URBAN NOISE OBSERVATORY AND MANAGEMENT TOOL – APPLICATION TO QUEBEC CASE

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1 Abstract

Despite the densification of cities and the resident exposure to high noise levels, no centralized data of the noise evolution is currently available in Quebec. This makes it difficult to assess the impacts of urban noise on the population. This study seeks to take stock of the methods of observation and management of urban environmental noise around the world. Indirect methods of urban noise management such as the introduction of noise policies, planning practices and the development of quiet zones are first presented. Ways of organizing existing noise observatories around the world are then described, it is discussed how it would be possible to observe the evolution of urban noise in a Quebec context.

2 Data collection method

The data analyzed were collected using three different methods: a bibliographic study, a web-based question form, and interviews with specialists in the field. The questionnaires included around fifteen questions related to urban noise management. Approximately 25 responses to the online questionnaire were received from specialists from Canada, France, UAE, The Netherlands, New Zealand, Hong Kong, China, Slovenia and Switzerland. Ten interviews were also conducted.

3 Noise management good practices

3.1 Legislation

Noise management and control can be done through regulations, planning and incentive schemes. The WHO has defined noise emission limits in order to prevent public health risks [1] and the European directive 2002/49/ EC is a good example of regulation [2]. It sets out three actions:

- Map exposure to environmental noise,
- Be transparent with the public about the impacts of noise,
- Adopt action plans based on the mapping.

Noise control measures are often corrective and not preventive. Noise planning and prevention are good habits to adopt when carrying out an urban development. Incentives can be financial or political in nature. In Brussels, victims of noise pollution have access to subsidies to finance the sound insulation of their homes. Also reporting of noise levels during real estate transactions could be mandatory. Builders would thus be encouraged not to build new buildings in areas with high noise levels [3].

3.2 Urban planning practices

The main sources of urban noise are related to transport. Road traffic noise levels are reduced by decreasing the road fleet density, by traffic management, by appropriate regulatory measures, by lowering speeds and by incentive schemes to reduce noise at source. The road fleet density can be reduced by promoting the development of active and collective transport (London or Paris action plans for example) and by limiting the place of the solo car in urban planning. Limiting noise induced by vehicles at source (Jacob brakes prohibited in certain areas in New Zealand) or prohibiting vehicles at certain times (Hong Kong) are also effective solutions.

Reducing railway noise is generally the responsibility of railway companies and often requires regulations and strict acoustic criteria for the infrastructure conception. Air traffic noise is also complex to control because it involves a large number of different actors. A good solution to reduce it is to apply operating restrictions and operational procedures. The management of airborne noise in Brussels is a good example. The airport is monitored by a network of stations making it possible to initiate proceedings against operators.

3.3 Quiet zones

In Montreal, INRS identified 2266 quiet zones corresponding in majority to green or residential spaces. The beneficial effects of green spaces are well known. For example, they promote psychological restoration, whether affective, cognitive or physiological, which promotes the alleviation of stress. An issue of environmental equity is also associated with the distribution of quiet areas. Quiet areas can also provide economic benefits. The direct economic effect related to noise reduction estimates an increase in property value of approximately 0.5% per decibel.

ISO 12913-2 Acoustics-Soundscape makes it easier to compare results between several studies. This method proposes to evaluate all the sounds perceived in a sound environment in all its complexity. The studies will therefore use different data collection techniques related to human perception, the acoustic environment and the context. This data collection can be done by guided interview, questionnaires, mobile applications, etc. The population survey provides information related to psychoacoustics such as human perception of the sound environment.

4 Observation of noise evolution

4.1 Existing observation structures

It appears that few different countries are equipped with this type of structure and the structures identified are quite variable. Non-profit associations are very present in France

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through *BruitParif* and *Acoucité*. They include a large number of members: state enterprises, associations, communities and activities. These associations are the largest observatories met in this study but it's possible that some of them weren't found because on the cultural distance (Asia for example). Noise observatories can be developed by governmental institutions. For example, In India, the Ministry of Environment has started a program to develop a noise measurement network. There are currently 70 measurement sites in operation spread over 7 different cities [4] with a target of 160 stations in 25 cities. Aéroport de Montréal took the private initiative to make the WebTrak online tool available to the public. This allows aircraft trajectories to be consulted and the associated noise levels to be known. The Worldwide Aircraft Noise Services website (mainly used in Germany) offers citizens' committees to install a network of measurement stations in order to demonstrate that airborne noise levels exceed thresholds.

4.2 Noise mapping

Noise mappings are useful for visually representing the noise levels caused. To date, very few maps have been produced in Quebec Different simulation methods exist. The physical models are based on modelling the physical phenomena of aerial sound propagation. These are the ones most commonly used. Statistical models are based on regression equations describing the relationship between a pollutant and its environment (Land Use Regression model). The modelling is built from a series of sound level measurements, detailed GIS input data and several regression equations. This method has been used for example for Shanghai [5], Vancouver, Toronto, Halifax and Montreal [6]. It is also possible to use an artificial neural network in addition. These statistical models are limited because they don't take into account precisely the built environment, but they make it relatively easy to assess statistical criteria of noise exposure.

4.3 Observation by measurement network

The use of a network of permanent noise measurement stations is common around the world. For example, Station 7hz network is a light, robust and reliable system allowing the display of data measured in real time on an easy-to-use and modular web interface and an automatic detection of sound events (artificial intelligence training).

Noise observation can also be done using mobile measurement networks. These networks consist, for example, in the citizen use of mobile noise measurement applications (NoiseCapture app is an example) or the use of bicycles or vehicles equipped with sound level meters.

5 Quebec context

5.1 Current noise management in Quebec

Noise has been considered a contaminant since the adoption of the Environmental Quality Act, but no regulations govern its monitoring or exposure, whether inside or outside a building. The university community also develops projects that address urban noise. The *Sound City* project, for example, aims to develop knowledge on the management of urban noise. The *Vivre en Ville* organization aims to encourage the development of viable communities across Quebec and provides the public with documentary resources related to environmental noise.

5.2 Prerequisites for a Quebec noise observatory

A noise observatory cannot operate with total autonomy. This must work in cooperation with the technical services of the state, the university network and the data producers. The creation of an urban noise observatory in cities such as Quebec and Montreal is possible, but requires the following elements:

- Raising awareness among the population and decision-makers of the challenges of urban noise,
- evolution of the legislation to induce the development of noise observation and management tools,
- Cooperation to share know-how in this field,
- Stable funding.

6 Conclusion

Legislation must, as best as it can, harmonize the methods for assessing urban noise and clearly determine the noise thresholds to be respected. This must also allow the authorities to intervene effectively in noise issues. These issues require the expertise and coordination of several distinct areas. The creation of a noise observatory in the form of an association would generate this coordination and would bring together in one entity the knowledge acquired in the observation and management of urban noise. Such an observatory could thus be maintained thanks to membership fees and thanks to funding that could be included in legislation or come from the government. A more detailed report is available on demand.

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