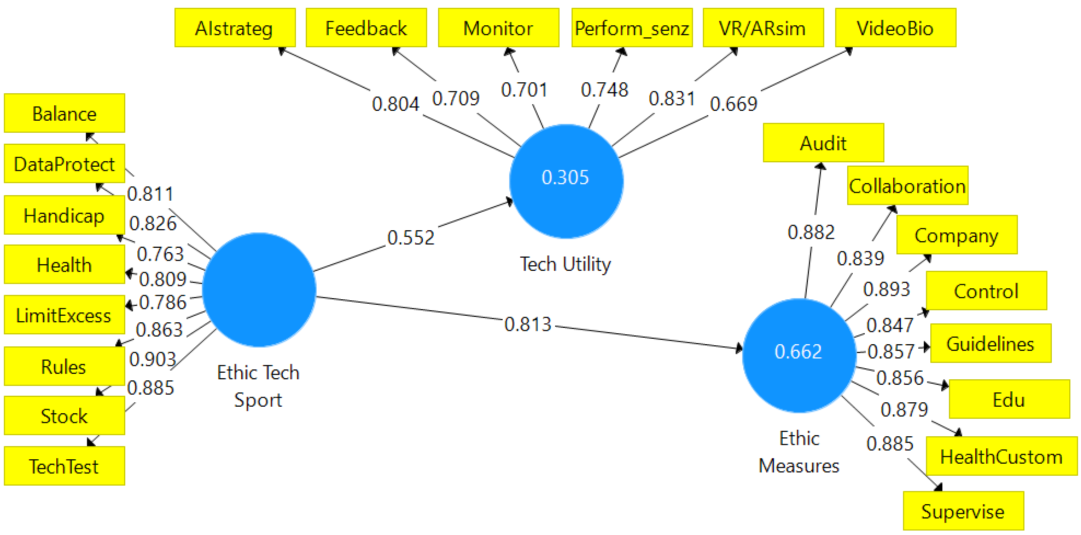

Figure 1. Path analysis of R2 by SmartPLS software (SmartPLS analysis (reprinted from SmartPLS software, version 3.3.9, created on 9 January 2024 (Ringle et al., 2015))

One may observe that all sub-items that form the main variables have very high loading factors (greater than 0.7), meaning they are all very important factors that explain the relationship between these variables. In addition, the path coefficient is equal to the correlation coefficient in this model, meaning there is a very high positive correlation between EthicTech and Ethic Measures (0.813). Another medium positive correlation between EthicTech and TechUtility (0.552) and between Ethic Measure and TechUtility (0.481). In addition, the R Square Adjusted value proved that 66 % of the variance of TechUtility is explained by the EthicTech, and 30.1 % of the variance of Ethic Measure is explained by the EthicTech.

Another important data is F square vàlues: Ethical Tech Sport - Ethical Measures (F=1.956), Ethical Tech Sport - Et Tech utility (F=0.438) and R Square Adjusted values: Ethical Measures (R^2adj= 0.660) and Tech utility (R^2adj = 0.301). All these vàlues are higher than the admitted threshold, meaning that this assumption is correct, as might be observed in Table 6.

F Square	Ethical Measures	Tech utility	R Square Adjusted
Ethical Measures			0.660
Ethical Tech Sport	1.956	0.438	
Tech utility			0.301

Table 6. The variance is explained (SmartPLS analysis (reprinted from SmartPLS software, version 3.3.9, created on 18 January 2024 (Ringle et al., 2015))

5.3. Validation

Instead of PCA or Exploratory Factor Analysis, we used **Confirmatory Factor Analysis (CFA)** and PLS-based metrics for construct validity: Convergent validity was verified using Average Variance Extracted (AVE > 0.5); Internal consistency was established using Cronbach's Alpha and Composite Reliability (CR > 0.88); Discriminant validity was verified through the Fornell-Larcker criterion and HTMT ratios, ensuring construct uniqueness.

For higher confidence in the regression model, it is important to select items according to how they pertain to the overall score after assessing the connections between each item and the overall score and between each item and each other. Thus, the investigation decided to calculate Cronbach's alpha (CA) index for this procedure. CA ranges from 0 to 1. A scale is considered consistent if its value is more than 0.70 (Tavakol & Dennick, 2011), according to the majority of academics. In PLS-SEM (CTA-PLS), confirmatory tetrad analysis could discriminate between reflecting and formative estimation strategies (Gudergan, Ringle, Wend & Will, 2008). The procedure is like Bollen and Ting's confirmatory technique of evaluating model-implied vanishing homologous pairings in the PLS-SEM setting (Bollen & Ting, 2000), except for the bootstrapping procedure employed to evaluate the predictive power of the model-implied tetrads (Gudergan et al., 2008).

Steps one through three should be taken to create the Partial Least Squares Algorith m (PLS) (Wold, 1982): (1) estimation of latent variable scores; (2) computation of outer weights and path coefficients; and (3) placement of variables (Lohmöller, 1989) as a sequence of regression models concerning different weights. The Path Coefficient PLS Analysis (PLS) may be created with SmartPLS 3.0 software (Hair et al., 2017; Ringle et al., 2015; Henseler, Ringle & Sarstedt, 2012). All the aforementioned affirmations are supported by the data in Table 7, where the indicators have values greater than the threshold.

	Cronbach's Alpha	rho_A	Composite Reliability	AVE
Threshold	>0.7	>0.7	>0.7	>0.5
Ethical Measures	0.961	0.961	0.961	0.753
Ethical Tech Sport	0.947	0.949	0.947	0.692
Tech utility	0.886	0.886	0.882	0.557

Table 7. Model validation criteria - Construct Reliability and Validity (SmartPLS analysis (reprinted from SmartPLS software, version 3.3.9, created on 18 January 2024 (Ringle et al., 2015))

The discriminant validity criterion Fornell-Larcker is met because the values on the diagonal matrix are larger than all values below them (in the same row and column) as may be seen in Table 6. Thus, the investigation may assume that these variables were distinct from each other, as noted in Table 8.

Fornell-Larcker Criterion	Ethical Measures	Ethical Tech Sport	Tech utility
Ethical Measures	0.868		
Ethical Tech Sport	0.813	0.832	
Tech utility	0.481	0.552	0.746

Table 8. Discriminant Validity (SmartPLS analysis (reprinted from SmartPLS software, version 3.3.9, created on 18 January 2024 (Ringle et al., 2015))

5.4. Model Fit

We reported model fit statistics including **SRMR = 0.046** and **NFI = 0.863**, which indicate good model performance (Hair, Hult, Ringle & Sarstedt, 2022). Bootstrapping (5,000 samples) confirmed the statistical significance of all path coefficients.

The Standardized Root Mean Square Residual (SRMR), which has a value less than 0.1 (Diamantopoulos & Siguaw, 2006), explains a good match. The parameters d ULS and d G represent the squared Euclidean distance and the geodesic distance, respectively, and were used to determine the discrepancy depending on the eigenvalue value. To determine the Standardized Fit Index (NFI), also known as the Bentler and Bonett Index (NFI) (Van Laar & Braeken, 2002), the investigation subtracts Chi2 from 1. More model parameters lead to a better (larger) NFI result (Hair et al., 2022). Comparing the estimated values and saturated values of the models, the estimates for SRMR, (Saturated = 0.045, Estimated = 0.046), d ULS (Saturated =0 .519, Estimated = 0.540), d G (Saturated = 0.589, Estimated = 0.590), and Chi-Square (Saturated = 611.234, Estimated = 611.821) are greater. The higher the NFI (0.863), the better the model. Thus, the investigation may assume that the model is trustworthy and supports these variables and their corresponding relationships, as shown in Table 9.

Model fit	Saturated Model	Estimated Model
SRMR	0.045	0.046
d_ULS	0.519	0.540
d_G	0.589	0.590
Chi-Square	611.234	611.821
NFI	0.863	0.863

Table 9. Model Fit (SmartPLS analysis (reprinted from SmartPLS software, version 3.3.9, created on 18 January 2024 (Ringle et al., 2015))

The Variance Inflation Factor (VIF) for each concept was used to assess each variable's importance. The variance inflation factor (VIF) measures how many high correlations between the predictor variables have inflated the variance of the calculated regression coefficients. Estimated regression coefficients are unstable and inaccurate and might result from high VIF values. The VIF is less than the acknowledged threshold of (5), indicating that there is no indication of collinearity between the variables (Ringle et al., 2015). A summary is given in Table 10.

	VIF	Variable	VIF	Variable	VIF
AIstrategy	1.770	Perform_senz	2.445	DataProtect	2.740
Audit	4.393	Rules	3.782	Edu	3.241
Balance	3.073	Stock	3.319	Feedback	2.504
Collaboration	4.057	Supervise	3.540	Handicap	2.933
Company	4.465	TechTest	4.418	Health	3.494
Control	3.935	VR/ARsim	1.733	Health Custom	3.956
Guidelines	4.609	VideoBio	2.445	LimitExcess	2.937
				Monitor	2.274

Table 10. Collinearity Statistics (VIF) (SmartPLS analysis (reprinted from SmartPLS software, version 3.3.9, created on 18 January 2024 (Ringle et al., 2015))

In bootstrapping, subsamples are randomly produced from the original data set that is used to estimate the PLS path model. A significant number of random subsamples (5,000, for example) are generated. The estimates from the bootstrapping subsamples are used to compute the standard errors for the PLS-SEM results. To assess the significance of PLS-SEM data, SmartPLs software computes t-values, confidence intervals, and standard errors (Ringle et al., 2015). Using this data, t-values, p-values, and confidence intervals are generated to assess the significance of the PLS-SEM results (Sarstedt, Hair, Pick, Liengaard, Radomir. & Ringle, 2022). T-values indicate the coherence of the model and are much higher than 1.96 (Sarstedt et al.,

2022) and p-values are less than 0.01. The previously stated requirements are satisfied. Table 11 presents the bootstrapping analysis.

Relationship	Original Sample	Sample Mean	Std. Dev	T Stat	P Values
Ethical Tech Sport -> Ethical Measures	0.813	0.813	0.034	24.254	0.000
Ethical Tech Sport -> Tech utility	0.552	0.556	0.064	8.620	0.000
AIstrategy <- Tech utility	0.804	0.801	0.082	9.841	0.000
Audit <- Ethical Measures	0.882	0.880	0.030	29.236	0.000
Balance <- Ethical Tech Sport	0.811	0.810	0.042	19.487	0.000
Collaboration <- Ethical Measures	0.839	0.835	0.038	22.174	0.000
Company <- Ethical Measures	0.893	0.893	0.030	29.580	0.000
Control <- Ethical Measures	0.847	0.846	0.041	20.811	0.000
Guidelines <- Ethical Measures	0.857	0.855	0.032	27.169	0.000
DataProtect <- Ethical Tech Sport	0.826	0.827	0.039	21.031	0.000
Edu <- Ethical Measures	0.856	0.856	0.045	19.108	0.000
Feedback <- Tech utility	0.709	0.702	0.078	9.047	0.000
Handicap <- Ethical Tech Sport	0.763	0.759	0.044	17.466	0.000
Health <- Ethical Tech Sport	0.809	0.809	0.039	20.837	0.000
Health Custom <- Ethical Measures	0.879	0.879	0.037	23.839	0.000
LimitExcess <- Ethical Tech Sport	0.786	0.784	0.039	20.223	0.000
Monitor <- Tech utility	0.701	0.694	0.077	9.054	0.000
Perform_senz <- Tech utility	0.748	0.746	0.074	10.070	0.000
Rules <- Ethical Tech Sport	0.863	0.861	0.029	29.903	0.000
Stock <- Ethical Tech Sport	0.903	0.903	0.026	34.350	0.000
Supervise <- Ethical Measures	0.885	0.883	0.033	26.865	0.000
TechTest <- Ethical Tech Sport	0.885	0.883	0.025	35.819	0.000
VR/ARsim <- Tech utility	0.831	0.828	0.075	11.095	0.000
VideoBio <- Tech utility	0.669	0.670	0.085	7.847	0.000

Table 11. Bootstrapping Analysis (1000 samples) (SmartPLS analysis (reprinted from SmartPLS software, version 3.3.9, created on 18 January 2024 (Ringle et al., 2015))

Based on these results, it can be assumed that hypotheses H1, the challenges and potential drawbacks of tech introduction in sports influence the measures, and H2, the challenges and potential drawbacks of tech introduction in sports influence the utility of innovative technologies, have not been rejected.

6. Discussion

This study explores adaptive capacity in sport, focusing on institutions and professionals' ethical, effective, and sustainable response to integrating innovative technologies. It aligns ethical awareness, regulatory mechanisms, and practical utility, mirroring environmental governance and public health models.

The SmartPLS analysis revealed several important findings: A strong positive path coefficient (0.813) between *Ethical Use of Technology* and *Ethical Measures* supports the idea that ethical considerations in tech deployment directly influence the formulation of policies and behaviors to prevent misuse or overuse. The moderate correlation (0.552) between *Ethical Use of Technology* and *Tech Utility* confirms that technology's effectiveness is contingent on its ethical framing. The adjusted R^2 values indicate that 66 % of the variance in *Tech Utility* is explained by the ethical variables, emphasizing the central role ethics plays in determining the perceived usefulness of technology in sport. High values of composite reliability (CR > 0.88) and Average Variance Extracted (AVE > 0.55) for all constructs confirm the reliability and convergent validity of the model. Bootstrapping analysis (5,000 samples) provided high t-values (> 19) and statistically significant p-values (< 0.001), ensuring the robustness and significance of all tested paths. The Fornell-Larcker criterion and HTMT ratio confirmed discriminant validity, proving that each construct measured a distinct concept. The goodness-of-fit indices, particularly the Standardized Root Mean Square Residual (SRMR = 0.046) and Normed Fit Index (NFI = 0.863), further confirm that the proposed model fits the data well and supports the theoretical assumptions. Together, these results position the SmartPLS-based structural model as a reliable and nuanced tool for understanding how ethical principles shape the implementation and the perceived value of innovative technologies in sport. Moreover, it offers a replicable analytical pathway for future researchers working at the intersection of ethics, technology, and sport.

The application of technology in sports raises several ethical considerations that must be carefully examined. While technology can improve fairness, accuracy, and overall sports experience, it also introduces new challenges and potential drawbacks. The current knowledge gaps in the field of technology used in sports (Qi et al., 2024) and the best practices for integrating technology in an ethical and responsible way were the center of this research, which focused on the introduction of technology in sports, particularly in soccer, as this is one of the most popular sports with the most resources available.

This research has obtained different and significant results, including the fact that equity should be one of the presuppositions of ethics. In this sense, this research highlighted the relevance of trying to balance the use of technologies (Xue & Li, 2022).

Consistent with other authors (e.g., Spitz et al., 2021; Armenteros et al., 2019), the aim was to collaborate on the appropriate use of technology in sport, particularly in soccer, but the results can be used in other sports. In addition,over-reliance on technology can diminish the importance of human capacity and decision-making. It is essential to find a balance between technological assistance and the fundamental skills of athletes and officials.

Integrating normative ethics into evaluating sports technologies offers a more robust framework for assessing their long-term implications. Future research should incorporate cross-cultural and philosophical approaches to ethics, exploring how principles of justice, duty, and virtue are interpreted in different sporting and technological environments (Sampedro, 2023; Kulkarni et al., 2024).

On the one hand, the use of technology in sports should be ethical. The main objective is to maximize performance (West et al., 2021) in a fair way (Serrano-Durá et al., 2021; Grady, 2023), keeping the data safe (Sun et al., 2021; Grady, 2023), and protecting the integrity and authenticity of the competitions (Serrano-Durá et al., 2021; Williams & Manley, 2016; Lazareva & Brigadnova, 2020). On the other side, innovative technology such as video assistant referee (VAR) (Spitz et al., 2021; Armenteros et al., 2019), which increases assertiveness in case of doubt (Nuhrat, 2023; Spitz et al., 2021), should be used as an auxiliary tool (Galily, 2024).

Another relevant result was privacy and data collection: Many sports technologies collect and analyze large amounts of athletes' data, including their performance, health metrics, and biometric information. Protecting athletes' privacy rights and ensuring informed consent for data use, including measures to store sensitive information (Grady, 2023; Sang & Wang, 2022; Dhiman et al, 2022).

Finally, highlight that among the main results, it can be said that ethics in using innovative technologies in sports has greatly influenced how measures are evaluated. However, over-reliance on technology can diminish the importance of human capacity and decision-making. It is essential to find a balance between technological assistance and the fundamental skills of athletes and officials, and can compromise the integrity and authenticity of sports competitions (Williams & Manley, 2016).

7. Conclusion

The research argues that, in this sample, the challenges and potential drawbacks of introducing technology into sport influence innovative technologies' measures and usefulness. In addition, aiming to introduce innovative technological tools, according to this research, there are ethical aspects to be considered, such as fairness and equity, governance and regulations, privacy and data collection, inclusivity, dependence, overreliance, accuracy, transparency, spectator experience, and long-term health implications. It is crucial to prevent problems related to the overuse of technology. In this sense, regulation, education, awareness, user empowerment, digital well-being initiatives, responsible practices by companies, audits, as well as multi-stakeholder involvement, ethical AI and algorithms, and data privacy and security actions are a few measures that can be implemented.

There are many uses of innovative technologies with significant contributions to the field of sport, such as performance analysis, performance tracking devices, AR and VR to create simulations, video recording, biomechanical analysis, AI to collect and analyze data, and health monitoring systems.

This study also has drawbacks. First, the study depends on self-reported data, which might bring possible conscious or unconscious biases. Using a cross-sectional design is another limitation because it offers a single perspective, without dynamics in the interactions, as it refers to a single view in time, a fact that reduces the ability to capture changes or developments over time, reducing the ability to prove causal links definitively. Non-probabilistic sampling, namely in Romania, applied to football coaches limits generalizability. Furthermore, the sample profile, which is based on teachers, coaches, and athletes from Romania, also represents a limitation to the scope of the results, making it difficult to generalize the conclusions.

The choice of sample profile can also limit the possibility of generalizing the conclusions. Finally, it should be noted that many correlational studies have multiple and simultaneous links between variables, which makes it a little more difficult to determine the direction of the effects and establish causality.

The sample was limited to Romania, specifically to stakeholders associated with soccer. Romania was selected because it has more resources and support than other sports. In addition, it is better regulated, facilitating access and increasing relevance.

Despite this limitation, it is possible to raise some reflections from these results, which are called possible practical implications. For example, the study highlights the importance of ethical considerations in the sports ecosystem. In this sense, it is suggested that coaches and sports organizations incorporate technological literacy and ethics modules into their professional development to ensure responsible and transparent use of technology. Implementing internal data processing guidelines, including ensuring athletes' privacy, is also possible. In this regard, sports federations should create standardized ethical guidelines for implementing technology in competitions, including protocols for consent and supervision of the AI system.

Educational institutions should incorporate sports ethics and technological governance as essential curricular components, equipping future professionals with the skills to navigate the intersection of performance, innovation, and integrity. And technology creators should embrace user-centered and ethically informed design, ensuring that tools align with performance needs and ethical values.

Finally, it should be noted that the study encourages a values-driven approach to adopting technology in sports, prioritizing ethical considerations as fundamental design criteria.

For future research, because the Ethics of using technology in sports are a complex phenomenon, and artificial intelligence is an actual theme, it will be interesting to complement the quantitative data; we suggest qualitative research, such as in-depth interviews and focus groups, to provide an in-depth understanding of the ethical concerns and attitudes of coaches and athletes. It is also suggested that the impact of cultural differences in the country be assessed and comparisons with other countries developed. For example, comparisons between Romania and countries such as Germany (tech-advanced), Brazil (football-obsessed but tech-diverse), or Japan (AI-emergent) would offer valuable insights into the universality or specificity of the ethical challenges uncovered. These suggestions aim to improve understanding of the complex and dynamic relationships between the overuse of technology and its benefits and promote long-term commitment through successful measures. In addition, it is suggested that this research be replicated in other countries or contexts.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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