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The development of fitness centre architecture: Integration of modern trends and conventional approaches

Abstract. This study is concerned with the analysis of fitness centre architecture, with a particular focus on the integration of modern technologies with traditional design approaches. The objective was to examine the impact of contemporary architectural trends and technologies, including Building Information Modeling and artificial intelligence, on spatial solutions, functionality, and sustainability in the context of fitness centres. A comparative analysis was conducted between historical examples of Soviet-era sports complexes, which were imbued with ideological significance, and modern fitness centres, which are oriented towards the comfort and individual needs of users. The findings demonstrate that the process of globalisation has exerted a considerable influence on the standardisation of fitness centre design, frequently resulting in the erosion of national architectural characteristics. However, innovative approaches, such as the use of environmentally friendly materials and the integration of energy-efficient technologies, have been identified as pivotal to the development of modern fitness centres that are aligned with the needs of urban spaces. Based on an analysis of trends in various countries, recommendations were made for the creation of inclusive, eco-friendly, and innovative training spaces that support both social integration and individual goals. This study makes a significant contribution to architectural practice by offering ways to improve the efficiency of fitness centres through the use of modern technologies, the preservation of local cultural features, and the creation of comfortable environments for all visitors

Keywords: standardisation; globalisation; sustainability; energy efficiency; regionalism; typology

INTRODUCTION

Since the beginning of the 21st century, fitness centres have played an important role as places for improving physical health and as social and cultural spaces where people strive to enhance their quality of life. The relevance of this study is driven not only by the rapid development of the fitness industry in various cities but also by the desire to understand how architectural preferences and urban residents' needs are changing. Analysing the architecture of fitness centres allows for an assessment of how global trends and local characteristics are combined in creating urban spaces. In cities worldwide, including major metropolises and cultural centres, fitness centres are becoming embodiments of global trends, reflecting cities' aspirations to integrate into the global community. The analysis of these

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institutions' architecture presents not only architectural interest but also allows for an in-depth examination of the sociocultural changes occurring in the urban environment. This evolutionary path not only reflects general trends in architecture and construction but also reveals unique aspects of the influence of cultural and economic factors on urban infrastructure development.

When examining the development of fitness centre architecture, researchers face several key challenges. Historically, the development of fitness centres has undergone several key stages. Starting from simpler, functional buildings in the past to multifunctional complexes that incorporate the latest technological and architectural innovations. Studies covering this subject have been conducted by D. Blumetti *et al*. (2020) and M. Żychowska *et al*. (2022). It was noted that changes in governmental ideology are reflected in architecture, especially in authoritarian and socialist countries. For instance, the use of styles in courthouse architecture serves as a form of performance that expresses institutional power and adapts to the social context to maintain legitimacy and create a visual representation of justice.

In the context of exploring innovative approaches to the design of fitness centres, numerous aspects must be considered. Research in this area by B. Blocken *et al*. (2021), M. Evans & P. Farrell (2021) and A. Rosemina (2022) provided fairly extensive observations and measurement results of aerosol particle concentrations and CO_2 levels in various physical exercise scenarios with ventilation and air conditioning either on or off, which helped to understand methods of controlling the spread of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and other infections in indoor spaces. The combination of ventilation and intensive air purification using air conditioners significantly reduces aerosol particle concentrations, lowering the risk of clients contracting various diseases. The authors identified the main obstacles as the absence of mandatory industry standards and regulations for the use of Building Information Modeling (BIM) and Lean Construction (LC), the resistance of the industry to transition from conventional practices to LeanBIM, the high cost of software licenses, and the complexities of training and implementing BIM systems.

Globalisation has a substantial impact on the architecture of fitness centres, facilitating the transfer of technological innovations in architecture and construction internationally (Kucherenko *et al*., 2024). However, it also tends to overlook uniqueness and local character. Due to globalisation, architecture may become standardised and resemble other facilities in different countries, diminishing authenticity. E. Kalsum *et al*. (2024) analyse regionalism in architecture, focusing on how local perceptions influence the design of public state buildings in West Kalimantan Province, Indonesia, reflecting local cultural and environmental contexts. E.K. Duysebay & E.E. Duysebay (2022) explore the artistic language of modern Kazakh architects, highlighting the influence of cultural heritage on contemporary architectural practices. A.M. Adil & N.L. Seitakhmetova (2020) examine the impact of design and monumental painting on modern Kazakhstan architecture, focusing on its development and reflection of national identity.

The studies by the aforementioned researchers are indeed significant, as they help to better understand the complex aspects that have influenced the development of fitness centre architecture both historically and technologically. Despite the wide range of studies in this field, there are still some gaps that need to be highlighted. Attention must be paid to preserving the uniqueness and national identity of fitness centres in the face of standardised architectural solutions. The development of innovative approaches to design and functionality will help preserve diversity and cultural heritage in the architecture of such facilities. It is also important to delve into the environmental potential of fitness centres, including the assessment and improvement of energy efficiency, the use of environmentally friendly materials and technologies, and the impact on the environment during construction and operation.

The analysis of fitness centre architecture presents a complex challenge, requiring consideration of numerous factors and features and overcoming various methodological and practical obstacles. Therefore, the purpose of this study was to analyse a multitude of global architectural practices, both in the construction and the design phase of fitness centres, considering their role in the sociocultural environment of cities. The primary objectives of the study are to identify the problems faced by architects when designing such facilities and develop recommendations for the design of fitness centres of various profiles, considering the identified issues for effective use in the practice. This also contributes to the creation of healthy and sustainable urban environments that meet the needs of citizens.

MATERIALS AND METHODS

This study examined the architectural approaches to designing sports complexes within diverse political and social contexts, including the Soviet Union and Nazi Germany. The study also evaluated the extent to which these historical periods shaped contemporary fitness centre design. The methodology entailed a comprehensive review of historical documents, architectural literature, and case studies. The study drew upon a number of key sources, including the Resolution of the Council of Ministers of the USSR No. 1395 (1986), which outlined the Soviet Union's approach to the development of sports facilities, and architectural studies of the Olympiapark Berlin in Nazi Germany, which was constructed for the 1936 Summer Olympics. These sources furnished a basis for comprehension of the manner in which ideology influenced the configuration and functionality of sports facilities within these regimes (Kercher *et al*., 2023).

The analysis of the development of fitness centre architecture began with an extensive review of existing architectural structures, assessing their planning solutions and structural features by analysing their plans and sections available in open access, such as on the internet platform ArchDaily (Fitness center/Capote Marcondes…, 2023;

Norrvikens sports..., 2023). This review allowed for the identification of key trends in fitness centre design, from historical to contemporary examples, and enabled the comparison of typological features and planning solutions in various architectural styles. A comparative analysis of architectural styles was undertaken, employing a range of criteria, including building functionality, form, the symbolic representation of political ideologies, and the socio-cultural impact of the structures in question. The historical sports complexes were evaluated in comparison with the modern fitness centres, with particular attention paid to the influence of the political agendas of the time on their design. This comparison revealed that buildings erected during the Soviet and Nazi eras were designed with the primary objective of serving as propaganda tools, whereas contemporary fitness centres are primarily concerned with providing comfort, functionality, and an optimal user experience.

The study also reviewed specific case studies of modern fitness centres that integrate contemporary technologies like BIM and artificial intelligence (AI). Examples such as the World Class Fitness Club in Minsk, Belarus, were analysed to explore how these technologies optimize building design, enhance energy efficiency, and improve the overall user experience. In this case, BIM technology was used to visualize and model the building during the design phase, facilitating efficient construction and minimizing errors. Another noteworthy aspect of the study was the analysis of fitness centres integrated into natural environments, including Plateau D'Or in Goiânia, Brazil, and Norrvikens Sports Centre in Sollentuna, Sweden. These facilities were selected for their pioneering use of sustainable construction materials, including cross-laminated timber (CLT) and solar panels, as well as their commitment to integrating architectural design with the surrounding natural environment. An evaluation of the ecological aspects of these designs was conducted in terms of energy efficiency, sustainability, and minimal environmental impact.

In addition, the article analyses examples of fitness centres in Kazakhstan, China, the USA, France and Belgium. The selection of these fitness centres was based on their relevance to the research objectives, including their innovative design approaches, technological integration, and consideration of local environmental and social factors. This methodology afforded a comprehensive understanding of the evolution of fitness centre design in response to diverse political, cultural, and technological influences.

RESULTS

The early stages of the development of sports centre architecture in the Soviet Union began with the emergence of the first sports facilities in the early 20th century. During this period, sports structures were primarily built for mass sports movements and physical culture events; fitness centres, as they are known today, have yet to exist as a concept. The focus was on creating sports facilities for large-scale sporting events, training, and competitions in specific sports. The architecture and construction in the Soviet system were closely tied to state ideology, and all architectural projects were subject to strict control by central and regional authorities.

Architects did not integrate all functions, such as gyms, swimming pools, and cardio zones, into a single facility. This can be explained by the fact that in the Soviet system, a healthy lifestyle and physical activity were considered important aspects of education and preparation for work. Despite the active support and development of the construction and reconstruction of sports facilities during the Soviet period, they were primarily geared towards mass sporting events and state programmes. The functional purpose and form of sports facilities were determined by the ideology and needs of state and public programmes rather than individual needs or trends, as is common in democratic societies. During the Soviet era, physical activity and sports were mainly carried out within the framework of sports schools, children's sections, sports clubs, and stadiums. In such a system, there was no necessity to create comprehensive fitness centres where various types of physical activity could be pursued in one place. The Resolution of the Council of Ministers of the USSR No. 1395 (1986) states: "The main tasks of the USSR State Committee for Physical Culture and Sports are: enhancing the role of physical culture and sports in the comprehensive and harmonious development of the individual, preparing young people for work and the defence of the socialist motherland, strengthening health, fostering a healthy lifestyle, and organising active leisure for Soviet people".

A characteristic feature of the architecture of Soviet sports centres was functionality, expressed in clear geometric shapes and simple lines. The exterior of the buildings typically featured austere and restrained façades, devoid of excessive decoration or ornamentation. The buildings were designed with their purpose in mind, ensuring convenience for sports and training activities. In some cases, elements of constructivism or national styles could be observed, especially in the later periods of Soviet history. The sports complex "Salyut", built in Kamensk-Uralsky in 1961, exemplifies the typical style of the Soviet era, reflecting the principles of restrained neoclassicism. This style was often expressed in rectangular building shapes with minimal decorative elements. This brick and cinder block building has a rectangular plan. On the ground floor, the building features galleries with colonnades enclosed on three sides. However, in the 1970s, the space between the columns was filled with brickwork, altering the building's appearance. The sports complex "Dinamo" in Tbilisi, Georgia: This complex was one of the largest sports facilities in the Georgian SSR. It included a stadium, a swimming pool, gyms, tennis courts, and other facilities. The architectural style may have been inspired by traditional Georgian architecture, while the layout was designed to ensure mass access to sports events. One of the first examples of sports centres in Central Europe, built in the early 20th century, is "Olympiapark Berlin", which opened in 1936 in Berlin in anticipation of the Summer Olympic Games (Fig. 1).

Figure 1. "Olympiapark Berlin"

Source: iStock (2018)

This complex was created as part of the Olympic preparation project and included various sports facilities such as a stadium, swimming pool, sports halls, and training grounds. Notably, the organisation and hosting of the 1936 Olympic Games were complex events influenced not only by the Nazi authorities but also by various German and international participants. The Olympiapark embodied the architectural and engineering ideas of its time. The buildings and structures were designed with both functionality and aesthetics in mind, incorporating innovative technologies and building materials (Lehmann, 2021). As an architectural monument, it openly reveals National Socialist ideology through its finely artistic ensemble, created around the Nazi concept of the new Aryan man. The monumental sculpture, part of the park, represents a programme aimed at building the ideal Aryan body. Visitors to the park can (or should) view these sculptures to understand the historical and ideological significance they bear. Depictions of the body were used in National Socialist ideological politics as a tool to influence public opinion and shape desired stereotypes. These images were employed for education and instruction, teaching people to distinguish between "correct" and "incorrect" bodies according to Nazi ideals (Wildman, 1998).

Examples of sports complexes and facilities in Germany and other countries associated with the Nazi era highlight the architectural and symbolic features of that time. For instance, the stands of Maifeld and Langemarck Hall, which served as centres for sporting competitions, have distinctive architecture reflecting National Socialist ideology and the cult of masculinity. These complexes often served as tools for propaganda and mass manipulation under the Nazi regime. Similarly, in the Soviet Union, sports facilities were also designed to project power and advance the regime's ideological goals. While both regimes used architecture as instruments of propaganda and mobilisation, the ways in which these buildings reflected their respective political systems differed. Nazi structures often emphasized grandeur and strength to reinforce the image of the ideal "Aryan body", whereas Soviet sports facilities, though also monumental, were more focused on serving state programmes and mobilizing the masses for collective activities. The key distinction between the architecture of these sports centres and modern fitness centres is their strong connection to the political context of their time.

Over time, architectural solutions in fitness centres have become more diverse and innovative. Buildings have become more ergonomic, featuring increased natural light and ventilation. In addition, fitness centres now include not only sports facilities but also additional services such as saunas, cafés, beauty salons, and relaxation areas. The layout of such centres typically provides a convenient and efficient organisation of space for maximum visitor comfort. Fitness centres often do not reflect local traditions but are rather examples of globalisation in architecture. These facilities frequently adhere to standards and trends that are widespread worldwide, featuring similar design and functionality regardless of location. On the one hand, this provides architects with new tools and opportunities to create innovative and sustainable projects. On the other hand, it can lead to uniformity and a loss of uniqueness in architecture (Eldemery, 2009). Investment in sports facilities is becoming increasingly significant in the context of globalisation and the commercialisation of sports, as reflected in the growth in scale and luxury of fitness centres (Sklair, 2017).

It is important for architects to consider local features and the context of the city when designing fitness centres. This involves adapting the design to the climatic conditions and local landscape and considering cultural and social aspects. Moving away from standard modernism and experimenting with diverse designs can contribute to creating unique and attractive spaces that reflect the spirit of the city and local identity. It is essential to understand

that each region has its unique cultural, historical, and social specifics. When developing regionalisation strategies, these features must be considered, and local communities should be involved in the decision-making process. Only in this way can architectural and urban environments be created that reflect and respect local identity and cultural heritage. In addition, when implementing regional projects, it is necessary to consider and balance the interests between global trends and the needs of local communities (Trusova *et al.*, 2020). This may include accounting for economic, environmental, and social sustainability, respecting cultural diversity, and adhering to principles of social justice. Rethinking the impact of architecture on the external environment and the cultural identity of a city allows for the creation of more harmonious and sustainable structures. This can involve using traditional materials and construction methods, integrating elements of local architectural and cultural history, and creating spaces that promote social interaction and healthy lifestyles. This practice, therefore, has significant potential for effective implementation in the design of fitness centres.

Sports centres often become important public spaces where people gather and interact. The architectural design of these centres reflects the spirit of the community and national pride, significantly influencing visitor attraction. It serves as a means of cultural expression for the nation, reflecting its values, traditions, and identity. This is evident in the choice of architectural styles, design elements, and the use of symbolism and themes related to national heritage. Large countries strive to showcase their strength and prestige in sports by creating impressive and large-scale sports facilities, such as Olympic stadiums, arenas, and sports complexes designed for major sporting events. These structures have become symbols of national pride and are used to attract international attention and prestige.

The "Almaty Arena" Ice Palace in Almaty, Kazakhstan, built for the 2017 Winter Universiade, is an important symbol of the region's sporting and cultural life. The project utilised aluminium systems and protective structures from "ALUTECH". The Ice Palace not only contributes to the development of sports infrastructure but also serves as a place where people can gather, interact, and enjoy cultural events. Its construction and operation are crucial elements in shaping the social life of the region and strengthening the cultural and sports identity of Almaty and Central Asia as a whole. The design features simple lines, a minimalist aesthetic, and the use of glass and metal. The two colours of the Kazakh flag emphasise its national affiliation. The "National Stadium" in Beijing, China, also known as the "Bird's Nest", built for the 2008 Olympic Games, was conceived as a symbol of China's imperial heritage and its aspiration for global leadership. Other notable examples include the "Maracanã" in Brazil, the "Stade de France" in France, and the "Birmingham Arena" in the United Kingdom.

The architecture of fitness centres is often characterised by functionality and concise design, with dynamic elements to emphasise the building's sports orientation. Their external design typically aims to attract visitors, while the interior primarily reflects functionality. For instance, the "Fitnation" fitness centre in Almaty, Kazakhstan, is an example of modernist architecture, marking a transition from traditional decorative forms to an experimental and innovative approach that highlights the functional and structural aspects of the building.

The David A. Beckerman Recreation Centre at the University of New Haven seamlessly integrates two essential functions for an educational institution: a sports centre and a recreation area. This fitness centre becomes more than just a campus building; it transforms into a community hub for students, where they can not only work out but also participate in various events such as job fairs, concerts, and sports competitions (Fried & Kastel, 2020). This dual-function integration within a single space optimises resource usage and enhances the economic efficiency of both construction and operation. Constructing large-span structures to combine the sports centre and recreation areas can reduce costs for building and maintenance, as it eliminates the need for separate buildings for each function. Students can easily move between different zones within the same building or space, creating a more comfortable and functional environment. The sports complex in Kiel, Belgium, demonstrates innovative approaches to the organisation of functional zones. Using the principle of inversion, sports halls are located on the outer perimeter with maximum openness, and service areas are centralised. Space usage is optimised, and visitors' accessibility to various zones is improved.

The interior of the "Trois-en-Un" sports complex in Parsemain, France, lacks physical partitions, creating a visual separation of spaces due to its intricate architecture. This allows the sports areas to be used for large open events as well as for smaller groups requiring separate spaces. The complex features an intricate roof design with panoramic windows, allowing ample natural light to enter the space. Moreover, there are outdoor sports fields on the premises. The complex meets the Swiss Minergie standard for sustainability and energy efficiency, with its roof completely covered in solar panels.

The "Plateu D'or" fitness club in Goiânia, Brazil, comprises two main blocks. The first block is designated for the pool, sauna, and rehabilitation/physiotherapy activities, while the second block is for strength training, aerobics, and Pilates. The pool in the first block is housed in a building with a metal structure and a retractable roof, allowing for flexible use for both training and leisure on weekends. This area is integrated with the rehabilitation pool and sauna, making it fully accessible to visitors. The second block contains rooms for strength training, aerobics, and Pilates, situated under a large "shade" structure that protects from intense heat and provides greater transparency and integration with the landscape and forest. A snack area connected to these spaces supports users and club activities, maintaining good contact with the gardens and existing forest (Fitness center/Capote Marcondes..., 2023).

The centre uses natural materials such as wood and metal, reducing environmental impact and supporting sustainable resource use. The proximity of the fitness centre to the existing forest area and its integration with the landscape help preserve the natural environment and biodiversity.

The Norrvikens Sports Centre (2023) comprises three buildings on the lake shore in Sollentuna, Sweden, for canoeing and skating clubs. It uses natural materials like wood and metal with a simple yet effective design. The facades are painted blue to reflect the surrounding nature, and the interior walls are clad with hewn spruce boards, creating a cosy atmosphere. In addition, the buildings incorporate energy-efficient solutions such as the use of prefabricated CLT panels and simple tar board cladding, contributing to reduced energy consumption and emissions. The overall design allows the buildings to blend into the natural landscape, highlighting their environmental integrity and sustainability (Bandura *et al*., 2023).

The integration of BIM and AI represents considerable potential for the transformation of the construction industry. BIM currently serves as the digital foundation for architectural, engineering, and construction projects, while AI provides new tools and methods for analysing these data and making decisions that are more informed (Pan & Zhang, 2023). BIM constitutes a digital building model containing information about its physical and functional characteristics throughout its lifecycle stages, including design, construction, and operation. BIM is a comprehensive process of creating and managing information for constructed assets. Based on an intelligent model and supported by cloud platforms, BIM integrates structured interdisciplinary data to create a digital representation of the asset throughout its lifecycle, from planning and design to construction and operation. The use of BIM in conjunction with machine learning algorithms enables the analysis of space planning data and client needs to create optimal fitness centre designs. AI can assist in predicting visitor traffic and optimising equipment placement and zones for maximal space utilisation. BIM can incorporate safety visualisations and scenario modelling to help builders make informed decisions for ensuring safety, analysing equipment service data, and predicting maintenance needs or equipment replacement, thereby enhancing service efficiency and reducing equipment downtime (Bannikov *et al*., 2019). The application of data analysis and machine learning enables fitness centres to develop personalised training programmes for clients based on their goals and preferences. This also aids in collecting and analysing training data and client progress for continual improvement of training programmes and service delivery.

In urban environments and highly developed areas, constructing a fitness centre in a natural setting might be impractical due to the limited availability of suitable land. However, integrating fitness centres into the natural landscape can be achieved through the design of elements that mimic natural forms and objects. An example of such a solution is the concept of incorporating a green facade into a fitness centre using 3D-printed components. For instance, suitable materials and components for the green facade are selected based on a 3D model. The primary elements include pots or containers made from eco-friendly materials such as recycled plastic or composite materials and aluminium or steel frames that will attach to the building facade and hold the plant modules. An integrated drip irrigation system with automatic control capabilities is also included. A drainage tray or system prevents water stagnation and facade damage. The components are manufactured at a factory using modern technologies, with 3D printing employed to create prototypes and complex elements, thereby accelerating the process and reducing costs. For example, the 3D-VtGW modular system of vertical green walls made from concrete, fabricated using 3D printing. This system consists of two-layered concrete printed by a 3D printer, with a cavity filled with insulation. It is integrated with a 3D-printed concrete surface featuring a sinusoidal shape (Fig. 2).

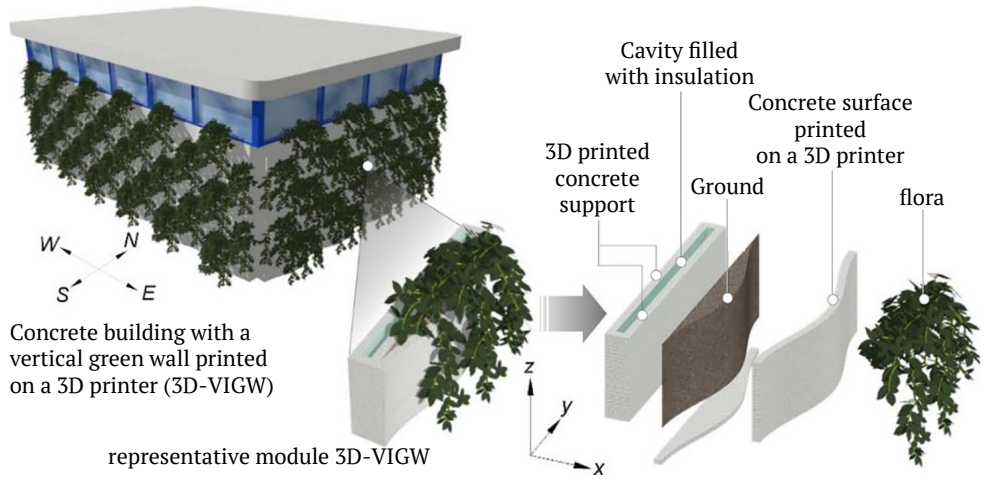

Figure 2. 3D-printed Vertical Green Wall (3D-VtGW) composition
Source: A.P. Capêto *et al*. (2024)

The structural system of the "World Class" fitness club in Minsk, Belarus, exemplifies a comprehensive solution aimed at achieving client goals such as adherence to exterior design, minimisation of construction timelines, cost optimisation, and ensuring high-quality real estate (Fig. 3).

Figure 2. "World Class" fitness club in Belarus
Source: Design project of World Class fitness club (2020)

Innovative structural solutions were employed to address these challenges. Successful implementation involved the use of unique pre-stressed concrete cantilever parts (sections 2 and 3) measuring 12 metres, fully leveraging the benefits of post-tensioning: stress relief and initial compression. BIM technology was utilised for precise visualisation and building modelling to closely align with the design project. The building was divided into several independent sections for simultaneous construction, contributing to reduced construction time. Each building section features a unique structural system tailored to its functional purpose and design requirements. For instance, the pool area is equipped with a monolithic technical floor and steel trusses, while the training zone employs reinforced concrete composite structures, optimising construction costs for each part (Tur *et al.*, 2020). In this project, the application of BIM facilitated detailed structural planning and advanced three-dimensional modelling, streamlining collaboration among project participants. Furthermore, this technology enabled the verification of 3D models for compliance and the incorporation of corrections at early stages of design. As a result, there were no delays on the construction site due to incorrect design decisions or errors in the project. This demonstrates that the speed of design increased, project management with numerous participants became more efficient, and the risks of errors in the project were minimised.

DISCUSSION

The analysis presented in the study not only highlights the factors driving the development of fitness centre architecture but also touches upon the prospects for improving structural, sociocultural, and planning solutions. Particular attention is given to the efficient use of resources and the adherence to sustainable development principles, devising methods to enhance appeal to a broad audience. One way to significantly improve fitness centres during the construction and design phases is through the application of artificial intelligence practices in combination with various digital technologies.

This subject was also explored by P. Nusen *et al.* (2021), who analysed the efficiency of combining BIM and MOGA in the systematic approach to planning and scheduling renovation projects, providing valuable insights for decision-making. The authors highlight that BIM creates a digital model of a building containing data about its physical and functional characteristics, while MOGA optimises various project aspects considering multiple objectives. The study described focuses on the combination of BIM and machine learning algorithms to analyse and optimise the design of fitness centres, considering various factors such as space utilisation and client needs. In contrast, the aforementioned authors evaluate the effectiveness of combining BIM and MOGA in the systematic approach to planning and scheduling renovation projects. Thus, while both studies share a common theme of using BIM in construction, they focus on different aspects of this process in combination with other methods. The integration of various functions into a single fitness centre space represents an innovative approach that optimises resource use and enhances the efficiency of the construction and operation processes. Before such concepts became widespread, fitness centres and recreational areas were considered separate entities requiring distinct buildings and infrastructure. However, modernist architectural trends aim to create more flexible and multifunctional spaces where different functions can coexist harmoniously (Nedosnovanyi *et al.*, 2023). This is particularly emphasised by the implementation of national policies in European countries, encouraging physical activity through public events and engaging the older generation.

B.S. Flowers (2017) also investigated the multifunctional approach in the design of sports architecture, analysing stadiums as centres of sociocultural activity and important elements of urban infrastructure. The author highlights the potential of stadiums for multifunctional use, including temporary stadiums that can be easily modified or even dismantled after the event, allowing cities to use spaces more efficiently and economically. This aligns with study findings indicating that the integration of multiple functions within sports buildings enhances resource and space efficiency, which is essential for densely populated urban areas. Such integration also promotes environmental sustainability and attracts a larger number of visitors.

Fitness centres can host various cultural events, such as exhibitions, concerts, dance evenings, and other activities, enriching the cultural life of the city and drawing new visitors. The current study notes that globalisation has caused significant changes in the fundamental perception of fitness centre architecture. Most of these changes include technological innovations and the re-evaluation of space utilisation for different functions. However, a major

drawback is the simplification of a large category of buildings, including fitness centres, which leads to the neglect of national style and regional context. This aspect has garnered attention from numerous researchers. Among them, D. Ponzini (2020) highlights the misconception that globalisation automatically leads to the homogenisation of cities, a view that was prevalent during the industrialisation period. The author argues that such a simplistic perspective is not only incorrect but also hampers the understanding of the complex dynamics of urban transformation. The researcher emphasises that the departure from national style is inevitable but does not necessarily threaten the degradation of architectural style.

L. Lefaivre & A. Tzonis (2020) and S. Giamarelos (2022) note that after World War II, large-scale reconstruction and postcolonial building projects by state and transnational organisations often ignored local ecology, culture, and community, leading to failures in many cases. This sparked a resurgence of regionalism, which actively and critically re-embraced vernacular architectural traditions and expressed the aspirations of marginalised and forgotten communities. Critical regionalism faces the challenge of adapting to the postcolonial era, with the emergence of numerous new nation-states. While the discourse of critical regionalism emphasised context, it often remained confined within national boundaries, potentially leading to an oversimplified understanding of architectural context. Architecture can serve not only functional purposes but also carry symbolic significance, reflecting dominant ideologies and social relations (Tsyrfa *et al*., 2024). For example, strict geometric forms and rigid boundaries may symbolise authoritarian or hierarchical structures. Sports architecture has cultivated national pride, reinforced loyalty to regimes, and supported their political objectives. International sporting events, such as the Olympic Games or World Cup, continue to serve as demonstrations of a state power and prestige to the international community.

B. Hughes & P. Issaias (2023) also explored the impact of political institutions on society and space and the relationship between architecture, social relations, and ideology, using Italian architecture during the fascist regime as an example. Similar to the current study, the authors conclude that political institutions and social structures have left their mark on the architecture of sports centres and facilities, even after these structures have been formally changed or simplified. This creates challenges when altering or rethinking the use of specific spaces.

The review of the above studies and the comparison with the obtained findings demonstrated key trends in the formation of fitness centre architecture. The discussion highlights the relevance of applying BIM technology in combination with MOGA and AI. It also examines the influence of historical factors and political ideologies on the architecture of fitness centres. The degree of influence of globalisation on the architecture of fitness centres is discussed, which highlights the divergence of opinions on this issue among different authors and architects. This is crucial for analysing the multitude of factors accompanying the design and implementation of such buildings.

CONCLUSIONS

This study presents a comparative analysis of the architectural evolution of fitness centres, examining the impact of political ideologies and technological advancements on their design over time. The research demonstrated a stark contrast between the sports facilities constructed during the Soviet and Nazi eras, which were significantly influenced by state ideology, and the modern fitness centres, which prioritise functionality, comfort, and user experience. In the Soviet Union and Nazi Germany, sports complexes were designed with the explicit purpose of serving as propaganda tools, reflecting the political ideologies of their respective regimes. Such facilities were used to advance the interests of the state and to exert control over society. Their architectural style was frequently employed as a means of symbolising strength, discipline and nationalism. In contrast, contemporary fitness centres are more focused on the well-being of individuals, offering multifunctional spaces that cater to a diverse range of users.

The incorporation of contemporary technologies, including BIM and AI, has been identified as a pivotal aspect influencing the design and construction of contemporary fitness centres. These technologies facilitate more effective resource management, reduce construction costs, and enhance overall project quality. Fitness centres that integrate sustainable design elements, such as the utilisation of eco-friendly materials and energy-efficient systems, have been observed to have a positive environmental impact and contribute to a more sustainable urban environment. Furthermore, the study underscored the significance of regionalism in architectural design, advocating for the conservation of local cultural and environmental characteristics in the planning and construction of fitness facilities. It is recommended that future research concentrate on enhancing the accessibility of fitness centres in rural areas and incorporating social functions into their design, with the objective of further improving community engagement and promoting inclusivity.

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CONFLICT OF INTEREST

None.

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Розвиток архітектури фітнес-центрів: інтеграція сучасних тенденцій і традиційних підходів

Анотація. Це дослідження присвячене аналізу архітектури фітнес-центрів, з особливим акцентом на інтеграцію сучасних технологій з традиційними підходами до проектування. Мета полягала у вивченні впливу сучасних архітектурних тенденцій і технологій, зокрема інформаційного моделювання будівель і штучного інтелекту, на просторові рішення, функціональність і стійкість у контексті фітнес-центрів. Було проведено порівняльний аналіз між історичними прикладами спортивних комплексів радянських часів з ідеологічним значенням, та сучасними фітнес-центрами, орієнтованими на комфорт та індивідуальні потреби користувачів. Результати дослідження демонструють, що процес глобалізації справив значний вплив на стандартизацію дизайну фітнес-центрів, що часто призводить до розмивання національних архітектурних особливостей. Однак інноваційні підходи, такі як використання екологічно чистих матеріалів та інтеграція енергоефективних технологій, були визначені як ключові для розвитку сучасних фітнес-центрів, що відповідають потребам міського простору. На основі аналізу тенденцій у різних країнах, були розроблені рекомендації щодо створення інклюзивних, екологічних та інноваційних тренувальних просторів, які сприяють як соціальній інтеграції, так і досягненню індивідуальних цілей. Це дослідження робить значний внесок в архітектурну практику, пропонуючи шляхи підвищення ефективності фітнес-центрів завдяки використанню сучасних технологій, збереженню місцевих культурних особливостей та створенню комфортного середовища для всіх відвідувачів

Ключові слова: стандартизація; глобалізація; сталість; енергоефективність; регіоналізм; типологія