THE EVOLUTION OF MODERN TECHNOLOGY IN OPTIMIZING ATHLETIC PERFORMANCE IN SPRINT EVENTS - AN INVESTIGATIVE APPROACH

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Abstract

Technological progress has significantly influenced the training and performance of athletes in sprint events, providing new tools for analysing and optimizing training. Modern methods of monitoring physiological and biomechanical parameters allow for a more precise evaluation of individual capacities and athletic progress. The purpose of this research is to investigate athletes' perceptions of the evolution of modern technology in optimizing athletic performance in sprint events and to analyse how modern technologies are perceived and used in sprint training. Research objectives: evaluating the level of knowledge and use of modern technologies among performance athletes.;analysing athletes' perception of the efficiency of modern technologies in improving performance in sprint events; identifying areas in which athletes believe technology can be improved to enhance performance in sprint training; examining the factors that influence the adoption and integration of modern technologies in sprint sports training. Research hypothesis: it is assumed that athletes who use modern technologies in their training believe that these technologies have a significant impact on their performance in sprint events, and that a more frequent integration of these technologies could contribute to optimizing athletic preparation.

Keywords: technology, performance, athletics, investigative approach

1. INTRODUCTION

The evolution of modern technology has had a significant impact on the sports field, especially in sprint events, where technologies such as heart rate monitoring, performance sensors, and video analysis are increasingly integrated into training. These innovations allow for more precise monitoring of athletes' progress, optimization of

training strategies, and rapid identification of technical errors. Additionally, wearable technologies and GPS tracking systems, alongside virtual reality and video analysis, have become essential for monitoring health, recovery, and athletic performance. In this context, another study by [13] highlights how technology has transformed performance analysis by shifting from traditional manual methods to real-time, objective approaches. As a result, athletes' performances are now evaluated much more efficiently, and coaches can immediately adjust training strategies.

Recent studies also emphasize the use of emerging technologies such as augmented reality and AI-assisted coaching, which offer enormous potential in transforming the sports industry, including in injury prevention [14]. These technologies not only improve physical training but also protect athletes' health and ensure competitive integrity, proposing a new era of safer and more efficient training. Coaches and instructors, regardless of their level, use a diverse range of technological tools to develop athletes and maximize their performance. Cutting-edge wearable devices, immersive VR simulations, and advanced analyses provide essential information for creating personalized training programs. Traditional training methods have been seamlessly integrated with contemporary technological innovations, fundamentally transforming how athletes train their bodies and perfect their skills [6]. Furthermore, the field of sporting events is continuously evolving, reflected in the use and development of Artificial Intelligence. Research mainly focuses on the application of AI in analyzing athletes' performances and optimizing training regimens. These applications include evaluating abilities, improving tactical strategies, and providing personalized training recommendations [4]. Advances in sports engineering have had a significant impact on enhancing athletic performance, making sports safer, more enjoyable, and more accessible. However, these innovations have also raised concerns related to competition fairness and the reduced active involvement of athletes, raising important ethical questions [9]. The athletic skills model proposes an alternative to traditional talent development theories, emphasizing the holistic education of movement and the overall health and well-being of athletes. This model promotes the development of "physical intelligence," including aspects such as agility, flexibility, and stability, through diverse and adaptable training programs. The main objective is to

develop a versatile and competent athlete before introducing specialization in a specific sport [15]. Most sports specialists, based on the studies conducted, have proposed various solutions to improve the training process and have promoted the use of modern methods and techniques. Thus, facilities, equipment, and IT technologies have been developed, which have significantly contributed to optimizing the training process.

Computer technology has also been integrated into the selection and training process of athletes, using various programs for physical effort planning and recovery. Information systems can also predict future results achieved by athletes, providing coaches with essential tools for evaluating progress and adjusting training strategies [10, 12]. Given the rapid pace of technological evolution, the question arises whether the type of mentality we have plays an important role in the training process and whether it is possible to change it to improve the instructional-educational process. It is evident that the professional mindset of coaches and instructors significantly influences the success of training methods and the adoption of new technologies in physical education and sports [1]. Despite technological advancements that tend to reduce the importance of sport and the time dedicated to it, there is a considerable number of young people who recognize the value of physical movement and its benefits, emphasizing the importance of physical education in developing a healthy society. Physical movement remains an essential pillar of a healthy lifestyle, and sport continues to be a fundamental activity for the development of physical, mental, and social skills in younger generations [2].

2. METHODOLOGY

The organization and conduct of the investigative approach took place between November and December 2024 and involved the participation of 60 children practicing performance athletics, of which 40 children were from Gura Humorului Sports School Club, and 20 children were from Suceava Municipal Sports Club, where I work as a coach. The questionnaire was distributed under the same conditions to all participants. Research Methods: the scientific documentation method was used to gather information from relevant secondary sources, contributing to the theoretical foundation of the study and the understanding of the context of modern technologies applied in athletics; the

observation method was applied to analyze the behaviors and reactions of the participants during training, to observe how they interacted with the modern technologies used; the survey method (questionnaire) was used to obtain direct data from participants, aiming to identify their perceptions and opinions regarding the use of modern technologies in sports training; the graphic method was used to visually represent the obtained results, facilitating the interpretation of the data and identifying relevant trends in the research. Inclusion criteria: athletes aged between 10 and 18 years who practice performance athletics; active athletes involved in performance training at the athletics clubs, namely Gura Humorului Sports School Club and Suceava Municipal Sports Club. Athlete participation was conditioned by obtaining parental consent, thus ensuring compliance with research ethics and willingness to complete the questionnaire according to the given instructions and within the allotted time, and validating the collected data. The research instrument consisted of a questionnaire designed to investigate the evolution of modern technology in optimizing athletic performance in sprint events, with the purpose of collecting students' opinions on this topic. The questionnaire was structured with 5 multiple-choice questions and one open-ended question, aiming to gather relevant perspectives on the use of technologies in sprint training.

The purpose of this research is to investigate athletes' perceptions of the evolution of modern technology in optimizing athletic performance in sprint events and to analyze how modern technologies are perceived and used in sprint training. Research objectives: evaluating the level of knowledge and use of modern technologies among performance athletes; analyzing athletes' perception of the effectiveness of modern technologies in improving sprint performance; identifying areas where athletes believe technology can be improved to enhance performance in sprint training; examining the factors that influence the adoption and integration of modern technologies in sprint sports training.

Research hypothesis: it is assumed that athletes who use modern technologies in their training believe that these technologies have a significant impact on their performance in sprint events, and that more frequent integration of these technologies may contribute to optimizing athletic preparation.

3. RESULTS

The purpose of data processing is to assess the physical condition of athletes and estimate their potential to achieve future performances [11]. Following the analysis of the collected responses, various perspectives and preferences of the respondents regarding the use of modern technologies in sprint training were identified, highlighting both the perceived benefits and areas where there are possibilities for improvementin their integration.

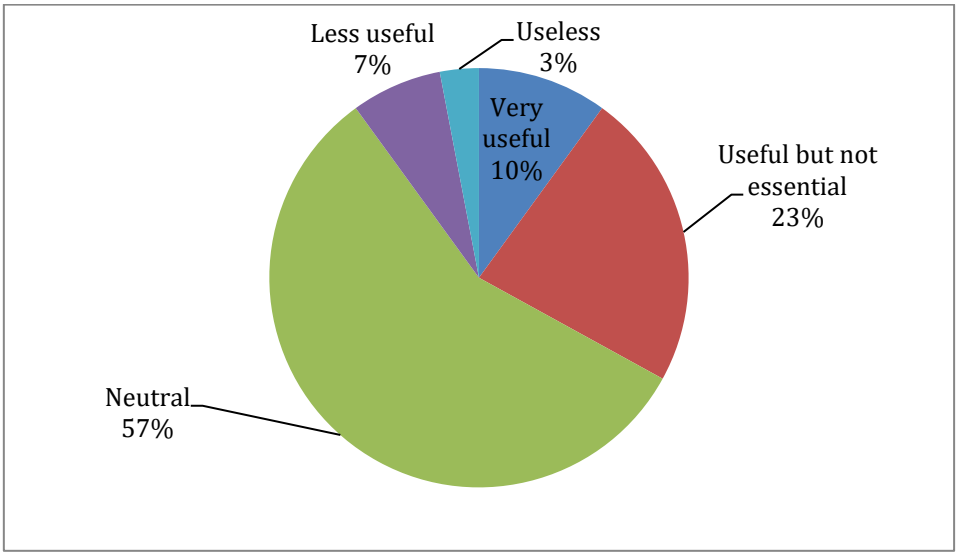

Fig. 1. Efficiency of modern technologies in sprint training

The data presented in Figure 1 indicate that the majority of respondents, 57%, are not convinced of the utility of modern technologies in sprint training, suggesting a balanced perception without a strong positive or negative opinion. This attitude may reflect the general view that these technologies do not have a significant impact on performance in sprint training. 23% of respondents consider modern technologies useful, but not essential, implying that although they are appreciated and recognized for their benefits, they are not seen as indispensable for achieving performance in sprint training. A significant minority, 10%, consider modern technologies extremely useful, indicating that some athletes and coaches are firmly convinced of the added value of these tools and their positive impact on performance. In contrast, a relatively small percentage, 7%, believe that these technologies have limited utility in the context of sprint training, suggesting a more critical or skeptical attitude toward their effectiveness. Only 3% of respondents consider modern technologies to have no significant impact on

sprint training, reflecting a minority opinion, but one that raises doubts about their efficiency.

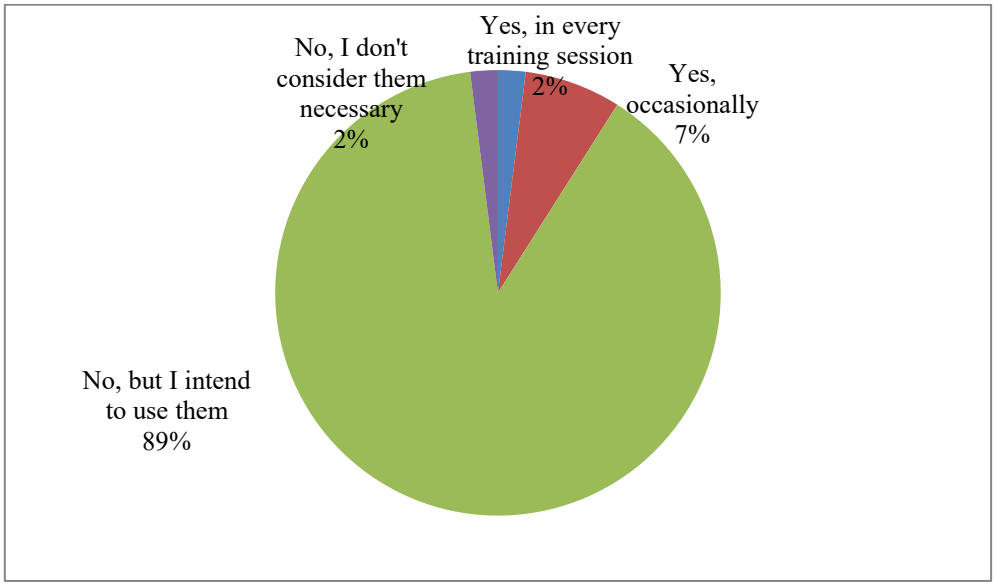

Fig. 2. Performance monitoring with technological devices in sprint training

In Figure 2, it can be observed that the majority of respondents, 89%, do not yet use technological devices for performance monitoring but intend to adopt them in the future. This suggests an openness to integrating technologies, but also a possible lack of accessibility or familiarity with these tools at present. A percentage of 7% uses technological devices occasionally, indicating moderate usage but not consistent integration into their training routine. Only 2% of respondents use these devices in every training session, suggesting a significant interest in continuous performance monitoring, although this practice remains rare. Another 2% of respondents do not use technological devices for performance monitoring and believe they are unnecessary, reflecting a negative or skeptical attitude toward the usefulness of these technologies in the training process.

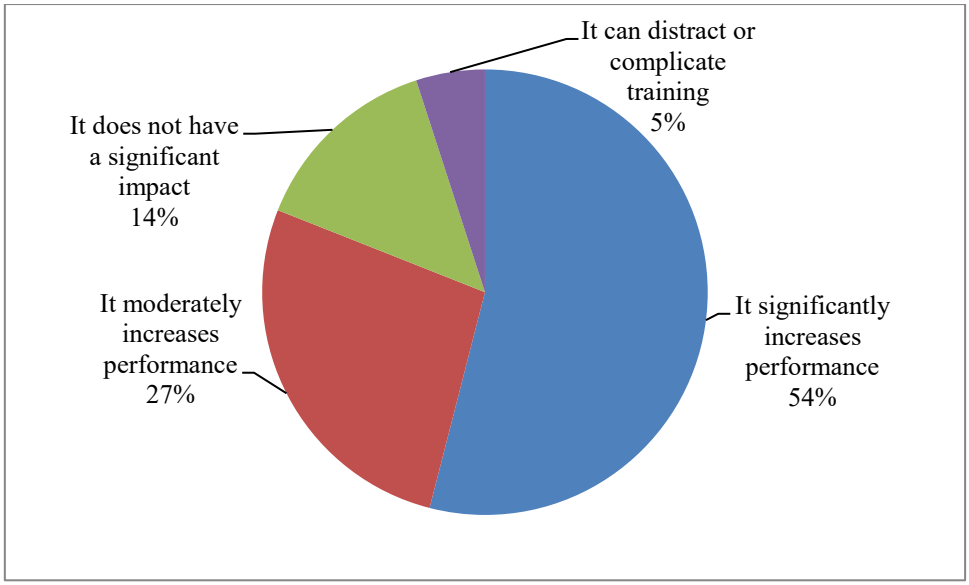

Fig. 3 The influence of modern technology on athletic performance

Regarding the distribution of perceptions of the influence of modern technology on performance in sprint events, Figure 3 shows that 54% of respondents believe modern technology has a significant impact on improving performance in sprint events. This response suggests that the majority perceive technology as an important and effective factor in optimizing athletes' performances in this area. A percentage of 27% consider technology to have a moderate impact on performance, indicating that while it is appreciated and recognized as useful, it is not seen as a decisive or sufficient factor for significantly improving performance in sprint events. A number of 14% of respondents believe that technology does not significantly influence performance, suggesting a more skeptical or reserved attitude toward its effectiveness in this context. Finally, 5% of respondents think that technology may have negative effects, such as distracting attention or complicating the training process, indicating a negative perception of the impact of modern technologies on the efficiency of sprint training.

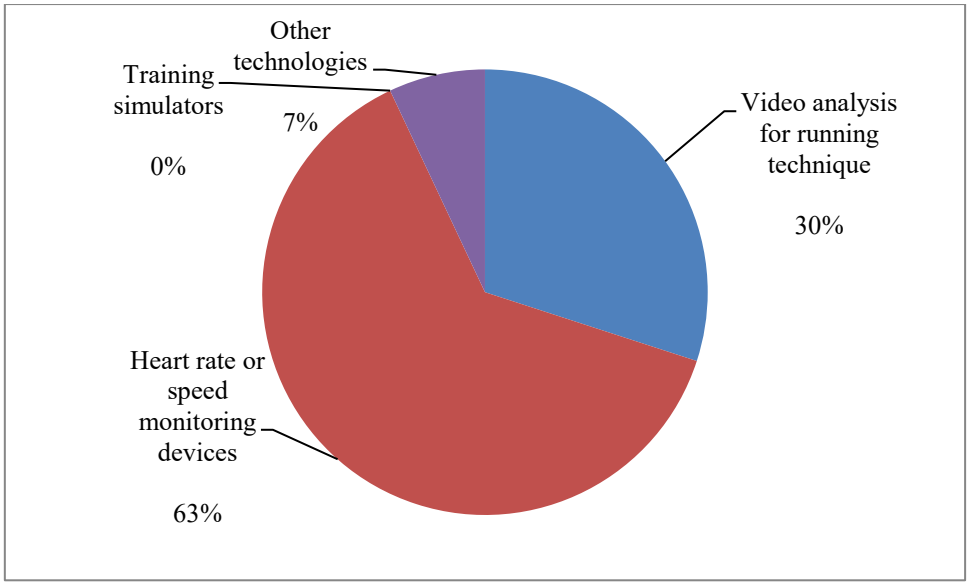

Fig. 4. Types of technologies used in sprint training

Another topic in the questionnaire, Figure 4, referred to the distribution of the use of different types of technologies in the training of performance athletes. The majority of respondents, 63%, have used heart rate or speed monitoring devices during their training. This type of technology is the most popular, suggesting a high interest among athletes in monitoring performance parameters such as heart rate and speed to improve training quality and adjust its intensity. A significant percentage, 30%, of respondents have used video analysis to improve running technique, indicating that a considerable portion of athletes are focused on refining their technique and use technology to identify and correct technical errors, aspects that can contribute to performance improvement. A percentage of 7% of respondents have used other types of technologies, which were not detailed in the question, suggesting that they used additional tools, such as biomechanical sensors or performance trackers, to support their training. No respondents have used training simulators, which suggests that these technologies are not perceived as frequently used in training or are not available in most cases.

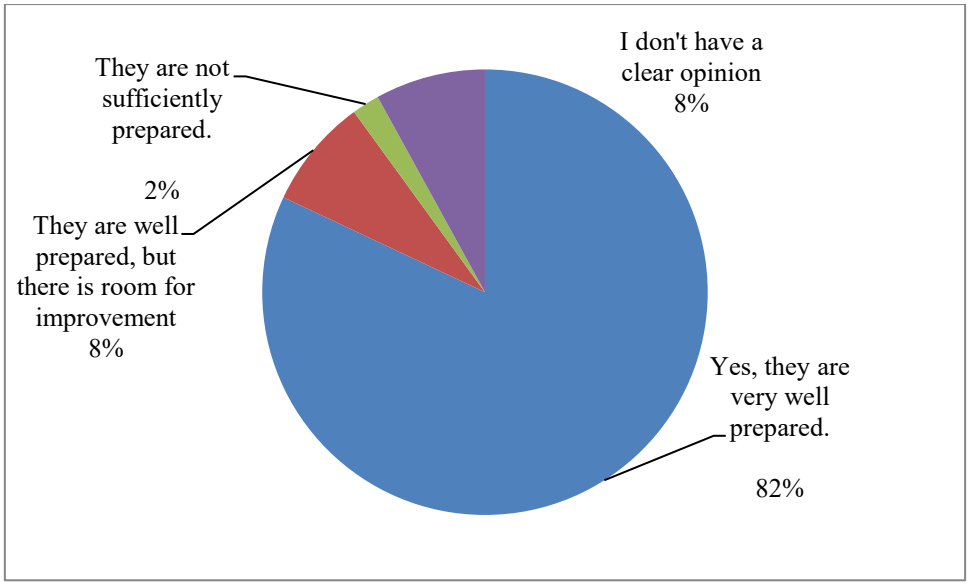

Fig.5. Coaches' training level for integrating modern technologies in sprint athlete preparation

In Figure 5, the distribution of respondents' perceptions regarding the preparation of coaches and technical staff for integrating modern technologies into the training process can be observed. The majority of respondents, 82%, believe that coaches and technical staff are very well prepared to effectively use modern technologies in training, suggesting a high level of trust in their competencies to apply technologies for improving athletes' training. A percentage of 8% of respondents consider coaches and technical staff to be well-prepared, but with room for improvement. This suggests an appreciation for their skills, while also acknowledging the need for continuous development in integrating modern technologies. Only 2% of respondents believe that coaches and technical staff are not adequately prepared to integrate these technologies, reflecting a minority opinion, but one that suggests potential gaps in their training. Finally, 8% of respondents have no clear opinion on the preparation level of coaches and technical staff, which may indicate a lack of detailed knowledge in this area or a neutral attitude toward the topic.

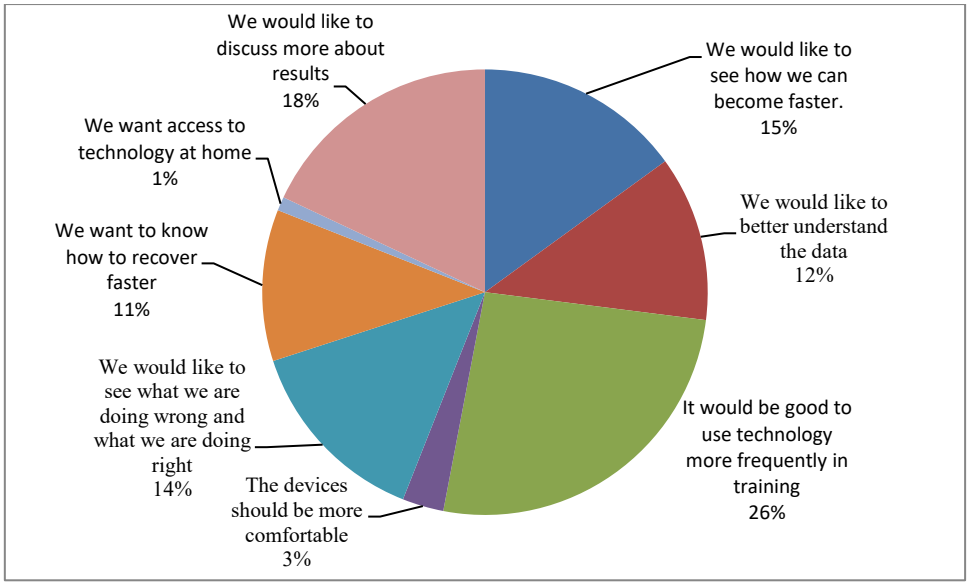

Fig. 6. Suggestions for optimizing the use of modern technologies in training

Regarding the distribution of wishes for improving the use of modern technology in training, Figure 6 shows that a significant percentage of 26% of respondents believe technology should be used more frequently during training sessions, suggesting a growing interest in regularly integrating technology into their training routine to maximize its benefits. 15% of respondents want to use technology to gain a more detailed understanding of their progress in terms of speed, indicating athletes' interest in monitoring and improving their specific performance. Another 14% of respondents wish technology would provide them with detailed feedback on their mistakes and achievements, which is valuable for correcting technique and optimizing performance. Nearly a quarter of respondents, 12%, want to better understand the data provided by the technologies used, suggesting a desire to more effectively interpret the collected information for application in training. 11% of respondents are interested in technology that can support the recovery process, a crucial aspect for enhancing performance and preventing injuries. 3% believe that technological devices should be more comfortable, emphasizing the importance of user comfort in the acceptance and use of these tools. 1% would like to have access to technology outside of training, at home, reflecting an interest in tools that allow continued monitoring and training even outside the gym environment. Finally, 18% of respondents want a more detailed discussion of the results obtained through the use of technology, suggesting an interest in a deeper analysis of the data and its application to improve performance.

4. DISCUSSIONS

In the study conducted by Chen and Dai (2024), the integration of artificial intelligence (AI) and Internet of Things (IoT) technologies in data collection has revolutionized sports analytics. These technologies allow real-time monitoring of performance and injury risks, facilitating prompt interventions and optimizing training sessions. This approach provides coaches and athletes with essential tools to enhance both performance and safety. Similarly, Gaudino and colleagues (2022) highlight the use of advanced technologies in injury prevention and monitoring training and recovery processes. Every sports discipline, from sprints to jumps and throws, benefits from technologies that optimize training and reduce risks. These studies emphasize the positive impact of technology on both the safety and performance of athletes.

5. CONCLUSIONS

1. The majority of athletes consider modern technologies useful, but not all use them consistently in training, suggesting a gap between their perceived importance and the actual application of these technologies in daily practice.
2. Athletes who regularly use modern technologies believe they have a significant impact on improving performance in sprint events, while others are not fully convinced of their effectiveness, highlighting the importance of balancing technology with traditional training approaches.
3. Many respondents indicated a wish for a better understanding of the data collected by the technologies used, suggesting a need for additional training for both coaches and athletes in interpreting and applying these data to optimize performance.
4. There is significant interest in more comfortable and user-friendly devices, indicating that the adoption of technologies can be influenced by their comfort and ease of use during training.
5. Although most athletes recognize the benefits of modern technologies, there is still some reluctance to their continuous and widespread use. This highlights the need for a clearer strategy and more efficient implementation of

technologies in the training process, tailored to the individual needs of each athlete.

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REFEREEING IN MODERN RUGBY: SYSTEMIC ADAPTATIONS TO CHANGES IN REGULATIONS AND NEW COMPETITION REQUIREMENTS

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Abstract

The study analyzes the impact of regulatory changes on the style of play and refereeing in rugby, highlighting the transition from a static game to a dynamic and offensive one. Recent legislative developments (including ELVs and World Rugby directives), statistical data on the increase in rucks and tackles, as well as the new requirements imposed on referees: high physical exertion, effective positioning and quick decision-making are examined. Three arbitration models are compared (France, New Zealand, England), to which is added a contextual analysis of Romanian arbitration. The study highlights the role of technology (TMO, video feedback) in supporting decisions and continuous training. The conclusion proposes the concept of "integrated contextual refereeing" as an emerging paradigm, in which the referee's decision is the result of an interaction between the rules, the style of play, technology and professional training.

Keywords: rugby, refereeing, rule changes, game dynamics, decision-making, technology.

1. INTRODUCTION

The rules of the game of rugby evolved relatively slowly in the first century of the sport's existence, being formally codified only in 1845, at the Rugby School. The establishment of the International Rugby Football Board (IRFB) in 1886 – which later became World Rugby – was a pivotal moment in the direction of standardisation of regulations at international level. Until the end of the twentieth century, the changes made to the rules were few and mainly aimed at clarifying fundamental aspects, such as the definition of the try, the organization of the tidy scrum or the resumption of the game after scoring the points, without significantly influencing the general philosophy of the game.

However, the professionalization of rugby in the 1990s, as well as its expansion on a global scale, generated obvious pressures to adjust regulations in relation to the new requirements regarding the safety of athletes, the attractiveness to the public and the fluidity of the game actions. Thus, in 2008, the package of legislative reforms known as Experimental Law Variations (ELVs) was introduced, which marked an inflection point in the approach to regulations, promoting a systemic vision meant to accelerate the pace of the game and encourage an offensive style, based on continuity.

Among the stated objectives of the ELVs were to reduce interruptions and increase the dynamism of the actions, which is also confirmed by the increase in the proportion of effective playing time – from about 28% in the 1980s to over 44% in the 2010s (Hughes & Bartlett, 2002, p. 337). In support of the consistent application of these regulations, World Rugby issued, between 2018–2024, a series of official guidelines entitled Law Application Guidelines, which provide explicit instructions on the correct interpretation of the regulations. The preamble to these documents emphasises that referees must apply the 'spirit of the game' equally to the letter of the law (World Rugby, 2018a, p. 2).

The regulatory changes that have occurred in recent decades have substantially reshaped the competitive style of the game of rugby and have generated new demands for the referee body. If in the past the game was characterized by a slower pace, with static structure and frequent interruptions, today it stands out for its accelerated dynamics, a continuous flow of phases and an increased intensity of actions. In this context, referees are forced to manage successive game situations, carried out at a fast pace, which simultaneously require quick reaction, optimal positioning and contextual interpretation of the rules. Our research, as a goal, aims to carry out a critical analysis of the evolution of modern rugby laws and to investigate the concrete impact of regulatory changes on the style of play and on the practice of refereeing. In addition, three international models of arbitration – France, New Zealand and England – are analysed in order to highlight how the national systems of formation and application of the rules have integrated the new requirements of contemporary gambling. Finally, the study introduces and argues the concept of "integrated contextual arbitration" as an emerging paradigm, which defines modern arbitration as a complex function at the

intersection between the normativity of the regulation, the rhythm of the game and the technological support.

2. METHODOLOGY

This article is based on a review research, doubled by a theoretical synthesis with applicative valences. A documentary analysis of the regulatory changes of the last three decades has been carried out, including scientific studies, official reports and directives issued by the international forum World Rugby. The sources used included official game legislation (contemporary editions of the Laws of the Game and application guides), statistical data on game dynamics (such as World Rugby's 2022 analysis reports) and scientific literature focused on sports performance and refereeing. Information from referee development manuals (World Rugby, 2020), as well as articles and interviews with expert practitioners, has also been integrated to give both the theoretical and empirical dimensions of the subject. The analysis was structured around the main themes identified: the historical evolution of the rules, their influence on the style of play, the impact on refereeing (including the physical training and the decision-making capacity of referees), the role of technology in the arbitration process and the specifics of national application models. Finally, based on this synthesis, an integrative conceptual interpretation of the current trends regarding refereeing in contemporary rugby was formulated.

3. RESULTS

The historical evolution of the regulation changes in rugby. Throughout the twentieth century, rugby regulations have undergone rare and incremental changes, aimed at clarifying details without disturbing the traditional balance of the game. However, the professionalization and globalization of sport have imposed structural reforms, meant to respond to the new requirements regarding player safety, attractiveness and continuity of actions. The introduction of ELVs (Experimental Law Variations) in 2008 marked the transition to a systemic approach to reform, through continuous testing and adjustment (World Rugby, 2008). Among the major changes are the standardization of the tidy scrum ("crouch, bind, set"), the penalty of high tackles

and the redefinition of the ruck, all of which contribute to streamlining the game and eliminating stagnation. The impact of these measures is evidenced by the increase in effective playing time from 28% to over 44% (Hughes & Bartlett, 2002). For the consistent application of the new rules, World Rugby issued the Law Application Guidelines (2018–2024), which recommend a contextual interpretation of the rules, in the spirit of the game (World Rugby, 2018a, p.13). These changes reflect the adaptation of the regulations to contemporary dynamics and outline a new framework of responsibilities for modern arbitration.

The influence of changes on the style of play. The regulatory transformations of the last decades have profoundly reconfigured the style of play in international rugby. From a static structure, based on fixed phases and a fragmented rhythm, the game has evolved to a dynamic model, in which quick transitions and continuity of possession are a priority. Phases such as the ruck, advantage or quick rebound have been adapted to reduce stagnation and stimulate fluency. According to World Rugby data (2022), between 2010 and 2020 there was a 23% increase in the number of rucks and a 31% increase in successful tackles, while the average duration of a continuous action exceeded 52 seconds. This evolution, confirmed by the observations of Fuller et al. (2010), implies a fine synchronization between the referee's decision and the dynamics of the action. Thus, the referee plays an essential role not only in applying the rules, but also in maintaining the competitive rhythm. As Steve Hansen notes, "the speed of the game is greater than ever" (Hansen, 2021, p.5), and Glen Jackson warns that "any hesitation by the referee affects the offensive construction" (Jackson, 2019, p.7). In conclusion, the modern style of play requires referees to be more adaptable and able to make decisions in fractions of a second, in a competitive setting where fluency and coherence are as important as the exact application of the law.

Impact on referees: skills, positioning and physical effort. The regulatory changes of the last decades have imposed a profound redefinition of the profile of the rugby referee, both from the decision-making perspective and the necessary physical and psychological capacities. The modern referee must make quick decisions, position himself efficiently according to the dynamics of the game and constantly communicate with his brigade, in conditions of high competitive pressure. Physically, elite referees

achieve levels of training comparable to those of professional athletes. According to World Rugby (2020), they must sprint 20 m in under 3.2 seconds and cover 6–8 km per game, most of them in acceleration mode. Optimal positioning, supported by GPS monitoring and post-match video analysis, is essential for decision accuracy (Owen et al., 2019; Walsh, 2020). Cognitively, referees are exposed to a high level of decision-making stress, similar to that found in high-speed team sports (Pina & Mascarenhas, 2018). As a result, psychological training has become a mandatory component, including pressure simulations and expert feedback. In conclusion, performance refereeing is an interdisciplinary field, in which the referee is no longer a simple enforcer of the rules, but a complex professional, capable of integrating physical, tactical and mental requirements in real time**.**

Technology in arbitration: TMO, video feedback and error analysis. The integration of technology into rugby refereeing is one of the most profound transformations of the sport. If once the central referee was the sole authority on the field, today his decisions are supported by digital systems, in particular the Television Match Official (TMO), designed to identify clear infringements without disrupting the course of the game (World Rugby, 2018a, p.13). The BMT has helped to increase accuracy in critical situations (tries, tackles, scrums), but it has also generated additional public pressure on referees, who have to justify their revised decisions. Nigel Owens observed: "The BMT is not a shield for the referee, but a mirror... you must have the courage to make the decision before confirmation" (Owens, 2022, p.5). Research shows that TMO reduces major errors by 44% but lengthens the duration of matches by 18% (Journal of Sports Technology and Analysis, 2021, p.221), imposing a balance between accuracy and game pace. Referee training increasingly includes post-match video analysis and digital decision simulations. Jaco Peyper states: "If you don't review the questionable phases, you don't progress – you just repeat the mistakes" (Peyper, 2022, p.8). In this respect, the digital platforms in England, France and New Zealand contribute to the development of decision-making reflexes and to the homogenization of interpretations. However, over-reliance on technology can diminish referees' confidence. "A referee who is always waiting for video confirmation loses control of the game," warn Barnes and McNally (2021, p.34). Therefore, technology must be used

as a support, not as a substitute for arbitral discernment. In conclusion, the success of modern refereeing depends on the rational integration of technology, in a balance with decision-making autonomy, human competence and the spirit of the game.

International comparative model: France, New Zealand, England, Romania (Table 1). Although the basic rules of the game of rugby are uniform at a global level, being coordinated by World Rugby, their concrete application at national level varies considerably depending on the cultural context, competition traditions and referee training philosophy in each country. This contextual adaptation generates distinct models of arbitration, in which the same set of rules is interpreted and implemented differently. Table 1 summarizes these differences by comparing four representative paradigms – France, New Zealand, England and Romania – highlighting the specifics of each model in terms of refereeing orientation, the role of the arbitrator, the use of technology and training priorities.

France – Control of aggression and didactics of sanction. The French refereeing model is marked by a strict application of the rules, especially in sensitive areas such as the ruck or high tackles, with player safety and tactical-behavioral discipline as a priority. The referee is perceived as a "pedagogue of the field", who intervenes early in the match to prevent deviations through clear and firm sanctions (Bonhoure, 2018, p.12). This interventionist approach, supported by the frequent use of the BMT for disciplinary purposes, reflects an institutional strategy that prioritises regulatory authority and early scrutiny to ensure a safe and fair competitive environment.

Table 1. Comparison of arbitration models

Nr. crt.	**Arbitration model**	**Main orientation**	**Role of the referee**	**Use of TMO**	**Emphasis in training**
1.	**FRANCE**	Rigorous control, early sanctions	Pedagogue and guarantor of the discipline	Support for order and discipline	Prevention and sanction
2.	**NEW ZEALAND**	Contextual fluency, minimal intervention	Game Facilitator and Discreet Leader	Limited for maintaining fluency	Communication and anticipation
3.	**ENGLAND**	Decision consistency and continuous feedback	Coherent decision-maker, trainer through technology	Pedagogical and decision-making tool	Standard care and feedback

4.	**ROMANIA**	Frequent decisions, numerous gestures, tactical conservatism	Decision executor with increased involvement in phases	Low-use, less integrated	Decision-making technique and physical adaptation

New Zealand – Contextual fluency and decision-making leadership. New Zealand refereeing promotes a flexible interpretation of the rules, adapted to the fast pace of the modern game. The referee acts as a facilitator of continuity, intervening only when the spirit of the game is affected, not for every formal offense (Pollock, 2019, p.9). The model values anticipation, effective communication with players and reduction of interruptions, being supported by multidimensional training – physical, cognitive and tactical. In practice, a discreet but firm arbitration is pursued, based on decision-making leadership and the ability to maintain the fluency of the game without compromising competitive fairness.

England – Decision coherence and professionalization through technology. The English model of arbitration combines French rigor with New Zealand flexibility, emphasizing the consistency of decisions and the public's confidence in the arbitral act. Referees in the Premiership participate in mandatory video simulation sessions and performance audits (RFU, 2023, p.17), in a framework that favors standardization and continuous self-evaluation. The BMT is used not only as a validation tool, but also as an educational resource, and mentoring and constructive feedback support collaborative training. In Wayne Barnes' view, "coherent arbitration" is the key to accepting decisions (Barnes, 2019, p.4), which clearly defines the orientation towards transparent, predictable and professionalized arbitration.

Romania – Decision-making density, tactical conservatism and limited role of assistants. The refereeing style practiced in the Romanian Rugby Championship is distinguished by a pragmatic approach, oriented towards maintaining decision-making control through repeated gestures and frequent interventions, but with moderate physical involvement and reduced cooperation between brigade members. The analysis of the 16 matches played between 2019 and 2023 reveals a specific profile: the central referee was intensely solicited in terms of decision-making, performing an average of 60 basic gestures and 5 secondary gestures per match, but recorded a lower volume of

motor effort than the international referees, with about 40 short accelerations and a continuous travel time of about 25 minutes.

The assistant referees had a rather limited role, with about 30 basic gestures per match and an average physical activity, being mainly involved in the standard signals (touches, conversions), without a significant contribution in making complex decisions. The reduced number of advantage gestures and the increased frequency of scrums and replays suggest a conservative approach to the application of the rule, preferring to interrupt the game rather than contextual interpretation.

This model of refereeing reflects a competitive style in which the game is often fragmented, with a slower pace and with an increased reliance on the authority of the central referee. The lack of extensive collaboration between central and assistant staff, as well as the limited use of technological tools (such as TMO or video feedback), indicates a methodological gap with international standards.

However, the density of decisions and the complexity of the technical gestures assumed by the central referees demonstrate a functional adaptation to the particularities of the internal game, where discipline and control are priorities. In the absence of a high competitive fluency, the Romanian referee assumes the role of guarantor of order and strict enforcer of the rules, similar to the French model, but with less institutional and technological support. In conclusion, the Romanian style of refereeing can be characterized by a procedural conservatism, a high density of technical gestures and a medium physical demand, in a competitive context with a low pace and static structure. In order to align with international trends, it is necessary to strengthen cooperation between the members of the arbitration brigade, to perfom? training in the application of the advantage and the development of training platforms based on video feedback and decision simulations.

SPECIALISTS' OPINIONS AND THE CONVERGENT MODEL OF ARBITRATION

Recent transformations in contemporary rugby have led to a reconfiguration of the conceptions of refereeing, both in specialized research and in performance practice. More and more studies argue that regulatory changes should be understood as part of a systemic paradigm, not as one-off interventions. Fuller et al. (2010) show that

"legislative changes are effective only to the extent that arbitrators are able to apply them uniformly and contextually" (p.274). World Rugby supports this approach through interactive training programmes, such as RefSmart or the Match Officials Pathway, centred around mock decision-making and video feedback.

On a practical level, a new profile of the referee is taking shape: capable of contextual interpretation, quick adaptation and learning from experience. Glen Jackson emphasizes the need for a deep understanding of the game (2019), and Steve Walsh emphasizes the role of continuous self-evaluation (2020). Pina and Mascarenhas (2018) highlight, in turn, the importance of training under conditions of pressure and decision-making stress.

Recent technologies have contributed to the development of digital platforms that use artificial intelligence to simulate arbitrary decisions under realistic conditions. RefSmart and RFU solutions support the standardization of international training and the development of quick and coherent decision-making reflexes (RefSmart Project & World Rugby, 2023).

In this global context, arbitration in Romania presents a profile characterized by high decision-making density, conservative application of advantage and limited involvement of assistant referees, which requires a progressive alignment with current training standards.

These directions were summarized by Marco Gori (2021) in the "integrated contextual arbitration" model, which places the arbitrator in interaction with four essential components:

- *Rule changes* – as the initiator of the change in the game, they increase the complexity and speed of the game, requiring continuous adaptation from the referee;
- *The style of play* – as an effect of the rules and expression of collective tactics, it puts pressure on the referee through the need for uninterrupted anticipation and control;
- *The referee* – as a functional node of the system, interconnected with the other elements, he/she must adapt physically, decisively and relationally to the requirements of the game;

- *Technology* – as a support and decision corrector, it brings coherence, standardization and possibilities for assisted learning (e.g. through error analysis).

The model involves integrating these dimensions into a coherent approach, adapted to the requirements of modern rugby.

This framework confirms that the modern referee is no longer a simple enforcer of the laws of the game, but a strategic actor, at the center of an interdependent ecosystem, defined by the complexity of the rules, the dynamics of the action and the technological tools integrated into the decision-making process. He acts simultaneously as an observer of tactical movements, a regulator of interactions between players, a facilitator of the continuity of the game and a decision-maker in real time, in a framework subject to constant pressure generated by the competitive rhythm, the expectations of the public and the responsibility of sporting equity.

4. CONCLUSIONS

Recent regulatory reforms in rugby have significantly transformed the internal logic of the game, moving from a static and fragmented model to one characterized by continuity, intensity and sustained rhythm. The introduction of ELVs and the World Rugby Guide has had the effect of streamlining actions, increasing competitive attractiveness and reducing the risk of injury.

The regulatory changes have had a direct impact on the style of play, evidenced by the increase in the number of rucks, tackles and continuous actions, which imposes a greater responsibility on referees in maintaining the fluency and tactical balance of matches.

The profile of the modern referee is outlined as a multidimensional one, which requires not only an in-depth knowledge of the laws of the game, but also a physical preparation comparable to that of athletes, quick decision-making capacity, adaptability to the competitive rhythm and effective team communication skills.

Refereeing technology (TMO, video feedback, simulation platforms) is an essential tool in supporting the accuracy of decisions and the continuous training of referees. The correct integration of these tools can increase the objectivity of the arbitral

act, but excessive reliance on technology can erode the authority and decision-making confidence of the central arbitrator.

The comparison of national arbitration models (France, New Zealand, England, Romania) revealed significant differences in style, influenced by cultural, pedagogical and institutional factors. France promotes authoritarian and pedagogical arbitration, New Zealand relies on contextual fluency, England on coherence and standardization, and Romania stands out for its conservative style, with limited involvement of assistant referees and reduced use of advantage.

The Romanian refereeing style reflects a high gestural density and a moderate physical demand, being influenced by a fragmented rhythm of play. This profile highlights the urgent need to update referee training through exposure to international contexts, mock decision-making, advantage exercises and increased cooperation between brigade members.

The concept of "integrated contextual arbitration" summarizes the current arbitration paradigm, in which each decision is the result of an interaction between rules, game, technology and the human factor. The refereeing of the future requires multidisciplinary skills and the ability to adapt the intervention to the rhythm and spirit of the game, in order to guarantee fairness, safety and sporting spectacle.

This study is predominantly based on secondary sources, general statistical data and observations from the literature, without including direct empirical research on arbitration in Romania at the level of perception or self-assessment. Also, the differences in competition level between the analyzed championships (elite *vs* national) may influence the comparability of some data. In addition, the analysis of the referees' activity is based on a limited selection of matches, which may restrict the generalization of the conclusions regarding the Romanian specificity. For the future, it is recommended to complete these directions through field studies, interviews with active referees and participatory observation in internal competitions.

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