

## The Implementation of Acoustic Environment Simulator to Improve The Soundscape of Iconic Space

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### ABSTRACT

In general, soundscape study conducted by letting the participants to have the experience of the actual soundscape. This method usually conducted using in situ soundwalk or soundscape reproduction. Soundscape composition has become one of the methods to understand the soundscape of urban area based on human memory. In this study, the concept of soundscape composition with acoustic environment simulator has been implemented to understand and improve the soundscape of an iconic space. Two experiments were conducted in this study; first, the soundscape composition of Bandung's City Square (the existing condition); second, the improvement of the soundscape of Bandung City Square. This study has identified the soundmarks of Bandung's City square. The soundmarks are the sound of children, the sound of adhan, conversation, the sound of people sweeping the floor, and the sound of footsteps. The sound of traffic is used in both conditions to represent the urban area as the participant tent to keep this sound in the improved composition. This study also has determined the sound addition which can be used to improve the sound environment quality (the addition of birds chirping). In conclusion, soundscape composition successfully identify and improve the soundscape of the iconic area.

Keywords: Soundscape Composition, Iconic Space, Soundmark, Simulator

### 1. INTRODUCTION

The soundscape approach often used to understand the quality of sonic environment especially in the Urban area (1, 2, 3). Several methods used to gather the information and validated in some way to make a precise representation of urban environment. In-situ and laboratory experiment often used in soundscape study (4). In situ survey usually conducted with soundwalk method where a group of people directly experience and rate the acoustic environment. The amount of information can be collected to give a representation of the sound environment through questionnaire and semantic data (5). In terms to improve the sound environment quality, the in-situ method can't always give precise reference of the sound data and make it hard to analyze the output. Meanwhile, laboratory experiment usually used the reproduction of sonic environment to collect and analyze the soundscape. The most important thing from this method is the validation to represent the actual sonic environment. The previous study has successfully validated human perception and the sonic environment (6).

One of the main parameters of soundscape research includes human perception to analyze the soundscape. Hence, there must be a way to link human perceptions and a better representation of the sonic environment. Through soundscape combination using a simulator, the researcher can control the parameter of a sound object in order to analyze the cause of changing conditions in the simulation. This approach is also beneficial to give a wider range of the sound object to present the outputs which are useful for analysis (7). Another research implemented soundscape simulator in order to understand the soundscape of an urban area. The study implemented the soundscape composition method to construct the relationship between the sound object and soundscape dimension (6). The results show that simulator successfully becomes a tool that might help the urban planner to design and improve the quality of soundscape because people can create a sonic environment of a location and also manipulate

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the sound elements of soundscape (6).

This research tries to implement the concept of soundscape composition with acoustic environment simulator to understand and improve the soundscape of an iconic space. The space in urban areas usually dominated by various activities and facilitate the resident with various kinds of public facilities, one of them is City Square. The city square is one of an iconic open space in Bandung (Indonesia). This location is characterized by a fairly wide field and the functional buildings around it and often used as a gathering place to relax and socialize. This iconic space plays a role in urban cultural activities and reflects the city's cultural, hence the need to improve the acoustic environment around them is important.

## 2. METHOD

The study applies a laboratory experiment method using soundscape combination. There are two experiments were conducted in this study. The first experiment aims to identify the actual condition on a particular location using soundscape simulator. During the experiment, respondents were asked to create an actual simulated sound environment of Bandung City Square (Indonesia). They were asked to combine some sound objects in the simulator and give the rating on the semantic scale, consists the three dimension (relaxation, dynamic, and communication). They are also allowed to adjust the level and the position in every sound object.

In the second experiment, respondents were asked to create an ideal condition of sound environment of the same location as the first experiment. They allowed to add and eliminate some sound object in order to make the ideal condition of soundscape. They also can reduce or increase the sound level from the actual condition. After that, they were asked to give the rating on the semantic scale. The participants in both experiments are the people who already been and understand the sound environment in the location. The results from the second experiment intended to give information related to parameter or the sound object that the respondents used to improve the soundscape. Both data collected from these two experiments are analyzed conjointly.

### 2.1 The Simulation

The simulation in this research using acoustic environment simulator to create and manipulate the sound object of soundscape which has been developed by Sudarsono in his research related the soundscape simulator to predict the perception of acoustic environment (6). In this study, the simulator consists of several sound objects which categorized into 4 categories, such as natural sound, the sound of human activities, mechanical sound, and music sounds.

In the simulator, there are also semantic scales consist of three dimensions (Relaxation, Dynamic, and Communication) that must be assessed by the respondent. The recordings of soundscape composition are in the form of \*.WAV A-Format. The format will be processed using Reaper into B-Format (W, X, Y, Z) in order to enter the audio interface.

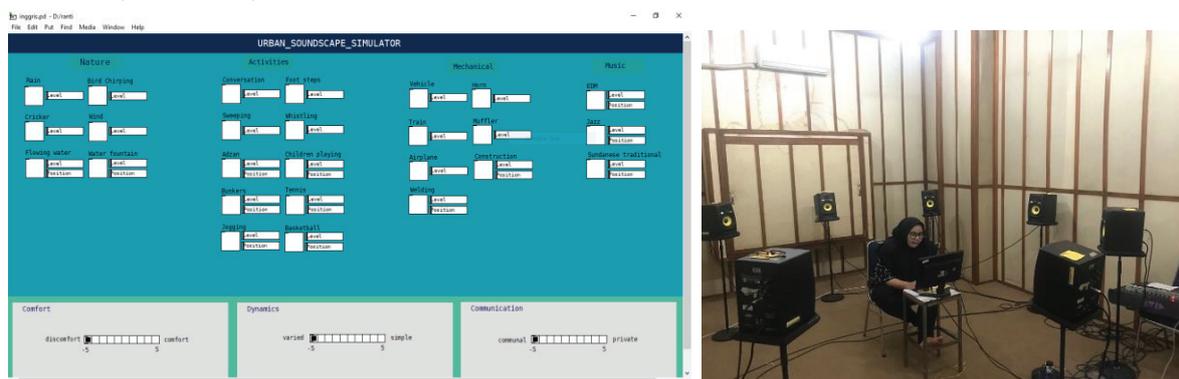


Figure 1 – The Simulator and Laboratory Experiment

The soundscape combination in the simulator is generated using 8 speaker systems in the laboratory. The configuration in the form of an octagonal simulation with the height of the speaker is adjusted according to the position of the ear when sitting, which is as high as 120 cm.

## 2.2 Procedure

The respondents were asked to create two conditions (actual and ideal) of urban sound environment in Bandung City Square for two minutes each, following these instructions:

- Respondents who take part in the simulation have already felt, experienced, and understood the sonic environment at the location.
- Respondents fill in the identity on the form provided.
- Before starting the simulations, 5 minutes tutorial and explanation are given in order to familiarize the respondent with the simulation
- First simulation; Respondents were asked to create the actual sound environment in Bandung City Square by combining several sound sources in the simulation and making judgments on the semantic scale, afterward.
- Second simulation; Respondents were asked to create the ideal sound environment in Bandung City Square to get a better perception of the actual condition and give rate on the semantic scale.
- Respondents are allowed to leave the simulation room.

## 2.3 Subjects

There are 25 students (20 female and 5 male; averaging 21 years of age s.d. 32 years of age). They are from the engineering, architectural, and art department. All the respondents were the people who already familiar with the sound environment and reported normal hearing. The experiments take place sequentially and require approximately 40 minutes for each individual.

## 3. RESULTS

The data from both experiments were analyzed conjointly to check the comparisons between the composition for the actual and ideal condition. The comparison includes the identification of the sound object and the perception of two soundscape composition. In order to identify the soundmark of Bandung City Square, the first experiment (the actual composition) has been validated with an in-situ experiment using soundwalk method that can be seen in figure 2.

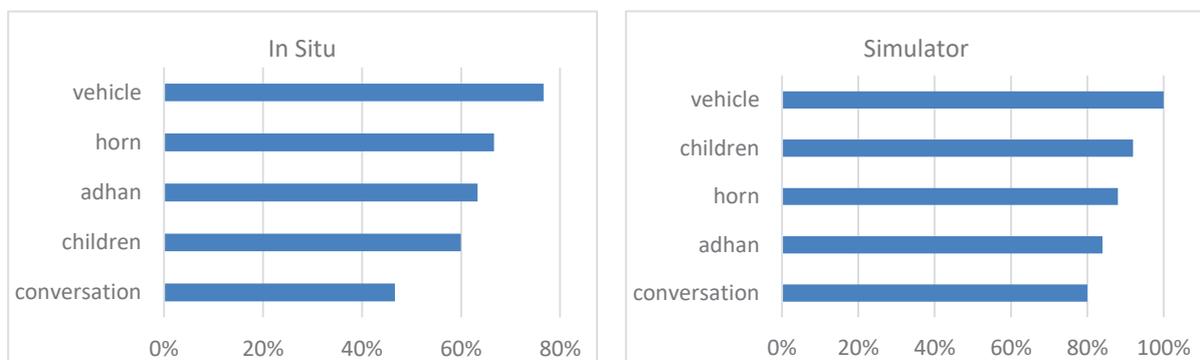


Figure 2 – Most Frequent Sound Object in Simulator and In-situ Survey

The graphs show that there are five top words described by respondents both in simulation and in-situ experiment. The sounds of conversation, adhan (prayer call), children, horn, and vehicle are the most described sound both in the In-situ and the laboratory experiment. Those sounds are the most frequent sound objects that the participants use to create the actual condition of Bandung City Square. The result will be analyzed in terms of sound objects chosen by respondents that can be seen in figure 3.

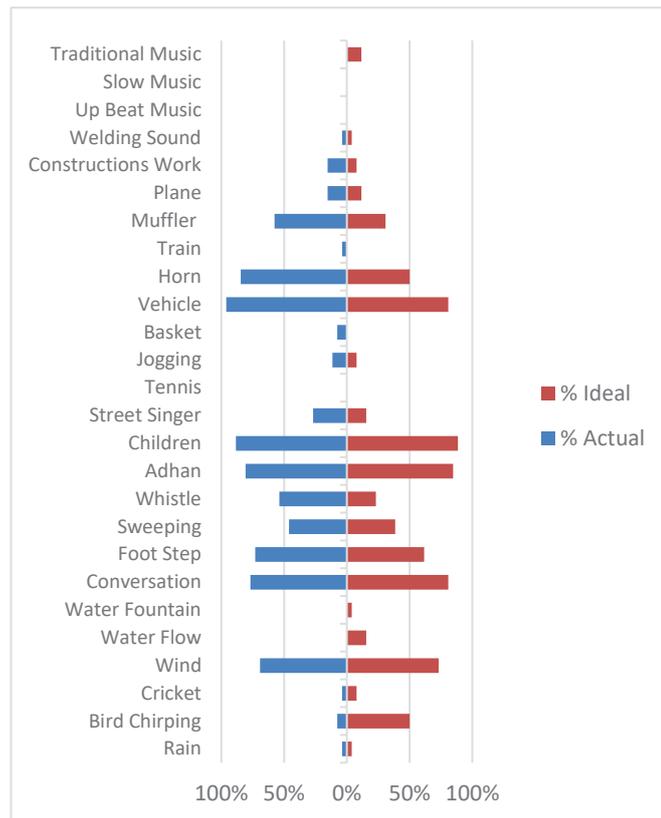


Figure 3 – Sound Object in Bandung City Square based on Actual and Ideal Compositions

The graphic above shows the sound object in Bandung City Square. From both experiments, it can be indicated that both experiments have a similar result. The occurrence of some sound object in those two experiments is not significant. The analysis from statistic test  $\chi^2$  ( $Z=28,2$ ;  $p> 0,05$ ) showed that the composition of the actual condition has a similar result with the composition of ideal condition. Based on previous results, the sound of nature such as the sound of birds and the sound of water increase the perception of pleasantness (8). However, in the ideal condition, 50% of respondent add the sound of birds chirping rather than the sound of water fountain or water flow because the location of Bandung City Square consists a fairly wide field with a lot of trees surrounding it. Hence the sound of birds chirping more suitable in this location. The most frequent sound object is chosen (above 50%) to describe Bandung City Square can be seen in Table 1.

Table 1 – Sound Object in Bandung City Square

No.	Sound Objects
1.	Adhan (prayer call)
2.	Children
3.	Foot Step
4.	Conversation
5.	Vehicle
6.	Horn
7.	Muffler
8.	Wind
9.	Birds Chirping*
10.	Water Flow*

The sound objects considered as the most chosen sound in this study as can be seen in table 1. Those are sound objects that represent Bandung City Square consist of the sound of adhan (prayer call), children, footstep, conversations, vehicle, horn, muffler, and wind. Those sounds mentioned, appear in both experiments, while the sound of birds chirping and the sound of water used to improve the sound environment quality and mostly appear in ideal condition. This result in line with the previous study that shows the natural sound prevailing in ideal scenes and often used to increase the perception of pleasantness (8,9). The mechanical sound such as the sound of the vehicle (traffics), horn, and muffler are used in both conditions to represent the urban environment as the respondent's tent to keep in the ideal composition. It can be concluded that the soundmarks that represent Bandung City Square itself consists of the sound of adhan, children, footstep and conversations.

In term of perception, the respondent rate their judgment in semantic scale consist of three dimensions (Relaxation, Dynamic, and Communication). The semantic consists of 1-10 scale. This analysis aims to determine the individual's perceptions of actual composition and improvement in the ideal composition.

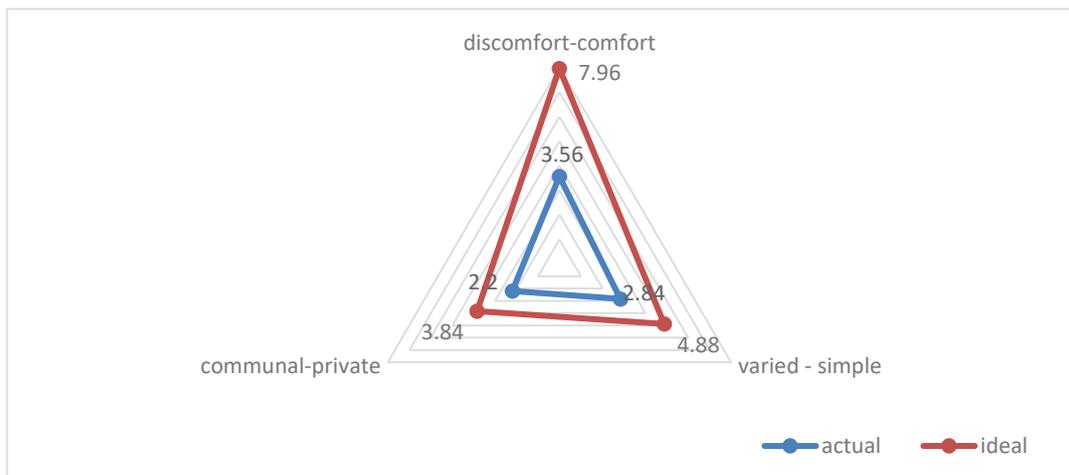


Figure 4 – Rate of Perceptions in Actual and Ideal Compositions

Table 2 – Statistic Analysis

	Annova-Mann Whitney (sig.)	Cohen's D	Mean Diff.
Relaxation	0.000	2.44	4.44
Dynamic	0.001	1.02	2.04
Communication	0.003	0.9	1.04

Based on the rating from both composition, there is a significant result of the dimension of Relaxation (comfortable-uncomfortable), Dynamic (varied-simple), and Communication (communal-private). Analysis of variance (Mann Whitney) was also conducted to compare the two experiments. Meanwhile, in the effect size test, only the dimension of relaxation has the strongest (2.44) impact among the three dimensions. This also can be seen from the mean difference between the composition of the actual conditions and the ideal composition. Relaxation shows the highest mean difference between the other dimensions. Dynamic and Communication also have significant results. In conclusion, respondents tend to expect a simple and private environment. But the value does not have a big enough difference and has a strong impact such as the dimension of relaxation.

#### 4. CONCLUSIONS

The methods were developed to analyze the sound environment for better representations of soundscape have been widely applied in soundscape research. The implementation of soundscape simulators is widely used by researchers to collect soundscape information in certain environments.

This study successfully applied the composition of the soundscape simulator to identify and improve the soundscape in iconic areas. This founding successfully identified the soundmarks of Bandung's City square. The mechanical sound such as the traffic sound is used in both conditions to represent the urban area as the participant tent to keep this sound in the improved composition (the ideal condition). The relaxation aspects more significant to give impact on the improvement composition. The sound addition which can be used to improve the sound environment quality is the sound of birds chirping. The sound of birds chirping more suitable for Bandung City Square because the location consists of a fairly wide field with many trees surrounding it.

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