



# A method for assessing soundscape in urban parks based on the service quality measurement models



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## ABSTRACT

The importance of the quality of the soundscape to the total environment of urban parks has been widely realized. With the purpose of exploring more efficient and effective approaches for the evaluation and analysis of the soundscape quality of urban parks, the quality assessment theories and methods that used in the areas of quality management and service industry are adopted in this study. A quality evaluation method for the soundscape is then proposed based on two well-known service quality measurement (SQM) models, Importance-Satisfaction (I-S) model and Improvement index (Ii) model. By simultaneously assessing both importance and satisfaction of soundscape elements in urban parks, this method can provide detailed and comprehensive information that can be used for guiding the soundscape design and improvement of urban parks. Finally, the proposed method is applied to a case study in Hong Kong. Based on the analysis of the data collected by questionnaire survey in this case study, the practicality and effectiveness of the proposed method is demonstrated, and a practical decision-making strategy for soundscape quality improvement of urban parks is summarized. According to the authors' best knowledge, this study is the first attempt to apply the SQM method of combining I-S model and Ii model to the soundscape study of urban park. The ideas and findings not only benefit the practical soundscape management, but also provide a valuable reference for the academic research of soundscape.

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## 1. Introduction

Urban parks play a significant role in sustainable urban environments. They can provide benefits such as air and water purification, reduction of the effects of urban heat island, and so on. In addition, urban parks can help preserve and promote the health of citizens who are often exposed to noise pollution and the stress of daily life [1,2]. These benefits to ecological environments and public communities have led to an intense interest in the study of how to accurately evaluate and efficiently improve the environmental quality of urban parks. In these researches, the total quality of an urban park is no longer visually dominant, the acoustic environment and its quality, especially the concept of “soundscape quality” [3,4], is receiving increased attention by various sectors including planners, architects and environmental consultants [5,6].

The concept of Soundscape introduced by the Canadian musician and composer Schafer in the 1970s [7], is a step forward in noise control, as it does not simply consider the sound in negative terms as both intrusive and undesirable (noise) but rather reconceives the conditions and purposes of its production, perception, and evaluation, accounting for a human-centred point of view [8,9]. The International Organization for Standardization (ISO) provides a clear definition of soundscape as “acoustic environment as perceived or experienced and/or understood by a person or people, in context” [10,11]. Indeed, the soundscape of urban parks is quite complex as it contains many different types of sounds that occur simultaneously or separately in time [12]. In order to gain a comprehensive knowledge of urban park soundscape quality, many recent researches have been conducted to explore individuals' preferences for different types of sounds in the park [13,14]. They reveal that the informational content of the soundscape is important for the perception of soundscape quality, in other words, the perception of a soundscape is influenced by the presence or absence of wanted and unwanted sounds [15]. Acoustic comfort

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of urban parks, as an important outcome of soundscape quality, is also widely studied recently, as well as its influence factors [14,16]. It is widely accepted that a reduction of sound level does not necessarily lead to better acoustic comfort. Especially when the sound pressure level (SPL) is below a certain value, acoustic comfort is related not to the sound level, but to the type of sound sources, the characteristics of users, and other factors [15,16]. For example, the factors, such as view, temperature, humidity, wind and other non-acoustical features of the environment, have interactions with soundscape [17]. Moreover, sound, space, people and environment are considered to be four vital elements and the interrelationships among them have been highly concerned in the soundscape studies of urban parks and other urban open spaces [13,18].

As the importance of soundscape quality to urban parks is increasingly acknowledged, it is commonly accepted that the soundscape design should be managed as part of the whole design and the soundscape planning should be integrated as early as possible in the design stage of new or reconstruction urban park projects [10]. In this situation, the exploration and development of frameworks, guidelines or guiding tools for the design of urban parks with good soundscape quality is urgently required. For example, a framework for the soundscape creation and design in urban open spaces is proposed by Zhang and Kang [13]. This framework is developed with a focus on sound and space, and its main principle can be summarized in the following process: (1) detect the overall sound level and take proper measures for noise reduction if the sound level is greater than 65–75dBA; (2) introduce suitable sounds and soundmarks by creating both active and passive sounds; and (3) design the space with appropriate boundaries or elements, such as trees or other vegetation forms, to further improve the soundscape. Another example of guiding the soundscape design is given by Brown [19]. Based on a review of progress in soundscapes, Brown has summarized the approach for soundscape planning in the following 4 steps: (1) define the place of interest and context, (2) establish acoustic objectives for the place, (3) identify the wanted and unwanted sounds at this place, and (4) conduct suitable noise management or soundscape design work, such as masking the unwanted sound by the wanted sound.

These developed frameworks provide helpful advices for soundscape design. However, as we can see, some of them only provide basic concepts or general principles for the design. In the practical applications, many specific questions have not been answered well. For example, when facing a practical quality improvement project of an urban park, how can we give an efficient and effective design to improve its soundscape? Can we deal with all the aspects of soundscape at a time, or if not, which quality attributes are significant and how to decide the priority of improvement objectives? Do we need to pay equal attention to all the sound elements in the park, or if not, which elements should be paid more attention to? Answers to these practical questions are particularly important because any efforts to improve the soundscape of a park cost time, money, and other resources. Most of the time, designers (or managers) are not able to take care of every element of the soundscape at a time (this is not necessary either). In order to make clear and precise decisions for the design, more detailed information about the soundscape quality of the park is needed and more accurate and effective approaches for the soundscape quality assessment are required [20].

The concept of analogy is often used in the soundscape research. For instance, various researchers have drawn a useful analogy between the soundscape and landscape terms [10,21,22]. The tools and interpretations that successfully used in landscape research are found to be useful in the study of soundscape [23]. From this point of view, when we are struggling with the question of how to accurately evaluate and improve the soundscape quality of an urban park, we cannot help asking the following question:

since the “quality” evaluation and improvement problems have been deeply studied for decades in the areas of quality management and service industry [24–26], can we again use the method of analogy and consider the park’s soundscape as a “product” or a “service” offered by the suppliers (e.g., planners and designers) to the customers (e.g., park users), and can we utilize the well-established quality measurement methods and improvement strategies that successfully used in quality management into our studies of soundscape?

This paper is an attempt to explore the answers to the questions raised above, and tries to propose a simple but effective quality assessment approach to help make decisions on the design of urban park soundscape. To accomplish these objectives, the rest of this paper is structured as follows. In Section 2, a brief discussion of the similarity between the characteristics of soundscape in urban parks and services in business is given, and some well-known service quality measurement (SQM) models, especially the Importance-Satisfaction (I-S) model and Improvement index (Ii) model, are outlined. To demonstrate the effectiveness of the proposed SQM method, a practical application of the SQM method by combining the I-S model and Ii model to the quality assessment of a modern urban park is given in Section 3 and its results are reported in Section 4. Section 5 gives a discussion of this study and proposes a decision-making strategy for urban park soundscape improvement by using the SQM method. Finally, Section 6 presents the conclusions.

In recent years, a considerable number of researches have been conducted to study the outdoor soundscape problems; however, related research that considers the quality management theory is quite limited. According to the authors’ best knowledge, the present study is the first attempt to apply the SQM method of combining I-S model and Ii model to the soundscape study of urban park. The idea and its application strategy proposed in this paper can be valuable for practical implementation in urban park quality improvement and as a reference for academic research on soundscape.

## 2. Service Quality Measurement (SQM) models

Quality is one of the most used and determined terms in the business world and service industry [27]. Excellent service quality and high customer satisfaction have become extremely important issues for service industries. The level of service quality is thus considered by managers and academics alike to be a critical measure of organizational performance [28,29]. The lack of objective measures makes businesses have to rely on consumers’ perceptions of service quality to identify their strengths and weaknesses, especially when they are to devise appropriate improvement strategies. Managers therefore require psychometrically sound and accurate tools to measure service quality and customer satisfaction. A number of service quality measurement (SQM) models, such as SERVQUAL model, Quality function deployment (QFD) model, Kano model, Improvement index (Ii) and Importance-Satisfaction model (I-S model), have been carefully studied and developed for this purpose.

Urban park soundscape can be regarded as a product or service produced by the park [13], while the park users as the customers (who have spent their time, energy and sometimes money to obtain this service). Similar with the traditional services in business [28], soundscape is complex, intangible, difficult to assess objectively and usually differently understood by different people. The quality of soundscape is also focus on meeting its customers’ needs (e.g., the need of getting in touch with nature [30]), requirements (e.g., the requirement of quietness) and how well the soundscape matches customers’ expectations (e.g., it is more disliked in

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