Influence of The Adoption of Acoustic Design Strategies on User Satisfaction in Convention Centres, In Lagos Nigeria

[1]A. A. Oluwatayo, [2]N. S. Adele

[1]College of Science and Technology, Department of Architecture, Covenant University, Ota, Ogun State, Nigeria
[2]College of Science and Technology, Department of Architecture, Covenant University, Ota, Ogun State, Nigeria

: [2]ngozi.adelepgs@stu.cu.edu.ng

Abstract:
Acoustic design shapes the auditory environment which inevitably affects the satisfaction of a user in a space. In convention centres, acoustics is a key part of the function of the space. Information is being passed across through lectures, conferences and meetings, or an audio reliant activity such as a play or musical performance is carried out. For the aforementioned events, the acoustic quality is a make or break of the event. This study aims to investigates the influence of acoustic design strategies on user satisfaction in select convention centres located in Lagos, Nigeria. A quantitative approach was employed, using surveys with questionnaires to gather data. A random sampling method was used to select convention centre users, with the sample size determined using the Cochran equation for infinite populations. Data analysis was conducted using SPSS to evaluate user satisfaction and acoustic strategies. The survey findings indicate that specific acoustic strategies significantly impact user satisfaction. These strategies include ceilings baffles and banners, vegetation as a noise barrier, furniture with fabric upholstery, and the incorporation of insulation and absorption materials like cotton fibre, foam glass, and foam plastic. The study emphasizes the importance of integrating these strategies during the design phase to create favourable acoustic environments within convention centres. By understanding this relationship between acoustics and user satisfaction, stakeholders involved in convention centre design, construction, and management can make informed decisions that enhance the satisfaction of users and have better performing convention centres.

Keywords: Acoustics, Acoustic Design, Convention Centre, User Satisfaction

1. Introduction

IN today's interconnected global landscape, conventions provide a platform for the exchange of knowledge, ideas, and innovations across various fields and industries. They facilitate the dissemination of best practices, research findings, and emerging trends [1].
Convention centres serve as large venues attracting a diverse array of individuals spanning various age groups, socioeconomic backgrounds, and interests [2]. Similar to meetings, conventions allow people to gather to explore opportunities, exchange ideas, viewpoints, and information.
A convention centre, comprising one or multiple buildings, is primarily designed to accommodate large gatherings for meetings, rallies, and seminars. Its versatile design allows for customization, making it suitable for various events, including talks and musical performances [3]. These centres stand as key players in the Meetings, Incentives, Conferences, and Exhibitions (MICE) industry, driving economic advantages and fostering growth in their respective destinations [4].
As convention centres host a diverse spectrum of events, they require tailored acoustic conditions to maximize impact and audience satisfaction. Versatile acoustic design solutions enable these centres to adapt seamlessly to the unique requirements of different events.

Acoustics, the scientific study of sound, is important in the design, operation, and construction of buildings, significantly impacting health, well-being, and satisfaction [5][6]. Excessive noise levels and poor acoustic conditions in convention centres can lead to listener fatigue and detract from the overall experience of participants [7]. Therefore, optimal acoustics are imperative to fulfil the fundamental purpose of these venues.
User satisfaction in buildings is subjective and varies based on individual experiences and preferences [8][9]. It represents the measure of contentment and fulfilment experienced by individuals utilizing various spaces.
A building serves as a space tasked with fulfilling occupants' needs and expectations, providing a secure, comfortable environment that facilitates their activities [10]. User satisfaction is evaluated by comparing actual product or service performance to users' needs and expectations during and after the consumption experience [11].
In convention centres, user satisfaction extends beyond mere functionality to encompass comfort, engagement, and overall satisfaction with the facility. Acoustics play a significant role in

shaping these perceptions and directly influence user satisfaction through several key mechanisms. It is a major factor in ensuring optimal sound quality and audience engagement, thus significantly influencing the overall effectiveness and impact of such gatherings. Therefore, it is imperative to meticulously design the acoustic environment to ensure the clarity and intelligibility of speech within the space [12]. Thoughtfully crafted acoustic environments not only enhance the overall perception of the event but also contribute profoundly to the audience's engagement, thereby aiding the users' experience.

Popular convention centres are widely used for events other than conventions, such as parties and calendar events such as weddings and birthdays. Convention centres situated in urban locales contend with ambient noise sources that can impinge upon the quality and privacy of events. Effective acoustic design mitigates sound leakage into and out of convention centre spaces, which allows for event privacy and shields attendees from external disruptions.

While research addressing user satisfaction and acoustics has mainly focused on building types such as office buildings [8][13], and housing projects [14], there is a noticeable gap in understanding user satisfaction specifically concerning acoustics within convention centres. The purpose of this research is to investigate the influence of the adoption of acoustic strategies on the satisfaction of users of convention centres in Lagos, Nigeria.

In venues such as convention centres, optimal acoustics are imperative to fulfil their fundamental purpose [7]. Intentional acoustic design is crucial; the seamless transmission of messages during meetings or conventions relies on clear and intelligible reception of information by the audience or individuals.

This study to contribute to the existing body of knowledge by gathering information from users of convention centres and similar structures to improve design practices. It seeks to provide valuable insights to convention managers and members of the design team on approaches to building designs that enhance user satisfaction in convention centres or spaces intended for conventions. The research identifies acoustic design strategies adopted in convention centres in Lagos, Nigeria, and assess their impact on user satisfaction. A structured questionnaire, informed by literature, was used to gather data on the adoption of these strategies. Three convention centres, each with a seating capacity over 2,000, were purposively selected. A sample size of 323 users was calculated using the Cochran equation, with respondents randomly chosen.

II. LITERATURE REVIEW

The development of convention centres in Nigeria has seen notable growth in recent years. The Eko Convention Centre, established in 1977 as part of the Eko Hotel and Suites, marked the inception of convention facilities in the country. Subsequently, the Abuja International Conference Centre in 1991 expanded the landscape [15]. More convention centres have since come up in include the Calabar and investments Port Harcourt. Future developments include plans for an international convention and exhibition centre in Lagos, reflecting the government's commitment to enhancing trade. Similarly, the construction of a high-quality convention centre in Abuja by the Bolton White Group highlights the growing infrastructure development [16]. Additionally, the increasing demand for suitable venues is evidenced by Nigeria's prominence among African countries hosting conferences and meetings.

Convention centres greatly differ in size with some spanning over 100,000m2 and some others spanning just about 4,500m2. Their features and range of functionalities are thus very different. However, there are basic features a convention centre should have to be able to dutifully carry out its purpose. An optimal convention centre must be located within an area zoned for concert halls and auditoriums. A convention centre must also have a hall for conventions and exhibitions and have bathrooms and ancillary services for the management of the centre.

[17] states that prime convention centres are invariably encircled by a plethora of lodging choices and transportation hubs for attendee convenience and have ample onsite parking.

Acoustics, derived from the Greek word acoustikos meaning "for hearing," is the scientific study of sound. Architectural acoustics deals with the generation, transmission and reception of sound in rooms. The indirect sound - the reflected sound, changes the quality of sound we hear in a room [18].

"Acoustic design" means the discovery of principles to enhance the aesthetic qualities of the acoustic environment [19]. It is not merely about imposing order but delicately enhancing the auditory realm—an art of sensitivity that weaves understanding, respect, and awareness to create environments where sound harmonizes with human experience [20].

Acoustic design strategies involve employing techniques and methodologies to control sound within a space to achieve specific goals, such as enhancing speech intelligibility, reducing noise levels, or improving the overall acoustic environment. [19] emphasize that specifying the acoustic objective must be the initial step for soundscape planning and management.

[21][22] highlight the role of room layout, shape, sound absorption, diffusion, insulation, and masking in shaping the acoustic environment of buildings. The research by [23] investigates the influence of room dimensions and arrangement on acoustic properties, revealing how larger rooms often suffer from longer reverberation times, leading to issues like echoes and uneven sound distribution, whereas smaller spaces may encounter phase cancellation and standing waves due to rapid reflections.

To address these challenges, [23] suggests strategically situating sound absorbers and diffusers throughout all available surfaces in large rooms. Additionally, the geometric configuration of a room influences the balance between direct and indirect sound, affecting perceived clarity and intelligibility. Different room shapes require tailored acoustic design approaches, with narrow spaces benefiting from sound-absorbing materials near the sound source and round rooms necessitating diffusing elements to disperse sound effectively.

The integration of sound-absorbing materials into building design, as discussed by [24] and [25], helps regulate noise levels by eliminating reflections that propagate sound energy throughout the space. Various sound absorption treatments, including acoustical foam panels, fabric-wrapped panels, ceiling tiles, and baffles, offer effective solutions, converting sound energy into heat as sound waves interact with their porous structure [26][27].

It is important to distinguish between sound-absorbing and soundproofing materials, as highlighted by [28]. While sound-absorbing materials focus on absorption within a space, soundproofing materials aim to prevent sound transmission between spaces. [29] classifies sound-absorbing materials into porous and resonant categories, encompassing materials like glass fibre, metals like aluminium, and perforated and plate resonant materials.

Sound diffusion plays a crucial role in distributing sound waves throughout a space to mitigate concentration in specific areas, as noted by [30]. Architectural design strategies, including surface irregularities and reflective elements, effectively achieve sound diffusion, particularly in critical environments like concert halls or studios [31][25].

Sound insulation, as discussed by [32][25] focuses on impeding sound transmission through different building components. Techniques such as double wall construction and cavity constructions are commonly employed to enhance sound insulation, alongside the use of false ceilings and honeycomb blinds to absorb sound waves and reduce noise levels [33][34][35].

In contrast, masking sound involves introducing another sound to elevate the threshold at which existing sounds become noticeable, thereby diminishing their perceived intensity [36][37]. A typical sound masking setup comprises various components like noise generators, equalizers, amplifiers, controllers, and strategically positioned speakers, effectively obscuring undesirable sounds and enhancing comfort and privacy for occupants within the space [38].

User satisfaction signifies the contentment, pleasure, or fulfilment experienced after using a product, service, or system. Poor acoustics can significantly decrease user satisfaction in a built environment.

Acoustics, a vital element of Indoor Environmental Quality (IEQ), holds a significant impact on occupants' satisfaction and well-being within buildings. It accounts for a quarter of the overall IEQ assessment [39]. Several key factors influence the assessment of acoustic comfort, ranging from traditional metrics like room noise level to more nuanced aspects such as acoustic privacy and personal control [40].

While measurable parameters like noise levels are informative, they don't capture the entirety of occupants' acoustic experiences. A comprehensive approach is necessary, considering both objective and subjective aspects of acoustic comfort. Post-occupancy evaluations (POE) are instrumental in providing insights into occupants' experiences and satisfaction levels. Studies by [41][42] demonstrated the effectiveness of POE combined with IEQ monitoring. By employing POE techniques, researchers were able to refine indoor environmental design, creating spaces where occupants' needs and preferences are meticulously considered. This approach ensures a balance between acoustic comfort and other essential environmental factors, such as thermal conditions and lighting, leading to enhanced occupant satisfaction.

Also, building designers and owners might not completely understand the reasons behind and consequences of inadequate acoustical performance. It is crucial to assess users' perceptions of the acoustical environment and identify specific aspects of building design that influence these evaluations [43]. The integration of user-centred design principles is essential in creating convention centres that effectively meet the diverse needs, preferences, and behaviours of stakeholders, including event organizers, exhibitors, attendees, and staff. To achieve this, it is imperative to thoroughly understand the requirements of these stakeholders to design intuitive, accessible spaces that align with their objectives. Previous studies have underscored the significance of user-centred design in convention centres, emphasizing its pivotal role in enhancing user experience and overall satisfaction.

For instance, research conducted by [3] investigated the parameters essential for designing functional convention centres, with a specific focus on space efficiency and circulation. Their findings highlighted the crucial role of space efficiency and well-planned circulation in enhancing user experience within convention centres. Clear wayfinding, minimal congestion, and optimized space allocation emerged as key factors contributing to a positive environment for attendees, exhibitors, and organizers, ultimately fostering satisfaction.

The research pertaining to user-centred design in convention centres does not address acoustic considerations, and research addressing user satisfaction and acoustics has predominantly concentrated on building types such as office buildings [8][13] and housing projects [14], there exists a noticeable gap in understanding user satisfaction specifically concerning acoustics within convention centres. The purpose of this research is to bridge this gap by examining the influence of acoustic strategies on user satisfaction within convention centres in Lagos, Nigeria.

The studies mentioned above have indeed conducted research on acoustics and user satisfaction in various settings, and while some have explored user-centric design ideologies, none have specifically focused on acoustics within convention centres. This study aims to fill this void by investigating the impact of acoustic strategies on user satisfaction within convention centres, providing valuable insights into enhancing the overall user experience in such facilities.

III. METHODOLOGY

This study investigated the adopted acoustic design strategies that impact on user satisfaction in selected convention centres within Lagos, Nigeria. The review of existing literature revealed acoustic design strategies currently being utilized in buildings. These strategies identified became the core of the survey material: the questionnaire, as they were the elements participants were asked about their adoption in the course of the survey. The questionnaire comprised of three sections: Section A, B, and C. Section A included questions about the demographic characteristics of respondents. Sections B and C required respondents to indicate the degree of adoption of acoustic strategies using a 5-point Likert scale, with Section B focusing specifically on acoustic elements and Section C on acoustic materials. The data retrieved from the survey were analysed using descriptive statistics.

The study population for this research consisted of the users of existing convention centres in Lagos State, Nigeria. Purposive sampling was employed to select the convention centres for the study. The seating capacity of the convention centres in Lagos, Nigeria was used as a determinant to select them. Three convention centres from the study area were carefully chosen based on specific criteria that they had a seating capacity of more than 2000 people.

For the survey, Cochran equation was used to calculate the sample size which was 323 individuals. The number of respondents were shared equally between the 3 convention centres chosen, amounting to a figure of 108 respondents in each convention centre. Individuals present in the convention centre were then chosen at random, ensuring a diverse representation of users' perspectives within the convention centres.

The methodology ensured validity and reliability through peer review evaluations and Cronbach's alpha tests, resulting in values of 0.756 for variables assessing the availability and adequacy of acoustic design strategies in the selected convention centres and 0.801 for variables concerning user acoustic satisfaction. These values signify acceptable reliability levels. Ethical considerations, such as voluntary participation, informed consent, anonymity, and confidentiality, were strictly observed, ensuring the study's integrity and adherence to academic standards.

TABLE I
DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

	Respondent's Characteristics	Frequency	Percentage
Gender	Female	57	22.6
	Male	195	77.4
Age Range	Below 16	5	2.0
	16 to 25	102	40.5
	26 to 36	88	34.9
	36 to 45	35	13.9
	46 to 55	11	4.4
	56 to 65	11	4.4
Educational Qualification	Primary Education	4	1.6
	SSCE	82	32.5
	OND/HND	69	27.4
	Bachelors	87	34.5
	Masters/PhD	9	3.6
Marital Status	Single	184	73.0
	Married	68	27.0
Convention Centre Visited	Eko Convention Centre	93	37.3
	Balmoral Convention Centre VI	77	30.9
	Balmoral Convention Centre Ikeja	79	31.7
Category of User	Visitor	98	39.4
	Worker	151	60.6

Source: Author's Fieldwork (2024)

IV. RESULTS AND DISCUSSION

A. Demographic of Respondents

Table I shows the demographic information of the survey participants involved in this study. It outlines the diverse profile of respondents, including factors such as age, gender, educational background and marital status.

Two hundred and fifty-two people in total participated in the study, indicating a response rate of 78.02%. It can be seen that among the participants, 57 (22.6% of them female) and 195 (77.4% of them male) were present. This demonstrates that more men than women took part in the survey.

According to the participants' age distribution, 5 people, or 2 % of the sample population, are between 16 years of age. 40.5% (102) were in between the ages of 16 years to 25 years, 34.9% (88) were between 26 years to 35 years, 13.9% (35) were between 36 to 45 years of age, while 11 people fell between 46 to 55 years of age and above 65 years of age each, accounting for a total of 8.8%.Nine (3.6%) of the respondents had their highest educational qualification as a master's degree or doctorate degree, eighty-seven (34.5%) had a bachelor's degree, sixty-nine (27.4%) had OND/HND, while 82 (32.5%) had their SSCE. The lowest of the population had primary education at 1.6% (4). This demonstrates a good sect of the responders were educated, 38.1% had a university education, and 65.5% had post-secondary school education. A hundred and eighty-four (73%) of the respondents were single, while sixty-eight (27%) were married.

B. Adoption of Acoustic Strategies

Table II displays the average ranking of the acoustic elements adopted in the chosen convention centres. A total of 17 variables were assessed to gauge the adoption of these elements. Notably, Double-Pane/Multi-Pane Windows and Wall Coverings received the highest mean scores of 4.67 and 4.66, respectively, indicating they were the most adopted elements in the convention centres. Conversely, Acoustic Foam and Honeycomb Blinds received the lowest rankings, indicating they are barely used in the convention centres.

TABLE II
MEAN RANKING OF ACOUSTIC ELEMENTS IN CONVENTION CENTRES

Descriptive Statistics	Mean	Std. Deviation	Rank
Double-Pane/Multi-Pane Window	4.67	0.844	1st
Wall Coverings	4.66	0.791	2nd
Acoustic Wall Panels	4.51	0.956	3rd
False/Suspended Ceiling	4.45	0.975	4th
Ceiling Tiles	4.43	1.025	5th
Furniture with Fabric	4.39	0.822	6th
Removable and Flexible Acoustic Materials	4.14	1.288	7th
Hollow Block Wall	3.18	1.155	8th

Zoning Of Noisy and Quiet Areas	2.96	1.407	9th
Fibreglass Blanket	2.32	1.668	10th
Vegetation as Barrier between noise source	2.27	1.315	11th
Cavity Wall	2.18	1.064	12th
Double Wall	2.05	1.019	13th
Fabric Wrapped Panels	2.02	1.566	14th
Ceilings Baffles and Banners	1.72	1.316	15th
Honeycombs Blinds	1.66	1.273	16th
Acoustic Foam Panels	1.50	1.296	17th

Source: Author's Fieldwork (2024)

Table III displays the average ranking of acoustic materials adopted in the chosen convention centres. A total of 18 variables were examined to assess the adoption of these materials. Aluminium with a mean score of 4.26 emerges as the most commonly adopted acoustic material, as indicated by the respondents. Conversely, Glass Fiber with a mean score of 1.75 received the lowest ranking, suggesting its limited usage in convention centres.

TABLE III

MEAN RANKING OF ACOUSTIC ELEMENTS IN CONVENTION CENTRES

Descriptive Statistics	Mean	Std. Deviation	Rank
Aluminium	4.26	0.752	1st
Perforated Plate Structures	3.94	0.905	2nd
Concrete	3.91	0.822	3rd
Reinforced Concrete	3.91	0.921	4th
Perforated Boards	3.76	1.265	6th
Micro Perforated Plate Structures	3.65	1.175	7th
Drapes	3.27	1.256	8th
Gypsum Board Partitions	3.12	1.130	9th
Pulp Boards	2.17	1.411	10th
Rock Wool Fibre	1.97	1.460	11th
Foam plastic	1.96	1.346	12th
Cotton Fibre	1.89	1.384	13th
Compressed Fibre Boards	1.87	1.235	14th
Foam glass	1.83	1.319	15th
Cellular Concrete	1.78	1.246	16th
Stone Masonry	1.76	1.152	17th
Foam metal	1.75	1.199	18th
Glass Fibre	1.75	1.139	19th

C. *Users' Satisfaction*

This section presents the results of the mean ranking of the user satisfaction variables, the analysis of the relationship between the satisfaction of users and the acoustic strategies adopted. The average ranking for the eight (8) user satisfaction variables is displayed in Table IV. The variable - The sound clarity of the convention centre is good - is shown to have the highest level of agreement among respondents.

TABLE IV

MEAN RANKING OF USER SATISFACTION VARIABLES

Descriptive Statistics	Mean	Std. Deviation	Rank
The sound clarity of the convention centre is good	4.38	0.758	1st
I can hear what the speaker is saying clearly	4.37	0.888	2nd
The echo in the convention centre is very minimal	4.16	0.723	3rd
I do not experience sound lags in the convention centre.	4.12	1.126	4th
The sound level in the convention centre is comfortable for me.	3.86	1.131	5th
The background noise level of the convention centre is acceptable	3.82	0.972	6th
In one-on-one conversations, I can hear what the other person is saying clearly	3.04	1.324	7th
Conversations can be made privately in the convention centre	2.93	1.307	8th

Source: Author's Fieldwork (2024)

The overall satisfaction was computed as the mean of all the user satisfaction variables and was recorded by making values 1.00 to 1.80 →1, 1.81 to 2.60 →2, 2.61 to 3.40 →3, 3.41 to 4.20→4, 4.21 to 5.00 →5. Where 1 is strongly disagree, 2 is disagree, 3 is undecided, 4 is agree and 5 is strongly agree. These values above are significant. It shows that 25% of the variables fall between 2.61 to 3.40, 50% in between 3.41 to 4.20, and 25% fall in the range of 4.21 to 5.00. A total of 75% agree with the user satisfaction variables.

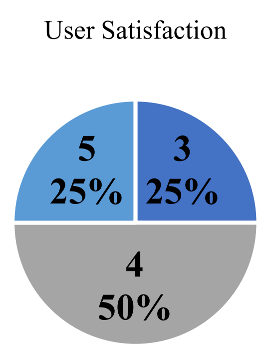

Fig. 1. Pie chart showing the percentage the extent of agreement of the user satisfaction variables.

D. *Influence of the adopted acoustic strategies and user satisfaction*

The analysis of the relationship between the satisfaction of users and the acoustic strategies adopted was carried out with regression analysis as shown in Table V. The dependent variables were user satisfaction factor and the independent variables were the acoustic strategies – elements and materials. The marginal level of significance is indicated by the significance level (p-value) of less than 0.05. Table 3 shows that Ceilings Baffles and Banners, Vegetation as Barrier between noise source, Furniture with Fabric, Cotton Fibre, Foam glass, Foam plastic, Perforated Plate Structures and Micro Perforated Plate Structures were the acoustic strategies that would influence user satisfaction.

The acoustic element with the most influence on user satisfaction is the micro perforated plate structures with a β value of 0.519, followed by foam glass with β = 0.439. The least influential acoustic strategy is vegetation as a barrier between noise source with β = - 0.158

TABLE V
REGRESSION ANALYSIS FOR ADOPTED ACOUSTIC STRATEGIES AND USER SATISFACTION

	Standardized Coefficients Beta	t	Sig.
Double Wall	0.009	0.171	0.864
Cavity Wall	0.017	0.314	0.754
Hollow Block Wall	0.049	0.826	0.410
False/Suspended Ceiling	0.075	1.210	0.227
Double-Pane/Multi-Pane Window	0.052	0.974	0.331
Honeycombs Blinds	0.056	0.793	0.429
Acoustic Foam Panels	-0.014	-0.206	0.837
Acoustic Wall Panels	0.014	0.228	0.820
Wall Coverings	-0.031	-0.551	0.582
Fabric Wrapped Panels	-0.109	-1.361	0.175
Ceiling Tiles	0.076	1.180	0.239
Ceilings Baffles and Banners	**-0.218**	**-2.590**	**0.010**
Fibreglass Blanket	0.072	1.096	0.274
Zoning Of Noisy and Quiet Areas	-0.114	-1.945	0.053
Vegetation as Barrier between noise source	**-0.158**	**-2.604**	**0.010**
Removable and Flexible Acoustic Materials	-0.071	-1.169	0.244
Furniture with Fabric	**-0.169**	**-2.290**	**0.023**
Drapes	0.081	1.390	0.166
Stone Masonry	-0.090	-1.428	0.155
Concrete	0.005	0.063	0.950
Reinforced Concrete	0.024	0.342	0.733
Cellular Concrete	0.112	1.531	0.127
Gypsum Board Partitions	-0.050	-0.808	0.420
Perforated Boards	0.019	0.295	0.768
Compressed Fibre Boards	-0.171	-1.843	0.067
Pulp Boards	-0.062	-0.827	0.409
Cotton Fibre	**-0.225**	**-2.503**	**0.013**
Glass Fibre	0.207	1.847	0.066
Rock Wool Fibre	-0.084	-1.070	0.286
Aluminium	-0.028	-0.465	0.642
Foam metal	0.056	0.538	0.591
Foam glass	**0.439**	**5.264**	**0.000**
Foam plastic	**0.173**	**2.022**	**0.044**
Perforated Plate Structures	**-0.285**	**-4.148**	**0.000**
Micro Perforated Plate Structures	**0.519**	**8.362**	**0.000**

Source: Author's Fieldwork (2024)

The findings from the mean ranking of acoustic strategies show that double-pane/multi-pane windows were the most commonly adopted elements while acoustic foam and honeycomb blinds were the least utilized elements. This suggests a preference for elements that aid sound insulation and perhaps aesthetics. Aluminium stood out as the most commonly adopted material and glass fibre had the lowest mean ranking for materials. This indicates a widespread usage of aluminium in the convention centres.

The relationship between user satisfaction and adopted acoustic strategies is explored through regression analysis, with user satisfaction factor as the dependent variable and the identified acoustic strategies as independent variables. Among the influential acoustic strategies, micro-perforated plate structures emerged as the most impactful. Foam glass is the second most influential strategy on user satisfaction, and the third perforated plate structures. Perforated plate structures offer sound absorption properties, but they have not been termed as the best sound absorption elements. The study by [29] posited that these perforated structures often require additional porous material for sufficient absorption, because they have limited absorption bandwidth due to their perforation diameters. On the other hand, [44] stated that the absorption capabilities of these structures are dependent on their thickness and perforation size. Their research showed that with a thickness of 2mm and perforation diameter 0.5mm, the SAC value of perforation of these structures can be as high as 0.86 under 4000Hz of sound. Nonetheless, micro perforated plate structures having more influence than the regular perforated plate structures are in line with studies that have shown the micro structures have better absorption capabilities as they have smaller perforations. Foam glass is also a sound absorbing material, making the three adopted acoustic strategies with the most influence on user satisfaction sound absorbing elements.

Vegetation as a barrier between noise sources is seen to have had the least influence on user satisfaction, with a β value of -0.158. While vegetation may offer sound absorbing and diffusion properties, its limited impact on user satisfaction also leans into the fact that a belt of trees, shrubs and greenery cannot effectively achieve noise screening objectives unless there is a relatively high biomass density as stated by [36]. This density limits the spaces between trees and necessitates larger trunk diameters or closely spaced plants.

Overall, the study's findings underscore the significance of thoughtful selection and implementation of acoustic elements and materials in convention centre design, emphasizing their potential to positively influence user satisfaction and overall experience.

V. Conclusion

This study set out to identify the acoustic strategies that influence user satisfaction in select convention centres. The findings reveal that ceiling baffles and banners, vegetation as noise barriers, fabric-upholstered furniture, cotton fibre, foam glass, foam plastic, perforated plate structures, and micro-perforated plate structures are the acoustic elements that significantly impact user satisfaction. These strategies are categorized as insulation and absorption components, structural elements, textiles, and plate structures. The findings emphasize the importance of adopting these strategies to create favourable acoustic environments. Many of these strategies are more effectively implemented at the inception of a project rather than post-construction. Clear acoustic objectives should be set for each space, with designs tailored to meet these objectives. Based on these conclusions, it is recommended that architects, builders, and convention centre managers prioritize the adoption of acoustic strategies from the project's outset to ensure optimal acoustic satisfaction of users. Additionally, continued research and practical application of acoustic strategies are essential to ensure enhanced user comfort and satisfaction in convention centres. By understanding the relationship between acoustic design and user satisfaction, stakeholders can make informed decisions that improve the overall experience for all users.

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