

Identifying Factors Influencing the Smartization of Sports Equipment in National Football Stadiums

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Eslam Mohammadipour¹
 Vajiheh Javani^{2*}
 Yaghob Badri Azarin³

¹ Ph.d of Sport Management,
 University of Tabriz, Tabriz, Iran

² Associate Professor of Sport
 Management, University of
 Tabriz, Tabriz, Iran

³ Professor of Sport
 Management, University of
 Tabriz, Tabriz, Iran

*Correspondence:

Vajiheh Javani, Associate
 Professor of Sport Management,
 University of Tabriz, Tabriz, Iran

Email:

v_javani2005@yahoo.com

ORCID: [0000-0002-6667-5575](https://orcid.org/0000-0002-6667-5575)

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Abstract

Purpose: This research aims to identify the factors influencing the smartization of sports equipment in national football stadiums.

Methods: The present study is applied in nature and conducted qualitatively using a descriptive phenomenological approach. The data analysis employed the Colaizzi method. The study population included 23 experts in related fields. Data collection was conducted through semi-structured interviews, and the MAXQDA software version 20 was used for data analysis and categorization. To ensure validity and reliability, criteria such as credibility, transferability, dependability, and confirmability were employed.

Results: The results indicate that smartization of football stadiums can significantly improve fan experience, resource management, and operational efficiency. Modern technologies such as the Internet of Things (IoT), artificial intelligence, and smart management systems contribute to optimizing equipment performance and enhancing stadium security. However, continuous support and maintenance of smart systems, especially in technical areas, data security, and energy management, are crucial. Additionally, high initial costs and the need for long-term investment pose challenges that require careful planning and sufficient resources.

Conclusion: The study concludes that smartization of football stadiums can enhance fan experience, improve efficiency, and reduce costs. However, sustained support and maintenance of smart systems, along with appropriate investment, are essential for optimal system performance. Successfully implementing these processes requires addressing technical challenges, ensuring data security, and managing resources effectively.

Keywords: Identifying - Smartization - Football Stadiums.

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Introduction

Smartization of sports equipment in football stadiums, as part of digital transformations, plays a crucial role in enhancing spectator experience, increasing security, and improving energy efficiency. This process, which significantly impacts the overall performance of stadiums, utilizes advanced technologies and innovations, paving the way for sustainable development in professional sports. As technology advances and the need for upgrading sports infrastructure grows, analyzing the factors influencing this process can be a vital step toward the development of professional sports and optimal resource utilization (Zarei et al., 2021; Mohammadi, 2020).

Smartizing stadiums requires robust technological infrastructure, including high-speed and stable internet for technologies like IoT and data-driven systems, sensors and monitoring systems to gather information on temperature, humidity, spectator movement, and other variables, as well as powerful servers to process generated data. One of the primary goals of smartization is to enhance stadium security and improve crisis management. This can be achieved through facial recognition and biometric systems that identify individuals and prevent unauthorized access, smart cameras equipped with artificial intelligence that detect suspicious behaviors and provide real-time alerts, and crowd management systems utilizing data analysis to optimize crowd flow and prevent overcrowding.

Additionally, smartization can reduce energy consumption and minimize environmental impacts. This is achieved through smart lighting systems that adjust illumination based on environmental conditions, intelligent HVAC systems that regulate temperature and ventilation based on spectator numbers, and renewable energy sources like solar panels to partially meet energy demands. Enhancing

spectator experience is another key advantage of stadium smartization, made possible by smart displays providing live and engaging information, mobile applications facilitating ticket booking, stadium navigation, and access to amenities, and augmented and virtual reality technologies offering new and exciting gameplay experiences.

For success in this area, proper policymaking and efficient management are essential. Adequate funding and investment for implementing smartization projects, collaboration with technology companies to leverage specialized expertise, and training and raising awareness among staff and spectators about the benefits and usage of smart equipment are vital steps. Furthermore, data analysis and advanced algorithms for efficient resource management and forecasting spectator behavior patterns can help increase efficiency and reduce costs.

In conclusion, smartizing sports equipment in football stadiums can significantly enhance service quality, reduce costs, and improve safety levels. Implementing this process requires careful planning, the adoption of advanced technologies, and effective stakeholder interaction. With adequate investment and attention to various aspects, smart and efficient stadiums can be developed to meet the needs of professional sports in the country and elevate Iran's international sports position. This journey also necessitates addressing legal and regulatory aspects, including establishing clear frameworks for data usage, ensuring individual privacy, and setting safety standards for systems. Relying on scientific research and successful global experiences, smartization can drive fundamental transformations in the structure and performance of stadiums and play a pivotal role in the sustainable development of sports in the country.

Materials and Methods

The present study is applied in nature and conducted qualitatively using a descriptive phenomenological approach. The data analysis employed Colaizzi’s (1978) method. The participants included university faculty members in sports management, sports facility specialists, and football stadium managers nationwide. A total of 23 individuals were selected as the sample. The participants were chosen based on their direct experience with or relation to the research topic. Inclusion criteria included professional, personal, and academic experience, participants’ full consent to participate in the interviews, and their ability to provide comprehensive and insightful information. Exclusion criteria included a lack of sufficient interest in continuing cooperation and incomplete or insufficient information provided by the participants.

The sampling method was purposeful and snowball sampling, continuing until no new non-repetitive concepts could be extracted from the interviews. Data collection was conducted through semi-structured interviews, and MAXQDA software version 20 was used for information analysis and categorization.

To determine validity and reliability, criteria

such as credibility, transferability, dependability, and confirmability were utilized. For credibility, interview transcripts and coding methods were shared with several participants and sports management professors, and their feedback was incorporated. For transferability, a detailed report of all research stages and demographic characteristics of the samples was provided. Reliability was assessed using inter-coder agreement. Two specialists in sports management who were familiar with coding methods coded the interviews, achieving an agreement rate of 82%, which is above the acceptable threshold of 60%. Confirmability was ensured by having several sports management professors and experts outside the research process review all stages, and their feedback was incorporated.

Results

The analysis of the participants’ data led to identifying the factors influencing the smartization of sports equipment in football stadiums in Iran. These include 65 sub-themes grouped into six main themes: technology and innovation, accessibility and usability, security and data protection, costs and investment, fan experience, and support and maintenance. Table 1 presents the main and sub-themes of the study.

Table 1 - Identification of Factors Influencing the Smartization of Sports Equipment in Football Stadiums

Main Theme	Sub-Themes
Technology and Innovation	<ul style="list-style-type: none"> - Smart systems for monitoring equipment status - Game analysis cameras - Player tracking systems - Fan crowd and traffic management - Data retrieval and problem prediction - Enhancing spectator experience with AR - Virtual reality training for players

Main Theme	Sub-Themes
	<ul style="list-style-type: none"> - Digital and mobile ticketing - Electronic payments and digital wallets - Interactive applications for game viewing
Accessibility and Usability	<ul style="list-style-type: none"> - Search and navigation systems in stadiums - Automated facilities for registration and entry - Real-time technical support - Simultaneous management of multiple users - Accessibility of systems and equipment - Fast and contactless payment facilities - Smart emergency call systems - Online services and problem prediction - Quick and easy exit routes from the stadium - Environmental status awareness systems
Security and Data Protection	<ul style="list-style-type: none"> - Protection of fans' personal information - Security of online payment systems - Identification and authentication systems - Security of player-related data - Prevention of cyberattacks - Protection of sensitive team and coach information - Access control to systems - Data backup and recovery - Security in wireless communication networks - Staff training in security - Real-time security analysis and monitoring - Protection of user data in applications - Prevention of traffic control system breaches - Transparency and security reporting

Main Theme	Sub-Themes
Costs and Investments	<ul style="list-style-type: none"> - Initial costs of implementing smart systems - Maintenance and support costs - Investment in IT infrastructure - Costs for staff training and empowerment - Investment in research and development - Cybersecurity-related costs - Financing models (foreign investment) - Communication and advertising expenses - Cost management and resource optimization - Energy costs and efficiency - Costs related to smart customer services - Role of sponsors and advertisements in project financing
Fan Experience	<ul style="list-style-type: none"> - Easy access to game information - Guidance systems in the stadium - Interactive match viewing experience - Special services for individuals with specific needs - Loyalty and reward systems for fans - Connecting fans with teams and players - Safety and comfort in the stadium environment - Mobile facilities and dedicated applications - Social spaces and gathering areas
Support and Maintenance	<ul style="list-style-type: none"> - Preventive and periodic maintenance - Training and empowering support teams - Updating and upgrading software and hardware - Continuous monitoring of system performance - Maintenance of security systems - Management of energy resources and consumption

Main Theme**Sub-Themes**

- Addressing issues related to mobile software and applications
- Data management and storage
- Identification and application of new technologies for maintenance

Discussion

In the context of smartening the sports equipment of football stadiums, the support and maintenance of systems and modern technologies are recognized as a fundamental pillar for ensuring the optimal and continuous performance of these systems. Preventive and periodic maintenance is crucial to avoid breakdowns and unforeseen issues. This type of maintenance involves regular inspections and identifying potential problems before they lead to failures. Moreover, to maintain systems at their highest level of efficiency, technical teams must be continuously trained to acquire the ability to repair and maintain smart systems.

Another important aspect of supporting smart systems in stadiums is providing 24/7 technical support. These services must be available so that in the event of technical issues, the technical team can act promptly, preventing any disruption in the match flow or the fan experience. Additionally, regular updates and upgrades to software and hardware systems must be carried out to ensure compatibility with new technologies and maintain optimal performance.

Backing up data is another critical aspect to consider in preserving the security of fan information, game statistics, and other essential data. Without a robust backup system, there is a risk of data loss in case of malfunctions or cyberattacks. Therefore, regular backup programs must be an integral part of the maintenance process.

Continuous monitoring of system performance using smart tools can help identify issues early and prevent disruptions. This monitoring includes evaluating the status of cameras, sensors, network systems, and other equipment. Alongside monitoring, effective processes must be implemented for managing energy resources and consumption to reduce costs and make effective use of renewable energy sources.

To enhance the quality of support and maintenance, employing advanced technologies such as artificial intelligence and machine learning can assist in identifying and predicting failures. These systems can simulate and automatically resolve issues, making repairs and maintenance faster and more accurate.

Compared to other aspects of stadium smartening, support and maintenance are vital for the success of these projects, ensuring that equipment and systems operate continuously without interruption. Given that smart stadiums require precise and well-planned maintenance, neglecting this aspect can lead to significant failures, reduced quality of services for fans, and even harm the stadium's brand.

Supporting and maintaining smart systems in football stadiums is one of the essential pillars for guaranteeing the optimal and continuous operation of these systems. Various equipment such as cameras, sensors, network systems, and other technologies deployed in smart stadiums require preventive maintenance and periodic upgrades. Since these systems directly impact the fan experience and game performance, preventive maintenance holds high importance. Regular inspections and performance evaluations help identify potential problems before major breakdowns occur, preventing

disruptions in stadium operations.

Technical and support teams responsible for maintaining these systems must be continuously trained and their skills enhanced. This training includes familiarizing themselves with new technologies, periodic repairs, and upgrading software and hardware to effectively address technical problems. Additionally, 24/7 technical support is essential, as problems may arise at any time, especially during match days. In such situations, having a technical team capable of quickly and effectively resolving issues is vital.

System updates are another critical aspect of maintenance. Given the rapid advancement of technologies, smart systems in stadiums must be regularly updated to remain compatible with new advancements and retain their efficiency. These updates include both the software and hardware of smart systems, which need to be continuously upgraded to fully utilize the benefits of modern technologies.

Data backup is another vital part of maintaining these systems. Smart stadiums collect a large volume of data daily, including information about fans, game statistics, equipment status, etc. This data must be stored regularly in backup systems to prevent loss in case of malfunctions or cyberattacks. Losing data can cause irreparable damage to the stadium and the fan experience.

Another essential aspect of support and maintenance is the continuous monitoring of system performance. Using smart monitoring tools, system performance can be tracked continuously. This monitoring helps in early problem detection, reducing breakdowns, and optimizing performance. These monitoring systems can respond automatically to problems or send alerts to technical teams for quicker corrective actions. Moreover, using advanced technologies such as artificial intelligence and machine learning allows for predicting and preventing issues before they occur. These

technologies enable the simulation and identification of faults, making the maintenance and repair processes faster and more efficient.

Attention to energy resource management and reducing energy consumption in stadiums is also a critical necessity of maintenance. Optimizing energy consumption not only reduces costs but also promotes the efficient use of renewable resources such as solar energy. Using smart systems for energy management can effectively reduce the operational costs of stadiums.

Given the importance of all these aspects, support and maintenance of smart systems must be carried out regularly and with high precision. These measures ensure that stadiums maintain optimal performance throughout the year, even during high-demand days and major matches, providing fans with the best possible experience. Neglecting accurate support and maintenance can lead to significant breakdowns, reduced quality of services, and a negative impact on the fan experience. Therefore, investing in the support and maintenance of smart systems not only extends the life of equipment but also enhances stadium performance and increases fan satisfaction.

Conclusion

In conclusion, the smartening of sports equipment in football stadiums is a fundamental tool for improving fan experiences and enhancing the operational efficiency of these venues. However, to fully utilize the potential of modern technologies, the support and maintenance of systems play a critical role. Preventive maintenance processes, training technical teams, regular system updates, and data backups are among the actions that must be continuously carried out to prevent issues and ensure optimal equipment performance.

Continuous monitoring of system performance, utilizing advanced technologies to predict failures, and smart energy resource management are key benefits of these

processes. Additionally, 24/7 technical support, which promptly addresses problems, plays a special role in maintaining the seamless operation of stadium services.

Ultimately, paying attention to these considerations can help maintain service quality, improve fan experiences, and prevent widespread failures in smart stadium equipment. Investing in support and maintenance, as an essential part of the smartening process, is not only economically viable but also ensures the long-term reputation and optimal performance of stadiums.

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