



User Experience and Design Performance in Turkish Basketball Arenas: A Qualitative Post-Occupancy Evaluation (POE) Approach

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Abstract

Despite the global popularity of large-scale basketball arenas, research on their design performance and user experience, particularly in regional contexts, remains limited. This qualitative Post-Occupancy Evaluation (POE) study explores the interplay between design, user experience, and facility management practices in three prominent Turkish basketball arenas. Utilizing on-site observations, document analysis, and interviews with facility managers, the research uncovers how design choices impact user experiences and operational efficiency. The findings reveal recurring challenges related to HVAC systems, natural ventilation, multi-purpose adaptability, and wayfinding. Additionally, the study highlights the influence of management structures on arena performance and the critical role of incorporating user feedback. By integrating facility managers' perspectives, this research offers valuable lessons and recommendations for creating future arenas that enhance both spectator satisfaction and operational efficiency.

1. INTRODUCTION

Large-scale sports arenas are increasingly prominent features of contemporary urban landscapes, serving as hubs for sporting events, cultural gatherings, and tourism [1]. Their design and management pose unique challenges for architects and facility managers, who must balance complex functional requirements with creating engaging and comfortable user experiences while ensuring long-term sustainability [2]. A systematic approach to evaluating building performance is essential to foster a continuous cycle of learning and refinement in the design process. This is especially crucial in arenas where user satisfaction is paramount and directly influenced by design choices impacting comfort, accessibility, safety, and overall enjoyment.

Post-Occupancy Evaluation (POE), a systematic method for assessing building performance in use, has become a vital tool for identifying successes and shortcomings in design and informing future improvements [3]. POE aims not only to document performance but also to contribute to the knowledge base of building performance, identifying gaps between intended outcomes and users' actual needs and expectations [4]. The seminal work of Preiser, Rabinowitz, and White [4] established a framework for understanding the complex building-occupant relationship, which has been further explored through diverse methodologies, including quantitative surveys, qualitative interviews, observational studies, and environmental monitoring [6]. These methods provide valuable insights into building performance's technical, functional, and behavioural aspects, leading to improved design, construction, and operation. Building performance evaluation pioneers Leaman and Bordass stress the importance of a holistic approach that integrates design and management throughout the building lifecycle [7, 8, 9].

Despite its recognized value, POE remains underutilized in the context of sports facilities, with research predominantly focusing on more common building types [10]. This limited attention restricts opportunities to learn from past projects and hinders the development of more effective, user-centered,

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and sustainable arenas [11]. Building upon a previous quantitative POE study of Turkish basketball arenas [12], which highlighted the need for standardized assessments of experiential quantitative performance, this paper focuses on three prominent large-scale basketball arenas in Turkey—Ankara Sports Hall, Ülker Sports and Event Hall, and Sinan Erdem Sports Hall—to investigate the interplay between design, user experience, and facility management practices.

Large-scale basketball arenas pose unique challenges that warrant a focused POE approach. These venues cater to diverse user groups with distinct needs and expectations [13], often hosting a variety of events beyond basketball, requiring adaptable and flexible design and management. User satisfaction is intertwined not only with design but also with effective facility management practices that contribute to a positive experience [7]. Additionally, the environmental impact of these large-scale venues necessitates sustainable design and management practices to mitigate negative consequences on energy consumption, resource use, and local biodiversity [14].

This study employs a qualitative POE approach, utilizing on-site observations, document analysis, and semi-structured interviews with facility managers. The collected data will be analysed using thematic analysis and coding to reveal key themes, patterns, and relationships between design choices, user experience, and facility management practices. By uncovering both successes and shortcomings in existing arenas, this research aims to provide valuable insights and actionable recommendations for architects, facility managers, and policymakers involved in creating future sports venues that enhance spectator experience and operational efficiency.

2. POST-OCCUPANCY EVALUATION OF ARENA DESIGN AND USER EXPERIENCE

Post-Occupancy Evaluation (POE) is a systematic process of assessing building performance in use, involving the collection of occupant and stakeholder feedback, and the analysis of data to identify areas for improvement [3]. Since emerging in the 1960s, POE has evolved significantly, with an increasing emphasis on standardized methodologies, robust data collection techniques, and integrating user feedback into the design process [15]. This reflects the growing recognition that buildings are complex systems whose success depends not only on technical aspects but also on meeting user needs and expectations [16].

POE methodologies can be broadly categorized as quantitative, qualitative, and mixed methods:

- Quantitative POE focuses on gathering numerical data, often using standardized occupant surveys, building performance measurements (e.g., temperature, lighting, acoustics), and statistical analysis. This approach excels in providing objective performance measures and enabling comparisons between buildings or design options [16, 17].
- Qualitative POE emphasizes in-depth understanding of user experiences through methods like semi-structured interviews, observations, focus groups, and thematic analysis. This approach provides rich insights into occupant perceptions, preferences, and behaviors.
- Mixed-methods POE combines quantitative and qualitative methods for a more comprehensive and nuanced evaluation, integrating diverse data sources for a holistic understanding of building performance and user experience.

The choice of POE methodology depends on research questions, context, resources, and desired detail. POE plays a crucial role in sustainable building design and operation [15, 16]. It identifies performance gaps, highlighting discrepancies between design intent and actual performance informs design decisions, enabling more informed choices prioritizing comfort, functionality, and sustainability [19]. Finally, POE helps optimize building operations, leading to greater energy efficiency, reduced maintenance costs, and enhanced well-being [20]. Despite its value, POE remains underutilized in sports facilities [10], limiting opportunities to learn from past projects and hindering the development of more effective, user-centered, and sustainable arenas [11].

Evaluating building performance in sports facilities requires a comprehensive approach that considers user satisfaction, thermal comfort, ventilation and air quality, acoustics, and energy efficiency. User

satisfaction is paramount in arenas, encompassing comfort, enjoyment of the event, ease of circulation, quality of amenities, and the overall atmosphere. Maintaining comfortable temperatures is also essential, given their large size and dynamic occupancy levels [21, 22]. Adequate ventilation and air quality are crucial for spectator health, particularly during crowded events [23].

Attending a basketball game is a multi-sensory experience encompassing the thrill of competition, social atmosphere, and comfort of the venue [24]. Spectator experience is shaped by comfort and amenities, atmosphere and excitement, connection to the game, social interaction, and safety and security. Comfortable seating, adequate legroom, good sightlines, and convenient access to amenities are essential and contribute to user satisfaction like other building types [18]. The arena's design and operation should foster excitement through dynamic lighting, high-quality sound, engaging displays, and well-designed social spaces [25]. Spectators crave a strong connection to the game, influenced by seating proximity, sightlines, and acoustics. Basketball games are social events, and arenas should encourage interaction through design. Finally, a sense of safety and security is paramount, achieved through clear exits, visible security measures, and well-maintained facilities.

POE provides a valuable tool for evaluating spectator experience in basketball arenas, capturing both quantitative and qualitative aspects of user satisfaction, informing design decisions for new arenas and improving the management and operation of existing venues.

3. METHOD

Research Design and Qualitative POE Approach: Despite a growing body of literature on sports venue design and management, there remains a significant gap in understanding the specific performance of large-scale basketball arenas, particularly regarding user experience in diverse regional contexts. This study addresses this gap by employing a focused qualitative POE approach to investigate the design and utilization of three prominent basketball arenas in Turkey. The study seeks to unravel the complex interplay between design choices, user experience, and facility management practices, ultimately aiming to inform the development of more effective and user-centered arenas in the future.

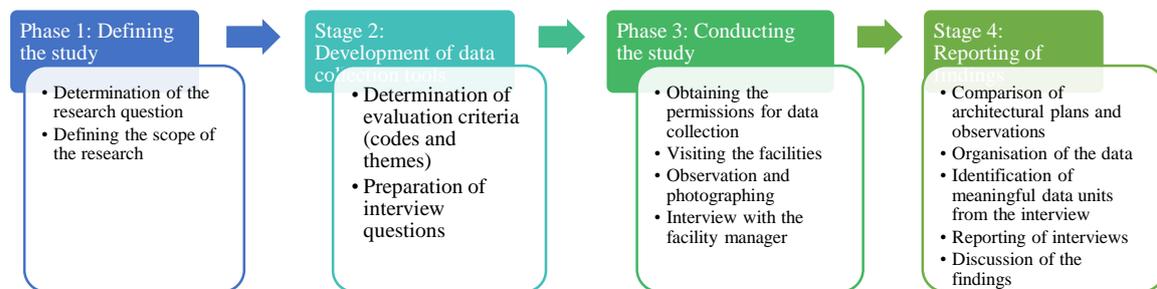


Figure 1. Research Methodology: An Overview of the Study's Key Stages

Selection of Case Studies: To ensure a comprehensive analysis of the diverse factors influencing large-scale basketball arena design, use, and management in Turkey, three prominent arenas were purposefully selected as case studies: Ankara Sports Hall, Ülker Sports and Event Hall, and Sinan Erdem Sports Hall. These arenas represent a spectrum of design approaches, user demographics, and operational contexts, providing a rich foundation for understanding the complexities of this building typology within the Turkish context. Drawing on the principles of user-centered design commonly employed in product and service development, this study adapted the "Voice of Customer" technique to the architectural realm. This approach involved gathering insights from multiple data sources, including on-site observations, document analysis, and in-depth interviews, with a particular emphasis on capturing the expert opinions and experiences of facility managers, who serve as key stakeholders in shaping the user experience within these venues.

Table 1. Overview of Case Study Arenas: Key Characteristics and Information

Ülker Sports and Event Hall	Sinan Erdem Sports Hall	Ankara Sports Hall
		
Year of construction: 2008 Location: Istanbul, Turkey Capacity: 16500 persons Architect: Omerler Architecture Project payer: Fenerbahçe SK Purposes of use: Basic sports activities such as basketball, volleyball, ice hockey, boxing, concerts and congresses.	Year of construction: 2010 Location: Istanbul, Turkey Capacity: 15000 people Architect: Nuhoglu Construction Project taxpayer: Istanbul Metropolitan Municipality Purposes of use: Basic sports activities such as basketball, volleyball, ice hockey, boxing, concerts and congresses.	Year of construction: 2010 Location: Ankara, Turkey Capacity: 10000 persons Architect: Yazgan Design Architecture Project payer: Ministry of Youth and Sports Purposes of use: Basic sports activities such as basketball, volleyball, ice hockey, boxing, concerts and congresses.

Data Collection and Analysis: A multi-method approach, incorporating on-site observations, document analysis, and semi-structured interviews with facility managers, was employed to gain a holistic understanding of the interplay between design, user experience, and facility management in the arenas. This triangulation of data sources enhanced the validity and reliability of the findings.

Direct observations during event and non-events provided a user-centered perspective on how the physical layout supported user flow and accessibility, while also revealing user behaviours and potential issues related to wayfinding, comfort, safety, and satisfaction [26]. Document analysis, encompassing architectural plans, facility reports, operational manuals, and maintenance records, offered a deeper understanding of the design intent, usage patterns, operational practices, and potential recurring problems [27]. Lastly, semi-structured interviews with facility managers, as key stakeholders in arena management [33], elicited their insights on design effectiveness, management challenges, user satisfaction, and recommendations for improvement. These interviews highlighted the factors shaping arena performance from a practical, operational perspective.

To extract meaningful insights from this data, a rigorous analysis process was undertaken. The collected qualitative data were systematically analysed using thematic analysis, a widely used method for identifying patterns and themes within qualitative data [28]. This involved coding the data, grouping similar codes into overarching themes, and analysing the relationships between those themes to understand the complex interplay of factors shaping arena performance. The data were interpreted using a framework adapted from the literature on building performance evaluation, focusing on technical, functional, and behavioural aspects. This comprehensive approach provided a rich understanding of the successes and challenges experienced within each arena. By comparing the findings across the three venues, the study gleaned valuable insights regarding best practices in design, management, and community integration for large-scale basketball facilities.

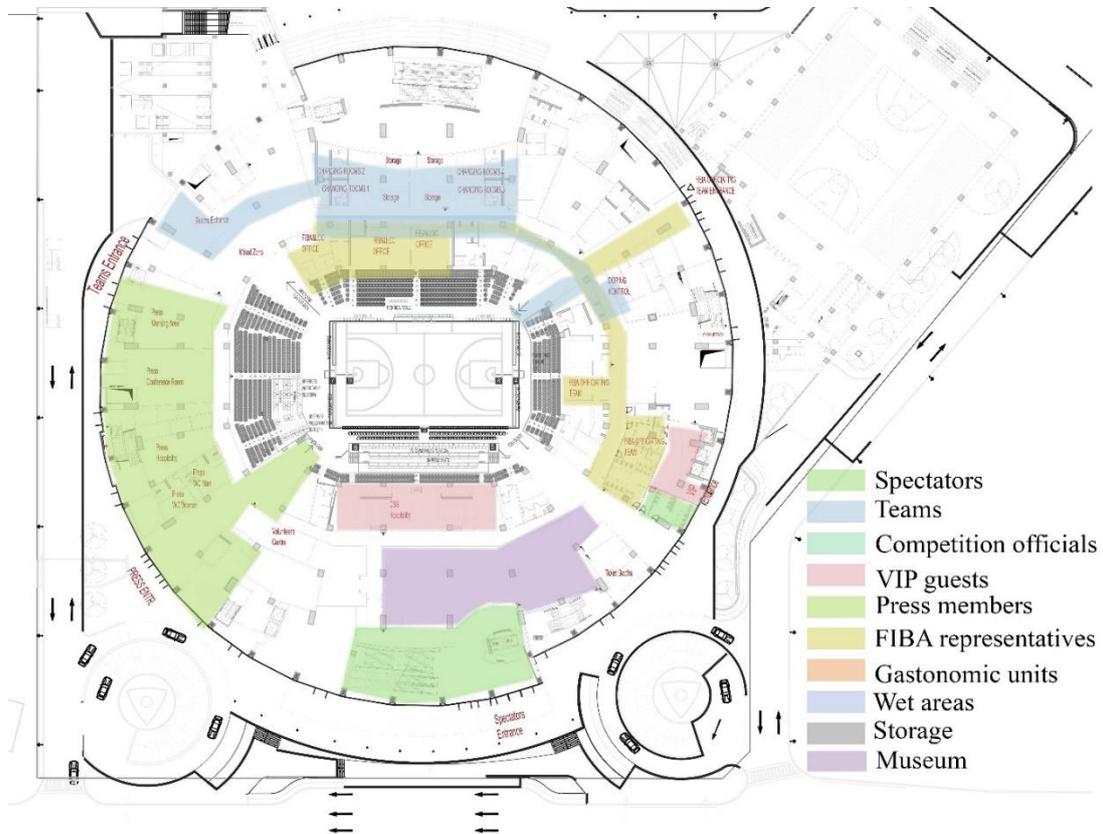
4. FINDINGS

This section presents the key findings from the qualitative POE of the three Turkish basketball arenas, organized by case study and analysed within the framework of technical, functional, and behavioural aspects.

4.1. Ülker Sports and Event Hall

Ülker Sports and Event Hall, designed by Ömerler Architecture, has been operational since 2012, boasting a capacity of 12,687 spectators. Located in Istanbul's Ataşehir district, the arena serves as the home court for Fenerbahçe Basketball Club, also hosting concerts, corporate gatherings, and theatrical performances. The ground floor is strategically designed to facilitate efficient and controlled circulation for diverse user groups. Separate entrances for press, teams, trucks, FIBA representatives, VIP guests, and

spectators effectively segregate traffic flow, minimizing congestion and enhancing security. This separation is maintained through designated corridors and circulation paths, allowing different user groups to navigate the facility efficiently.



ÜLKER SPORTS AND EVENT HALL

Figure 2. Spatial Organization of Ülker Sports and Event Hall (+0.00 Level): Highlighting User-Specific Zones

Spectators enter a spacious, well-lit foyer leading directly to grand staircases ascending to the upper seating levels, promoting a clear and intuitive path that minimizes confusion and fosters a sense of anticipation. Meanwhile, press members, teams, and VIPs are guided along separate corridors to their designated areas, each equipped with specific amenities and workspaces. This spatial segregation enhances security and privacy, promoting a more streamlined flow for all users.

The Fenerbahçe Basketball Club Museum on the ground floor adds another layer of engagement for fans and visitors. Situated near the spectator entrance but distinctly separate from event traffic, its spacious layout and well-designed exhibits offer an immersive experience, allowing exploration of the club's history. The museum serves as an independent attraction, even during non-event periods, solidifying the arena's role as a cultural hub

The ground floor's design demonstrably prioritizes clarity, efficiency, and comfort, contributing to a positive user experience. Separate entrances, designated corridors, wide spaces, strategically placed elevators, and accessible restrooms minimize congestion and promote inclusivity. Prominent signage, clear wayfinding graphics, and strategic lighting further enhance intuitive navigation, while convenient access to amenities like concessions, restrooms, and the museum adds to the overall enjoyment of a visit. By carefully considering the diverse needs of user groups, Ülker Sports and Event Hall achieves a balance between functionality, efficiency, and user experience.

From a technical perspective, Ülker Sports and Event Hall exhibits a mix of strengths and areas needing improvement. While the electrical, lighting, and furnishing systems are generally up-to-date, challenges related to thermal comfort and natural ventilation persist. Maintaining consistent temperatures within the seating bowl, particularly during high occupancy, proves difficult, with spectators reporting discomfort from overheating in summer and underheating in winter. This suggests potential shortcomings in the HVAC system's capacity or distribution efficiency, echoing findings from other studies on the complexities of thermal comfort in large-scale venues with fluctuating occupancy [29]. Furthermore, the lack of natural ventilation in the main hall and offices raises concerns about indoor air quality, especially during crowded events, potentially impacting user well-being.

Observations also revealed inconsistent lighting levels in certain areas, particularly lower-than-recommended illumination in concourses, potentially impacting pedestrian safety and comfort [30], the reliance on traditional metal halide lamps for court lighting contributes to high energy consumption, presenting an opportunity for retrofitting with more efficient LED systems [31]. The absence of visible renewable energy technologies further limits the arena's sustainability profile.

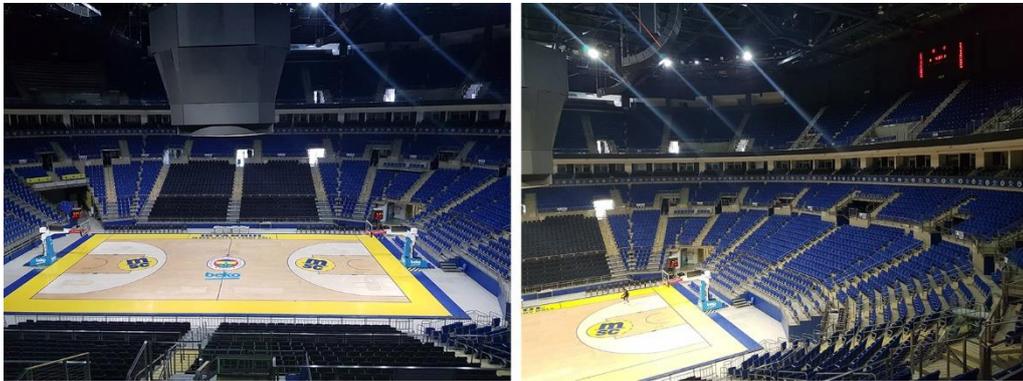


Figure 3. Interior View of Ülker Sports and Event Hall: The Main Court and Seating Bowl

Functionally, the arena is effectively utilized for various events, with basketball competitions comprising the majority of its use. The inclusion of sponsor areas and concessions contributes to revenue generation and enhances the spectator experience [25]. However, the integration of commercial units with external access, while providing additional income, could benefit from improved visibility and accessibility to attract customers. The well-designed museum, separate from main spectator areas, offers a valuable cultural and historical experience for fans and visitors (Figures 4, 5, and 6).



Figure 4. Sponsor Area within Ülker Sports and Event Hall: Integrating Branding and Spectator Amenities



Figure 5. Commercial Units with External Access at Ülker Sports and Event Hall: Balancing Revenue Generation and User Flow



Figure 6. Fenerbahçe Basketball Club Museum within Ülker Sports and Event Hall: Providing a Cultural and Historical Experience

The arena showcases commendable design flexibility and adaptability, accommodating events with diverse needs and attendance levels through a variety of meeting room configurations and efficient use of space. Features like retractable seating, movable partitions, and flexible stage setups allow for diverse uses. Even dividing walls are utilized for displaying exhibitions, showcasing a sophisticated integration of art and design (Figures 7 and 8).

Ülker Sports and Event Hall demonstrates a strong commitment to intuitive and efficient circulation, contributing to a positive user experience. The facility manager reported no significant wayfinding issues, suggesting that the arena's planned design and clear signage effectively guide users throughout the facility. This positive assessment is supported by observations of smooth spectator flow during events, with minimal congestion or confusion in key areas like entrances, concourses, and staircases. Strategic placement of prominent signage featuring clear wayfinding graphics and directional arrows enhances the ease of navigation.

Distinctive architectural elements further enhance wayfinding by serving as landmarks, aiding user orientation. The central atrium, with its soaring ceiling and abundant natural light, provides a central point of reference. Similarly, the strategically placed museum acts as a visual anchor within the concourse area. Color-coded zones for different user groups further simplify navigation, allowing quick identification of designated areas. Additionally, the intuitive spatial organization, with its clear hierarchy of spaces and logical connections, minimizes disorientation and allows users to develop a mental map of the facility easily. The ability to evacuate the arena in approximately 15 minutes reinforces the effectiveness of the circulation paths and the strategic placement of exits, demonstrating a commitment to spectator safety in potential emergency situations.

While the arena does not currently utilize formal building assessment certifications, a commitment to performance evaluation is evident. Comprehensive evaluations were conducted between 2012 and 2016, suggesting a proactive approach to assessment and improvement. Although not currently ongoing, the

facility actively incorporates user feedback, primarily complaints received via email or telephone, into its management practices. This responsiveness highlights a user-centered approach to arena operation and a dedication to enhancing the spectator experience. However, implementing a more systematic and ongoing POE program that incorporates diverse user feedback mechanisms and objective performance data could provide a more comprehensive understanding of the arena's strengths and weaknesses, ultimately leading to further improvements in design and operation.



Figure 7. Installations on Dividing Walls within Ülker Sports and Event Hall: Integrating Art and Design

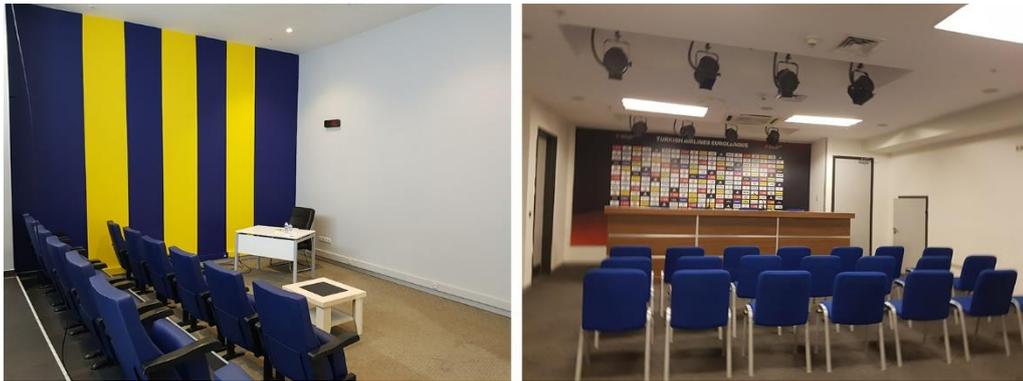


Figure 8. Meeting Room and Press Area at Ülker Sports and Event Hall: Accommodating Diverse User Needs

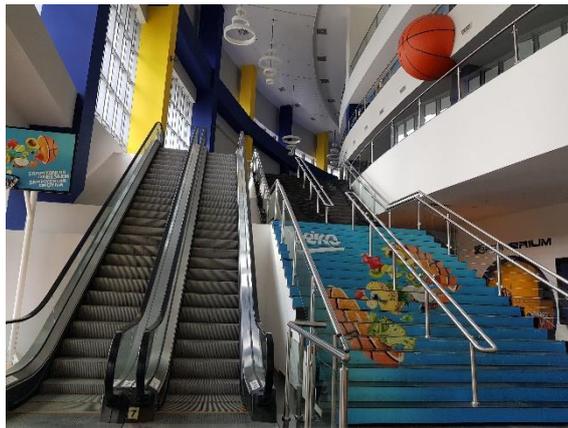


Figure 9. Spectator Staircase at Ülker Sports and Event Hall: Assessing Circulation and Wayfinding Ankara Sports Hall

4.2. Ankara Sports Hall

Ankara Sports Hall, completed in 2010 and operated by the Turkish Basketball Federation, has a capacity of 10,000 spectators. This multipurpose venue hosts diverse events, including basketball, volleyball, ice hockey, boxing, concerts, and congresses, with a unique design that allows for transformation into an ice

hockey rink, enhancing its adaptability. The arena employs a system of segregated entrances and circulation routes for different user groups, similar to Ülker Sports and Event Hall, aiming to optimize flow and minimize potential conflicts. Spectators enter at ground level and access the seating bowl via designated staircases, while VIPs, press members, athletes, and service vehicles are guided along separate paths. The ground floor houses the "CSS Lounge" for VIP guests, offering dedicated amenities and direct access to seating areas. The east facade is reserved for press members and FIBA officials, providing dedicated workspaces and observation points. Management offices are also situated on the ground floor, facilitating operational oversight. A designated lorry entrance ensures efficient delivery and setup for events, directly accessing the court area (Figure 10).

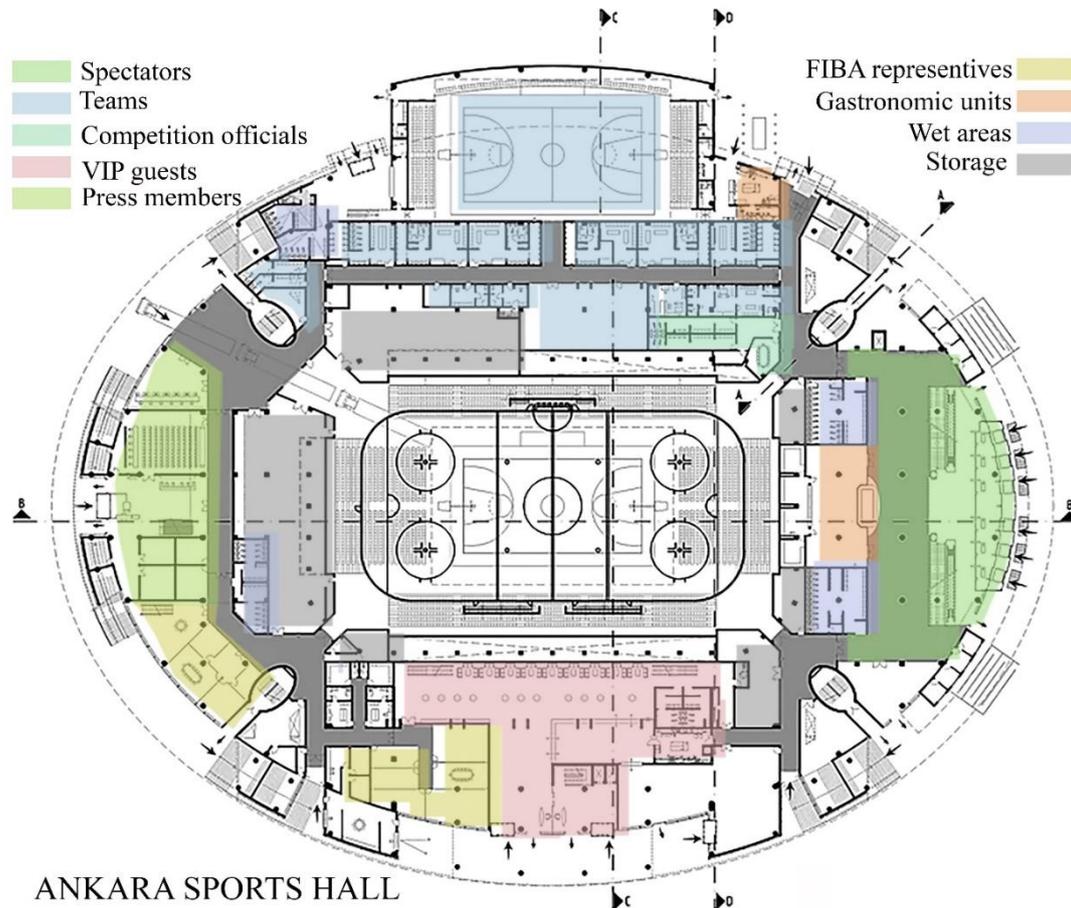


Figure 10. Spatial Organization of Ankara Sports Hall (+0.00 Level): Illustrating User-Specific Circulation Paths and Functional Zones

Despite these design features aimed at optimizing user flow and functionality, Ankara Sports Hall faces several technical, functional, and evaluation challenges. Persistent issues with thermal comfort were reported, particularly during summer and winter events, with the facility manager indicating that the HVAC systems struggle to maintain consistent temperatures within the main hall and offices, suggesting potential capacity limitations in handling fluctuating occupancy levels [23]. The lack of natural ventilation in the hall further compounds this challenge, impacting office areas where staff experience discomfort due to poor air quality and lack of fresh air, raising concerns about indoor air quality and the potential for high CO₂ levels during events, which could negatively impact user health and well-being [32].

The multi-purpose design necessitates different lighting levels for various events, but the existing lighting infrastructure lacks flexibility, forcing reliance on temporary lighting solutions. This approach creates logistical challenges and raises concerns about energy efficiency and cost-effectiveness. The outdated software controlling the LED lighting system further hinders optimal performance and adaptability.

Additionally, the sound system's limited coverage, concentrated in the center of the hall, results in uneven audio quality for spectators in certain areas.

While the facility manager expressed satisfaction with the furnishings' quantity and quality, he highlighted concerns about the structural integrity of the seating steps, noting their susceptibility to bending, buckling, and even collapse under heavy use during events, raising concerns about spectator safety and long-term durability. This issue emphasizes the need for more robust design or higher-quality materials to withstand frequent use and large crowds.



Figure 11. Interior View of Ankara Sports Hall: Showcasing the Main Court and Transformable Playing Surface

Functionally, the arena effectively serves its multi-purpose role but faces challenges regarding its transformation into an ice hockey rink. The facility manager cited high maintenance costs and potential disruptions as concerns, highlighting limitations in design flexibility for accommodating evolving needs. The arena features concessions within the foyer, offering food and beverages to spectators, and ten lodges, two of which can be combined, provide amenities for VIP guests (Figures 12 and 13).



Figure 12. Food and Beverage Concessions at Ankara Sports Hall: Assessing Placement and Adaptability for Various Events



Figure 13. Lodges at Ankara Sports Hall: Analysing Flexibility in Configuration and Usage

Despite these challenges, Ankara Sports Hall exhibits effective circulation and wayfinding systems, with clear signage and an intuitive layout ensuring smooth spectator flow during events. The strategic door placement allows for quick evacuation, demonstrating a commitment to safety (Figure 14). However, the lack of formal building performance evaluation, including certifications and user surveys, represents a missed opportunity to learn from user experiences, identify areas for improvement, and inform future design and management decisions.



Figure 14. Spectator Entrance and Foyer at Ankara Sports Hall: Highlighting Clarity of Circulation and Wayfinding

4.3. Sinan Erdem Sports Hall

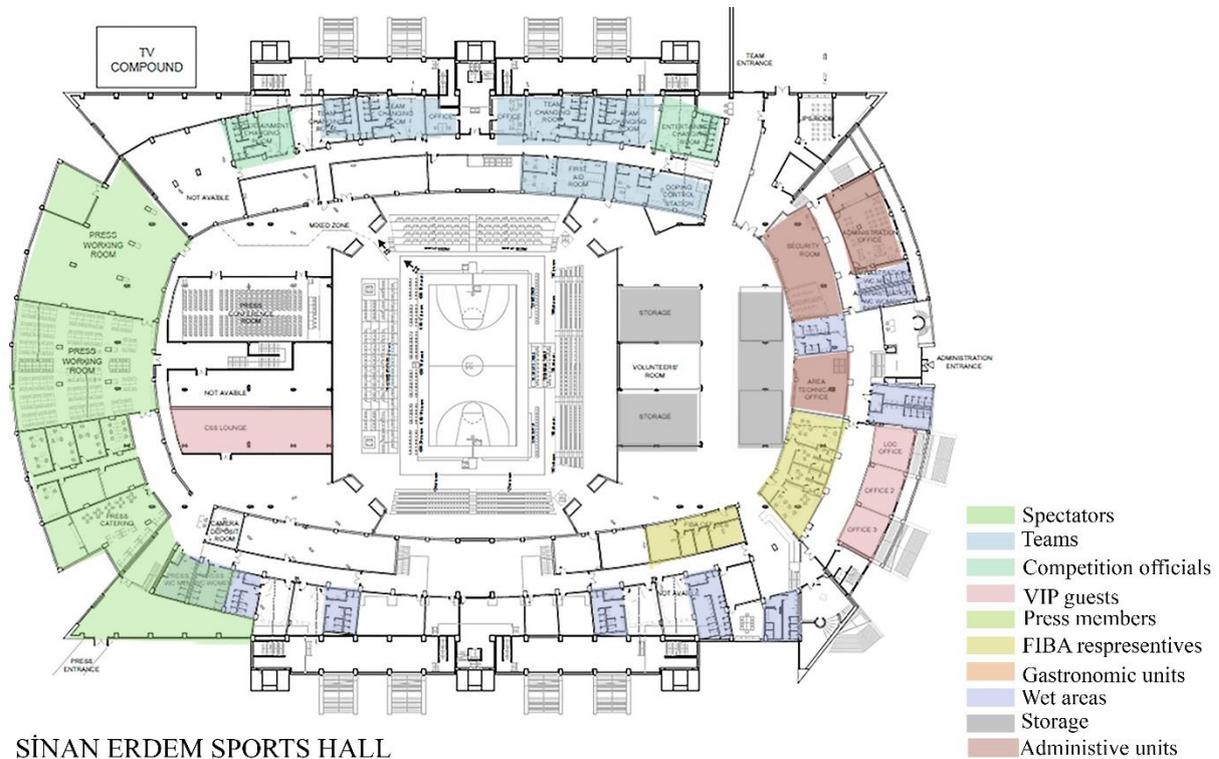
Construction of Sinan Erdem Sports Hall began in 1993 in Istanbul. The arena, consisting of a ground floor and two upper levels, accommodates 15,000 spectators and has served as a major venue for basketball competitions, concerts, party congresses, school graduations, and other indoor events. Designed to host the 2010 FIBA World Basketball Championship, the arena features extensive press areas, though these are not fully utilized for current events.

Sinan Erdem Sports Hall utilizes a hierarchical system of entrances and circulation paths, aiming to manage diverse user groups. Spectators enter at ground level and are directed to upper levels via staircases, while dedicated entrances provide access for basketball teams, VIPs, VVIPs, press, and management personnel. This system, however, exhibits significant weaknesses impacting user experience and operational efficiency. The sheer size of the building, combined with a lack of clear wayfinding cues and a complex circulation system, creates challenges for user navigation. Spectators reported difficulties in orienting themselves and locating their designated seating areas, leading to confusion and frustration, particularly during high-traffic periods. The steep staircases at the main spectator entrance further hinder accessibility and create a sense of disorientation upon entry. This complex and inefficient circulation system also impacts operational efficiency, as staff members struggle to navigate the building quickly and effectively, potentially delaying event setup, maintenance activities, and emergency response.

The east entrance leads to a dedicated zone for basketball teams, equipped with locker rooms, a first aid room, and a doping control room. A lorry entrance with direct court access facilitates efficient event logistics. The management entrance opens to administrative units, while VIPs and VVIPs are admitted through separate entrances, with VVIPs enjoying access to dedicated rest areas and VIPs utilizing the press entrance to reach the CSS Lounge. The absence of a dedicated training hall for athletes represents a notable functional limitation (Figure 15).

While the facility manager at Sinan Erdem Sports Hall reported achieving thermal comfort through the arena's HVAC systems, he acknowledged the substantial operational costs associated with maintaining these systems in such a large facility. This observation underscores the ongoing challenge of balancing user comfort with energy efficiency and cost-effectiveness in large-scale sports venues while the mechanical ventilation systems effectively provide ventilation comfort, their operational and maintenance costs are significant. The absence of natural air circulation in the lounge areas raises concerns about air quality and user comfort, potentially contributing to a stuffy and less pleasant environment. Carlucci et al.

highlight that over-reliance on mechanical ventilation in sports halls, especially if not optimally designed and maintained, can lead to increased energy consumption and inadequate air quality [32]. Occasional lighting malfunctions resulting in reduced illuminance levels suggest potential issues with the lighting system's reliability or maintenance practices. Ensuring consistent and adequate lighting is critical for user safety, visual comfort, and optimal task performance in sports venues.



SİNAN ERDEM SPORTS HALL

Figure 15. *Ground Level Usage of Sinan Erdem Sports Hall: Depicting User Zones and Circulation Patterns*



Figure 16. *Interior View of Sinan Erdem Sports Hall: Showcasing the Main Court and Seating Bowl*

Sinan Erdem Sports Hall is actively used for various events, with basketball competitions being the most frequent. The facility manager confirmed the adequacy of furnishings and equipment, indicating no significant deficiencies. Food and beverage concessions within the foyer area cater to spectators, but their placement and design could be improved to minimize congestion and enhance accessibility during peak event times (Figure 17). The haphazard placement of exhibition elements within a corridor, rather than a dedicated museum or display area, represents a missed opportunity to create a more engaging and informative experience for visitors (Figure 18). Integrating gastronomic areas and exhibition spaces more thoughtfully into the design process, rather than distributing them along circulation routes, could have enhanced their functionality and accessibility, ultimately improving user experience.



Figure 17. Food and Beverage Concession Area at Sinan Erdem Sports Hall: Analysing Placement and Impact on User Flow



Figure 18. Exhibition Area at Sinan Erdem Sports Hall: Assessing Functionality and User Engagement

A significant observation regarding Sinan Erdem Sports Hall is the presence of large, uncontrolled voids within the facility that are not actively utilized. These voids not only represent an inefficient use of space but are also potential sources of significant heat loss, impacting energy efficiency and operational costs. Additionally, the ad hoc creation of office spaces using dividers within the foyer area suggests a lack of foresight in the original design to accommodate administrative needs (Figure 19). This observation, along with the temporary relocation of the Turkish Basketball Federation's headquarters to the arena, highlights the need for more adaptable and flexible design solutions in sports venues to accommodate evolving needs and future changes in use.



Figure 19. Administrative Offices at Sinan Erdem Sports Hall: Highlighting Adaptations and Spatial Inefficiencies

The facility manager stated that the arena's electrical systems, furnishings, and overall spatial organization facilitated easy orientation, with no major wayfinding issues reported. However, the reported evacuation time of 35 minutes for a fully occupied arena raises concerns about the efficiency of

circulation paths and exit capacity. finding suggests a potential need for further analysis and optimization of the arena's egress systems to ensure spectator safety in emergency situations.

Although Sinan Erdem Sports Hall does not currently utilize formal building assessment certifications, the facility management team has undertaken efforts to collect user feedback. Complaints received from users have identified specific problems related to accessibility, particularly with disabled lifts and toilets, highlighting areas requiring immediate attention and improvement. However, a more systematic and comprehensive POE approach, incorporating diverse user feedback mechanisms and objective performance data, would provide a more holistic understanding of the arena's strengths and weaknesses, guiding more effective improvements in design and operation.

5. DISCUSSION AND RECOMMENDATIONS

This section synthesizes the findings from the qualitative POE of the three Turkish basketball arenas, highlighting successes and shortcomings in their technical, functional, and behavioural aspects. Based on these lessons, actionable recommendations are presented to guide the design and operation of future arenas in Turkey.

The case studies emphasize the crucial role of a user-centered approach in achieving optimal arena performance. Ülker Sports and Event Hall, despite technical challenges, demonstrates a strong commitment to user feedback and continuous improvement. Its well-planned design prioritizes intuitive circulation, clear wayfinding, and convenient access to amenities, creating a positive and engaging experience for diverse user groups. Ankara Sports Hall, while successfully accommodating various events, exhibits significant technical shortcomings related to HVAC performance, natural ventilation, and lighting flexibility. The proactive efforts of the facility manager to mitigate these issues underscore the importance of resourcefulness in addressing design limitations, but the absence of systematic user feedback collection and the high costs of transforming the arena into an ice hockey rink emphasize the need for a more integrated and user-centered design and management approach. Sinan Erdem Sports Hall, despite being deemed satisfactory by the facility manager, reveals spatial inefficiencies, potential safety concerns related to evacuation time, and limited adaptability in accommodating evolving needs. The underutilization of press areas, prolonged evacuation time, and ad hoc creation of office spaces highlight opportunities for improvement. The high operational costs of mechanical systems further emphasize the need for energy-efficient design solutions and incorporating natural ventilation strategies.

These case studies provide valuable lessons for shaping future basketball arenas. Future arenas should prioritize investments in modern, efficient, and adaptable HVAC systems with zoning capabilities to ensure consistent thermal comfort [23]. Integrating natural ventilation strategies, particularly in areas with prolonged occupancy, will enhance indoor air quality and contribute to energy efficiency. Flexible and adaptable lighting systems, utilizing a combination of natural and artificial sources, prioritizing energy-efficient LED technology, and incorporating smart controls, are essential [31].

Beyond technical considerations, thorough user research is essential to understanding the diverse needs of various user groups, ensuring spaces are designed for both functionality and enjoyment [26]. Adaptability for multi-purpose use should be prioritized, employing modular and convertible design elements to maximize flexibility. Circulation patterns should be clear and intuitive, minimizing congestion and maximizing accessibility for all users. Comprehensive wayfinding signage, strategic landmarks, and logical spatial organization enhance navigability and user comfort. Robust technology infrastructure allows for seamless adaptation to diverse event formats.

Crucially, future arena development must embrace proactive and adaptive management that prioritizes user feedback and performance evaluation [33]. Implementing formal building performance evaluation programs that incorporate both objective performance data and subjective user feedback is essential. Diverse feedback mechanisms, such as surveys, online platforms, and focus groups, will capture a wider range of user perspectives. Fostering open communication channels between facility managers, stakeholders, and design professionals will enhance knowledge sharing and collaborative problem-

solving, ultimately leading to the development of more effective, user-centered, and sustainable basketball arenas.

6. CONCLUSION

This research offers both theoretical and practical insights into the design and management of large-scale basketball arenas. By employing a qualitative POE approach, the study illuminates the intricate relationships between design choices, user experience, and facility management practices in three prominent Turkish arenas. The findings reveal that user satisfaction transcends mere technical performance, as it is significantly influenced by the interplay between design, operational practices, and facility managers' responsiveness to user feedback.

The identified challenges related to HVAC systems, natural ventilation, adaptability, and wayfinding underscore the need for a holistic and user-centered approach to arena design and management. This research emphasizes the importance of:

- **Prioritizing user comfort and well-being:** Investing in well-designed and efficient HVAC systems, incorporating natural ventilation strategies, ensuring adequate lighting and acoustics, and providing accessible spaces.
- **Designing for flexibility and adaptability:** Accommodating a variety of events and user needs through modular and convertible design elements to maximize spatial flexibility.
- **Integrating technology effectively:** Utilizing smart building systems, energy-efficient lighting controls, and advanced sound and video technologies to enhance functionality, user experience, and sustainability.
- **Establishing robust feedback mechanisms:** Implementing ongoing performance evaluation programs that incorporate both objective performance data and subjective user feedback to enable continuous improvement.

While the study's focus on three Turkish arenas may limit the generalizability of the findings, the qualitative nature of the research provides rich insights that lay a foundation for further exploration. Future research can expand the scope to include a wider range of arenas and incorporate quantitative data collection methods, such as user surveys and environmental monitoring, to further validate and generalize findings. Investigating the economic impact of design choices and the influence of specific elements on fan behaviour and crowd management would also provide valuable insights for future arena development. Despite its limitations, this research contributes to the growing body of knowledge regarding best practices for designing and operating large-scale sports venues. By emphasizing user experience, sustainability, and continuous improvement, this study encourages a shift toward a more holistic and user-centered approach to arena design and management, ultimately leading to the development of more successful, impactful, and sustainable sports venues worldwide.

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