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WHERE DOES INDOOR SOUNDSCAPING STAND IN ARCHITECTURAL PRACTICE? OPINIONS OF THE BUILT ENVIRONMENT EXPERTS

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ABSTRACT[*]

Noise regulations and acoustics standards have been increasingly in operation to manage noise exposures in built environment fields. On the other hand, with its positive attitude towards sounds and addressing sounds as a resource, the rather recent field of soundscaping has not been much considered by experts in the built environment. Accordingly, this study aims to address this gap and collect opinions and feedback from built environment experts on the role of indoor soundscaping during architectural practice. Interviews with field experts such as architects and interior architects are carried out through semi-structured questionnaires to gather data on; (1) noise, acoustics, and soundscape-related considerations and applications, (2) awareness of noise, acoustics, and indoor soundscape terminology, (3) integration of indoor soundscaping principles in architectural design and application. Within the scope of this study, the data gathered from the field experts are used to drive evaluations on awareness, expectation, and importance regarding the role of indoor soundscaping during architectural practice and more specifically, sound in spatial design. As a result, this study is expected to be an initial step to increase awareness regarding the importance of including indoor soundscaping during architectural design and application by revealing the overlooked points obtained from field experts.

Keywords: *architectural acoustics, soundscape, interior architecture, awareness*

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1. INTRODUCTION

The regulation on the protection of buildings against noise [1], which has been effected in 2018 and prepared based on COST Action TU0901 (2009) (Integrating and harmonising sound insulation aspects in sustainable urban housing constructions gone and acoustics standards), has led to the consideration of obligatory noise abatement actions for indoor spaces in Turkey. Hence, the acoustic comfort notion has begun to extend beyond the environmental noise-related precautions for enclosed spaces. Moreover, developing a soundscape approach in the research field aims to take a step forward to enhance the sound environment from the user's point of view with a positive attitude to sound. Herein, soundscape application and/or consideration in professional practice becomes a significant issue besides noise abatement policies. The soundscape approach focuses on the sound environment "as perceived or experienced and/or understood by a person or people, in context"[2], unites the noise management and user perception on the acoustic environment in a holistic attitude [3], and provides positive perspective by regarding the sound as a resource than a waste to be managed [4, 5]. Bild et.al's study [6] stated that the relationship between people, sound, and their sound environment is based on the two overarching aspects 'object centered' and 'human centered'. Hereof, the 'object-centered' approach relates to the physical properties of sound, and the 'human-centered approach' considers people's perception, interpretation, and experience on a sound environment [6].

The developments on soundscaping have been mostly enhanced under the scope of 'urban soundscape' regarding open public spaces such as concept, data gathering, evaluation and analysis, and finally the real-world application field followed by the published ISO standards

and specifications (ISO 12913-1,2,3) [2, 7, 8]. On the other hand, the enhancement of indoor soundscaping, which regards the sonic environment of inside of the buildings, has rapidly developed in the research field but dropped behind the urban soundscape for field application. Accordingly, this study focuses on enclosed spaces from the perspective of indoor soundscaping. Indoor soundscaping differs from urban scale with both 'object-centered' and 'human-centered' aspects. Indoor soundscaping differs from urban scale with both 'object-centered' and 'human-centered' aspects. Our previous studies[9-11], highlighted that the major 'object-centered' difference is the effect of architectural acoustics i.e. building and room acoustics. In general, 'as object-centered aspects', the urban soundscape and noise management field give priority to the sound levels and limit values of noise. However, when the interior becomes the case, architectural acoustics gain importance as additional data both for physical aspects of sound and user perception. In acoustic spaces, where the primary function is sound, such as staged buildings, auditoriums, concert halls, etc., room acoustics parameters gain importance to satisfy the goal of building function properly.

On the other side, in non-acoustic spaces, where the primary function is not sound, sound design and perception get involved additionally as space experience which refers to the basics of environmental psychology aspects within the indoor soundscape approach. In other words, 'human-centered' aspects of indoor soundscaping need to have different problem-solving approaches for user perceptions, interpretations, experiences, and preferences that are affected by the different sounds, functions, and activities compared to the urban scale. Therefore, indoor soundscape studies need context-specific adaptations, despite indoor soundscaping has been derived and grounded on the urban soundscape approach.

1.1 Aim and research questions

The user-oriented approach of the soundscape has revealed an interest in how sound is considered 'by the actual professionals who shape our urban built environments through everyday interventions? [12]'. The same concern has also appeared for the indoor soundscape field since the concept is beyond the noise abatement and user-oriented as same with the interior architecture perspective. Accordingly, research questions are developed as listed below;

(1) Do the professional practitioners of interior built environments consider and apply noise and soundscape-related components?
(2) What are the noise and indoor soundscape terminology awareness levels?
(3) How do the practitioners integrate noise and indoor soundscaping principles in architectural design and application?

1.2 Scope of the study

As an initial attempt to investigate indoor soundscape application in practice, the awareness and point of view of built environment experts are aimed to be surveyed in this paper. Similarly, several studies, which act as a backbone for this study, were conducted from the perspectives of professional experts and city planning on urban soundscape application [6, 12-14]. The scope of the study in terms of study field is indicated clearly in Figure 1, which demonstrates the different scales of the built environment and professional disciplines of indoor and urban soundscape fields.

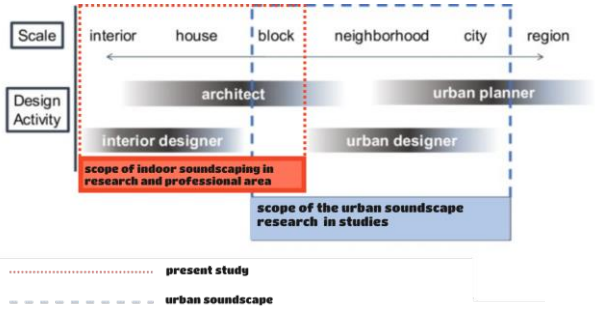

Figure 1. The scope of urban and indoor soundscape (retrieved and adapted from [13]).

According to **Figure 1**, it can be defined that the indoor soundscape approach interests with interior, house, and block scale of the built environment where interior architects and architects handle the design and application process. In general, indoor soundscaping overarches each enclosed space. On the other hand, the study was conducted in Turkey, which has its own noise and sound-related legislative approach and surveillance controlled by several ministries and municipalities.

1.3 Legislative approach in Turkey

Studies [9-11] that we conducted previously, which were investigate and compare the legislative policies of Turkey-Europe, and urban-indoor soundscape applications, showed that integration of indoor soundscape approach to architectural process can be provided with the governmental enforcement. These studies lead the following attempt for the development of indoor soundscaping to investigate the

field experts' (architects, interior architects) knowledge/ awareness, approaches, and applications about noise and sound-related issues. Previous studies also indicated that although urban and indoor soundscaping are areas of interest that have gained momentum in academic research, it has not yet developed in the field of application. Here, besides indoor soundscaping principles, noise regulations have gained importance as well since they are the documents that have surveillance by the government that is in effect in Turkey.

In Turkey, two regulations within the indoor soundscape approach's area of interest exist. One is the 'Environmental noise control regulation' which was first prepared in 2005 based on the European 'assessment and management of environmental noise' [15], and having changes and adaptations in time and published the final version in 2022 [16]. The other one is 'The regulation on the protection of buildings against noise' [1], which was prepared based on COST Action TU0901 (2009) and went into effect in 2018. Environmental noise regulation indicates noise abatement and management by decreasing sound levels and specifying the limits. Building-related regulation is generally related to the building acoustics application to prevent, manage, and guide the vibration and sound transmission in buildings. In the legislative approach of Turkey, except directly noise-related ones, there are regulations for different functions of public use buildings like tourism areas, museums, shopping malls, hospitals, public buildings, heritage sites, etc., which also include the noise management issues briefly.

2. METHOD

The basis of the method was retrieved and adapted from Steele et.al's studies [12, 13], which are the backbone of this pilot study, to develop and test an evaluation method for the current situation of indoor soundscape application in practice. Accordingly, semi-structured interviews were conducted to collect in-depth data from built environment experts. To analyze the collected comprehensive qualitative data systematically, an inductive Grounded Theory (GT) coding process was used [12, 17-19]. 'Constant comparison' and 'theoretical sampling' are two notions that are frequently used in this procedure. As soon as the data is gathered, the researcher can develop an inductive theory by classifying, categorizing, and associating data through constant comparison [19-21]. In addition, several studies, in which we investigated coding and analysis approaches [20, 22-25] used GT and coding procedures to evaluate perceptual approaches of users for specifically indoor soundscape. Therefore, the method of this study was structured based on the GT with reliable scientific studies [13, 14, 17-25], and aimed to conduct a pilot study with 5 participants to test the interview and method to answer the research questions.

2.1 Participants

In this pilot study, semi-structured interviews were conducted with 5 participants, who are either architect (N=1) or interior architect (N=4) and own their own company (N=2), or work as a freelancer (N=3). The educational and professional information of the participants is presented in **Table 1**. During the decision process of who will be the participants, it was paid attention to ensure that the experts had at least 10 years of experience in the practice and were still actively working. N=1 participant has a bachelor's degree, N=3 participants have a master's degree and N=1 participant is a Ph.D. candidate. All experts have been conducting design and application processes, and some provide consultancy services (N=2). N=2 participants deal with both architectural and interior architectural projects, while N=3 participants perform only interior architectural projects and adaptive reuse and/or refunctioning projects. Finally, the scope of the projects, they mainly carry out, are tourism facilities (N=2), dwellings (N=4), industrial buildings (N=1), offices (N=3), and restaurants/café (N=1).

2.2 Interview

The semi-structural interviews were conducted face-to-face with the participants in periods ranging from 30 to 50 minutes. While identifying the questions Steel et.al's study [12] was taken as a basis. However, since urban and indoor soundscaping has major differences in concept, minor structural changes have done. Thus, some questions were retrieved directly, some questions adapted to the indoor soundscape approach, and some questions were newly formed. While adapting and forming questions to indoor soundscaping, architectural acoustic and noise management aspects have been included as well to evaluate the sound considerations in practice with all dimensions. On the other hand, questions were translated and prepared in Turkish, since the study was conducted in Turkey with Turkish native speaker participants.

Table 1. Participants' educational and professional information.

Data		P1	P2	P3	P4	P5
Education Level		Master's degree	Bachelor's degree	Master's degree	Ph.D. Candidate	Master's degree
Years of Experience in practice		38	16	17	13	14
Profession	Architect					
	Interior Architect					
	Academician/Instructor					
Scope	Design					
	Application					
	Consultancy					
	Architecture					
	Interior architecture					
	Adaptive reuse/ refunctioning					
	Conservation					
Graduate study area/Specialty		Prefabricated housing estate	N/A	Furniture	Visual & computational design	Wayfinding Digital applications
Field in Practice		Dwelling Tourism Industrial	Office spaces	Dwelling Office spaces	Dwelling Office Spaces	Dwelling Tourism Restaurant & café

As a result, four sections of semi-structured interviews were prepared. In the first 'Introduction' section, demographic, educational, and professional information was collected. In second 'List of Factors' section, it was aimed to obtain from the experts which technical issues they give priority in a project. The third 'Noise and soundscape-related considerations and applications' section was prepared to get data about the knowledge of participants on noise management and soundscape information and applications. In the final and fourth 'Project-based applications' section, it is required for the participants to determine a project that they have recently finished, and their engagement and consideration of sound in the chosen particular project were asked.

2.3 Analysis

As indicated before GT coding process was used to analyze qualitative data obtained from the interview process. In the coding process, keywords that were repeated, emphasized or considered important data were categorized to answer the 'Whys', 'Whats', and 'Hows' contexts [12]. In detail, 'Whys' would refer to the motivation that participants consider and approaches to sound, 'Whats' would be the definition of their approaches as a key concept, and 'Hows' would define the performance of their decision criteria and application methods as defined in Steel et. al's study [12]. Hence, in this study, a systematic path was followed as shown in **Figure 2**. After the interviews had finished, to perform coding, keywords were determined, categorized, and classified according to 'Whys', 'Whats', and 'Hows', and found the approaches primarily as; 'legislation', 'user/client/employer, 'function and location of the building', and 'design integrity'. Yet, there was revealed another dominant set of information from the coding process of each participant that is about sound consideration deficiencies in their approaches. Accordingly, the keywords were found answering the 'Whats', 'Whys', and 'Hows', where 'Whats' were identifying the 'deficiencies', 'Whys' were predicting the 'reasons', and 'Hows' were suggesting the 'solutions' for overcoming the deficiencies. As a result, both the two coding processes for (1) approaches and (2) deficiencies were pointed out in **Figure 2** with their process paths.

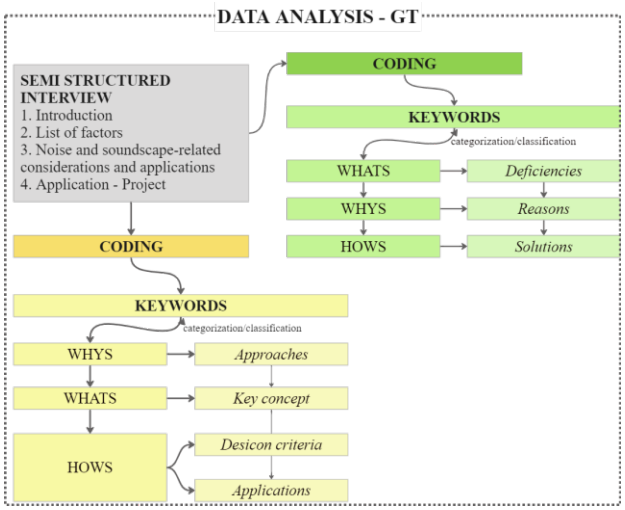

Figure 2. GT coding, categorizing, and classification process.

3. RESULTS AND DISCUSSION

In the analyses of the interviews through the GT coding process, four approaches were found as a motivation for sound consideration; **(A1)** Legislation, **(A2)** User, client, or employer, **(A3)** Function and location of the building, and **(A4)** Design integrity **(Table 2)**. A1 was indicated by P1 and P5. P1 and P5 both said *'Several ministries have regulations based on the building function/service. Each building type has regulations e.g., Tourism (P1), Shopping center (P5). Sound/noise-related applications are also forced and ruled by these regulations. They should be followed for the surveillance.'* A2 was highlighted by each participant since they are in contact directly with the user/client/employer for building scale. The common comments of P1-P5; *'As a result of the consultations with the clients at the beginning of a project, user demands, complaints, and noise sensitivity are identified and related applications are designed and applied by the expert.'* Besides, if the sound is not mentioned during consultations, experts take the initiative and make decisions to '*fulfill user comfort'* with sound-related applications, and not to get '*complaint feedback'* after the project will be completed (P1, P4, P5). To fulfill the A2 requirements several considerations are cared as '*noise abatement, providing speech and sound intelligibility, prevention of unwanted sound transmission'* (P1, P4, P5). The function and location of a building (A3) are other emphasized factors that all participants mentioned. Accordingly, experts take care of function-related considerations such as *'reduction of reverberation in restaurants'* (P5), *'preventing sound transmission in hotel rooms*' (P1), and *'office spaces'* (P4), *'organizing spatial relations according to noisy and noise sensitive rooms in hospitals'* (P1, P5). Location-related considerations were exemplified with *'interventions to the façade of a building located nearby heavy traffic roads'* (P1, P4) and *'industrial buildings'* (P2). The final approach (A4) design integrity was spoken about only by P4; *'It seems not to have a priority* (sound), *but it becomes internalized and considered instinctively at the beginning of the design process for design integrity. Interior architect already has transferred the knowledge about sound to the project, space-sound relations enrich and contribute to building identity.'* In the fourth project-based application section of the interview, we talked about the project that the participants chose, which was recently finished. As a result, information about applications of sound and noise interventions that experts use in their projects was identified. The interventions were stated as, sound isolation, absorber or reflective finishing materials according to needs, treatments on vertical and horizontal structural elements, organization of spatial relations, voids, and openings on façade and internal partitions, detailing, and furniture selection. P1 gave detail about a hotel project; '*we use double walls with aerated concrete and rock wool between them to prevent sound transmission between the rooms. Exterior walls were 25 cm aerated concrete to prevent noise from outside. For windows, thermal isolated double-pane windows were chosen which have high performance for sound isolation as well'*. P3 spoke of an open office; '*Sound absorbers were used on the ceiling and partitions between workstations'*. P4 mentioned the office project where planned individual offices, common spaces, and meeting room. *'Sound was one of the priorities of the clients that we should handle. Technical specifications about materials were prepared by an acoustic practitioner firm. One of the employers had Far East interest and suggested important significant points about sound. Absorber panels were used to increase speech intelligibility in the meeting room (Zen room). Walls between office rooms were treated to prevent sound transmission. Snack time area was an open space with reflective surfaces and could not be controlled in terms of sound'*. Finally, P5 talked about a restaurant project. '*Amplification system was installed for background noise masking. Measurements and tests were done by a professional firm. All materials were chosen according to sound control, such as ceiling acoustic panels, wood panels on walls, and door details for both thermal sound isolation'*. P2 chose an atelier project to talk about, however, the sound was not considered specific to that project.

Table 2. Approaches of field experts to sound revealed from the interview.

Approaches	Whys (Motivation)	Whats (Key concepts)	Hows (Decision Criteria)	Application
A1	Legislation	• Regulations • Specifications	•Enforcement •Surveillance	• Following rules
A2	User/client/employer	• From user/client/employer; Demands Complaints Noise sensitivity • Considered by the field expert; User comfort Complaint feedback	•Noise abatement •Speech/sound intelligibility •Prevention of unwanted sound transmission	• Isolation • Finishing materials • Vertical & horizontal partition elements • 2D&3D organization • Spatial relations • Voids, openings on façade & internal partitions • Detailing • Furniture
A3	Function and location of the building	• Function-related considerations • Location-related considerations	•Answering sound requirements •Noise-specific precautions according to location	
A4	Design integrity	• Sound integration with other technical and aesthetic needs for a completed design	•Internalized instinctively •Sound contribution to building identity	

Table 3. Deficiencies that field experts observed themselves.

Field	Whats (Deficiencies)	Whys & Hows (Reasons & Solutions)
Noise related regulations	• No idea about the definition, regulations, and applications (N=2) • Knows definition but no idea about the regulations and applications (N=3)	• Professional chambers • Surveillance & enforcements • Education in both undergraduate and graduate
Architectural acoustics	• No idea (N=1) • Knows the definition and some of the applications (N=1) • Heard but cannot define (N=1) • Knows terminology but does not have technical knowledge (N=1) • Knows terminology and some of the applications from a course in bachelor's degree building (N=1)	• Professional chambers • Education in both undergraduate and graduate
Soundscape	• No idea (N=2) • Heard but do not know about detail (N=2) • Knows urban soundscape (N=1)	

All participants pointed out the reasons and solutions during the third section of the interview 'noise and soundscape-related considerations and applications' when they were answering the terminology-related questions about noise management, architectural acoustics, and soundscape (**Table 3**). N=2 participants said that they have no idea about the definition of noise management, N=3 participants said that they know the definition, and all participants do not know about the noise regulations. However, they follow and use the building type/service-specific regulations, which include basic noise management requirements and applications, since these regulations have been controlled by the municipalities. P1 and P5 explained the reasons for this deficiency are insufficient education, surveillance of municipalities to enforce the regulations, and the important role of professional chambers to inform their colleagues about new and/or revised legislation and policies. The solutions they suggested to increase awareness and knowledge about noise management were the same as the reasons, which are the role of professional chambers,

governmental enforcement, and acoustics education in bachelor's and graduate degrees. Similarly, N=1 participant said that he/she does not have an idea about architectural acoustics, and N=4 participants said that they know the terminology but cannot define it or do not have detailed information. N=1 participant knows the terminology and some applications from the course he/she takes at university. Moreover, N=2 participants have not heard about the soundscape approach, N=2 participants heard but do not know in detail, and N=1 participant knows about the urban soundscape.

Finally, all participants have the same opinion that sound has a priority in design thinking and a field expert definitely should know about it, important in all building types, directly affects user comfort, and should be considered at the very beginning of the design process. Moreover, they all prefer to consult an acoustic expert if there is a condition exceeding their knowledge to satisfy the requirements and user comfort. One another point that the participants found remarkable, was the cost and budget restrictions in projects. '*Acoustic enhancements, consultations, and applications could be a high cost to afford by the clients, so it becomes impossible to apply although we know the appropriate application. Clients usually tend to give up sound treatments in the first place since there is not an effective legislation control*' (P1).

4. CONCLUSION

In this pilot study, it is aimed to investigate the considerations and ideas of professional experts of built environments under the scope of indoor soundscaping and to obtain preliminary information about the present condition in architectural practice. Besides, the essential outcome of the interview is to provide a methodology for comprehensive research that will be conducted with professional experts as a future study. This information provides a base for the enhancement of further studies adapting interview method and inductive Grounded Theory (GT) coding process and evaluation methods.

As highlighted findings; four approaches were revealed that are identifying how the field experts' consider sound in their projects. In this interview process, participants declare that their awareness and knowledge were weak about acoustics terminology. However, it is observed that all participants know and apply architectural acoustics (room and building acoustics) and noise management in their project but unconsciously of the terminology. On the other hand, the soundscape approach is the weakest point in architectural practice in terms of sound consideration. Also, participants suggested that enhancing awareness and knowledge about architectural acoustics, noise, and soundscape awareness and enhancement could be possible with education, professional chamber activities, and governmental enforcement.

5. ACKNOWLEDGEMENT

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