

## Concept of Communicating The Results of Noise Monitoring

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### ABSTRACT

Decibels and noise maps, data and colorful posters are untapped assets – in most cases they do not reach their final destination unless proper communication. This paper presents a unique concept of a combined technical and communicational approach. The case-study we examine is the practical application of long-term monitoring system to support urban planning. On one hand we present the benefits of noise mapping and a simplified noise indicator for communication. On the other hand, this paper presents a unique approach, the practical application of long-term monitoring system to support urban planning and the well being of residents. If not used properly, the output of a long-term noise monitoring system is limited to numeric values without leading to any conclusions. To avoid this common failure, the authors established the future goals of the system long before installing it. The main goal providing information on the noise situation for a) stakeholders of the govt. b) urban planners c) residents. Every group needs different ways of communication to understand and make use of the results. The presented concept delivers solution to address all three groups. Tools like simplified NPI or the developed dynamic noise map all automatically generated by the system serve awareness raising purposes.

**Keywords:** Communication, Monitoring, Noise Mapping

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## 1. INTRODUCTION

Without clear explanation, a lot of work done is useless. Decibels and noise maps, data and colorful posters are untapped assets – they do not reach their final destination: the residents, the stake-holders or the urban planners and designers. The key solution is communication: direct communication or indirect. Personal presence and addressing through the tools of modern technology. To be effective, both solutions must be used in a project process.

This paper presents a unique concept of a combined technical and communication approach. The main goal providing information on the noise situation. For that purpose, we need data, noise indicators, and a representative demonstration.

Over the last decade, a significant change was made in Dubai to improve the quality of living in the city with endeavour to maintain the social and economic growth that was achieved to date. The need to address the consequent environmental impact of noise is essential for, the city's development and to achieve Dubai's vision: Developing a Happy and sustainable City.

Our company provides continuous support in terms of noise protection and assessment to Dubai Municipality. In recent years, there have been studies revealing the problematic areas in terms of traffic, industrial and construction noise in the Emirate.

During the Noise Study for the Emirate of Dubai, over 400 measurements were conducted in the Emirate as well as a full noise map was prepared. (Methodology was equivalent to the noise mapping methodology as described in 49/2002 EC directive, but with the help of the large number of measurements the authors defined calculation standards for appropriate noise prediction in the GCC region).

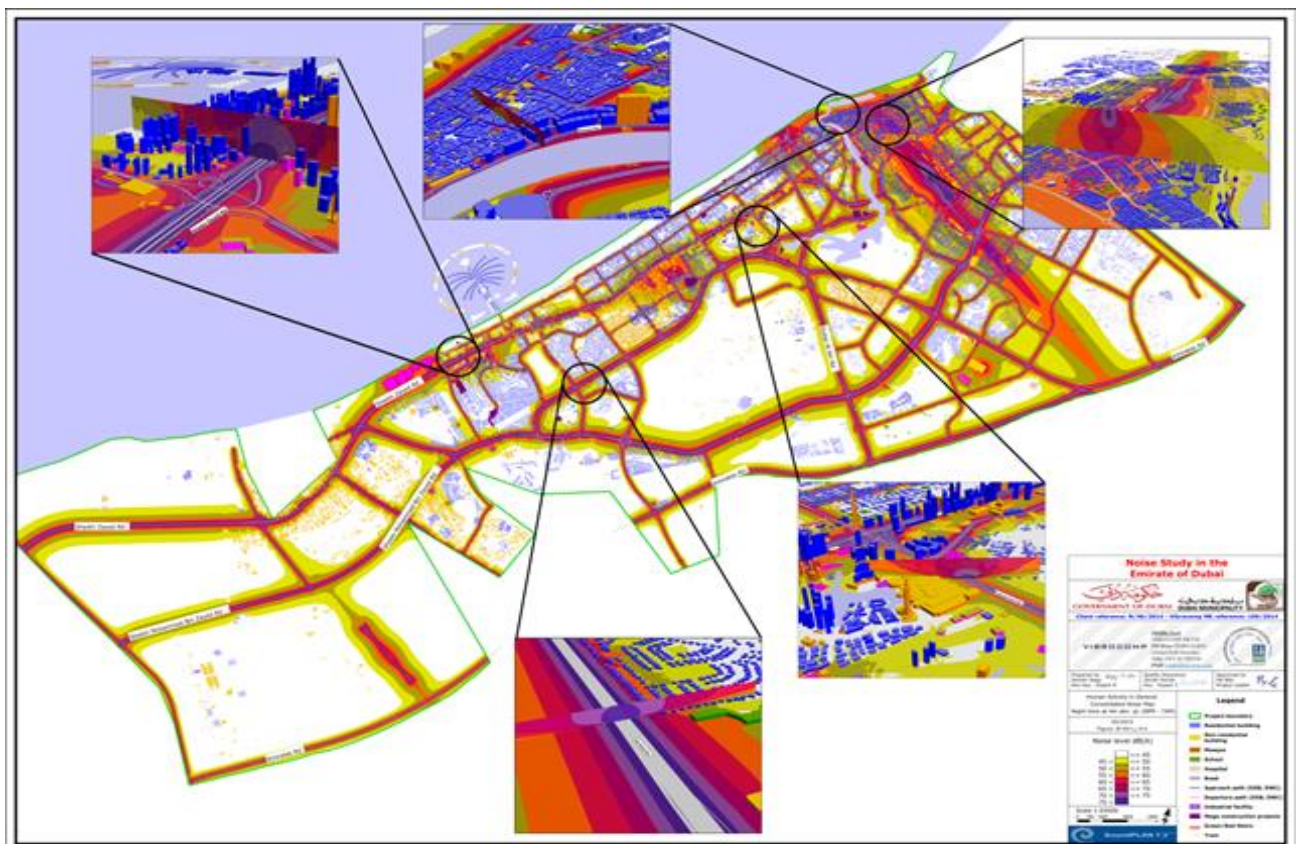


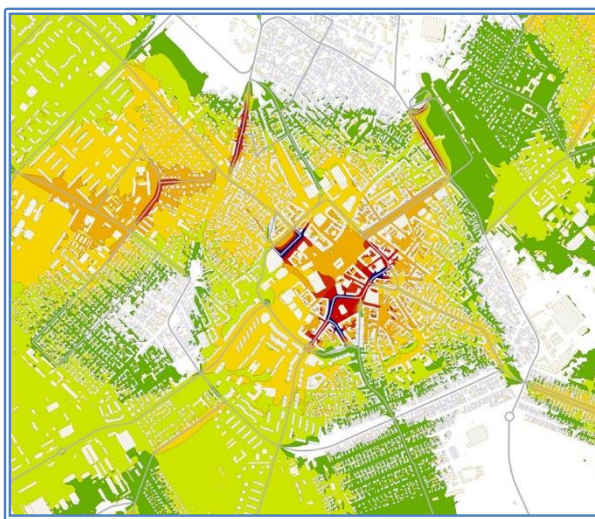
Figure 1. One of over 300 noise maps prepared for the Emirate of Dubai.

## Noise mapping = Noise indicator of the benefits

The noise map clearly shows the different levels of noise pollution. Difference noise maps show the extent of change. A good noise map is illustrative, it makes the noise propagation understandable as well as the noise reduction.

Multiple communication paths are required to deliver this. For example, oral presentations, and web surface - where everyone can find his/her home on the noise map.

The nature of changes, the acquired noise benefits are to be translated with the help of examples during the public forums in a way that is understandable for all parties. In all cases, we have to show the meaning of change in noise pollution, for example a 3 dB decrease means the traffic flow will be half the volume. Besides that, it is very important to emphasize with eligibility statements the degree by which noise situation become better e.g. due to developments' effect.



Number of affected residents (daytime)	without	with
Noise level dB(A)	Affected residents	Affected residents
50-55	3700	3400
55-60	1600	1500
60-65	1400	1300
65-70	800	600
>70	200	200
sum.:	7700	7000

Number of affected residents (night time)	present	future
Noise level dB(A)	Affected residents	Affected residents
45-50	2400	2100
50-55	1400	1300
55-60	1300	900
60-65	500	500
>65	0	0
sum.:	5600	4800

Figure 2. Difference noise map and eligibility statements

Therefore our colorful posters became noise maps helping us to translate the logarithmic formulas to common language.

But people usually need only a simple answer: is it okay to me? How can we show this in a simple and easy way?

For easy-to-understand communication, we have to rely on a real data set and a measurable simplified noise indicator.

## 2. LONG-TERM NOISE MONITORING SYSTEM AND COMMUNICATING

### 2.1 Preparations before the installation of the system

#### 2.1.1 Long-term goals

If not used properly, the output of a long-term noise monitoring system is limited to numeric values without leading to any conclusions. To avoid this common failure, the authors established the future goals of the system long before installing it. The main goal providing information on the noise situation for a) stakeholders of the govt. b) urban planners c) residents. Every group needs different ways of communication to understand and make use of the results.

### 2.1.2 Site selection

Based on the noise maps, different areas were proposed for the installations. The exact areas were chosen in close cooperation with Dubai Municipality to fulfil the requirements for long-term noise monitoring.

After the initial site inspections, design drawings for each location was prepared. These designs took all possible noise sources (including HVAC devices, transformers, etc.) into account so that the “unwanted” noise sources could be excluded.

Based on the preliminary inspections, stations were installed to be suitable for two types of noise sources; road traffic noise and aircraft noise. A year later, the noise stations were relocated so the noise stations were suitable for measuring industrial noise sources and monitoring the quiet residential areas. Many requirements were assessed during site verification – e.g. it was a must to have much lower background noise levels so that the noise sources can be differentiated.

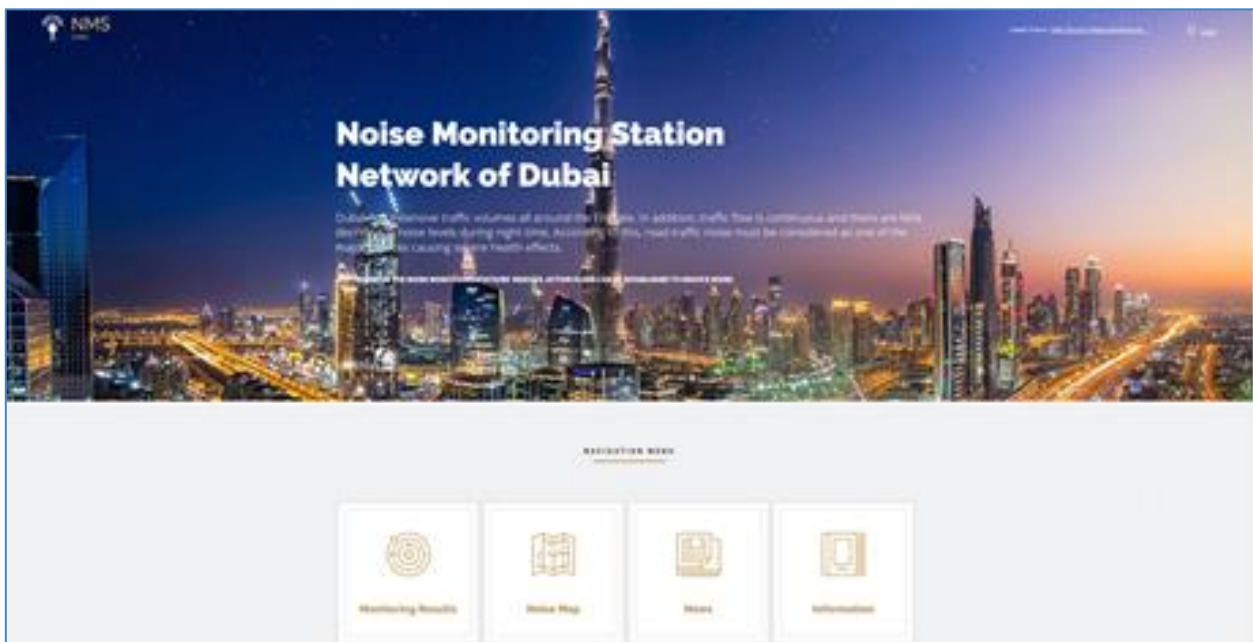


Figure 3. Noise monitoring station network of Dubai

### 2.1.3 Choosing the most appropriate device for the measurements

Many manufacturer offer long-term noise monitoring devices, mostly with similar conditions in the market. Despite this, choosing the most appropriate equipment for this project was demanding, not only that the equipment must withstand extreme local meteorological conditions (with temperatures being occasionally close to 50°C and sometimes high humidity) but they must also fit into the local landscape and contribute to the overall look of Dubai. The instrument shall be small and easy to operate remotely.

Besides the above requirements, as Dubai is also moving towards the usage of renewable energy, the system had to rely solely on solar power. A solar system was designed to ensure the stations receive power even during the winter months. In addition, the system also had to have a backup battery for the instrument to protect the monitoring station's internal battery and components from damage due to the excessive heat in Dubai.

The chosen types were EU instruments designed to operate in extreme climate conditions. The instrument selected received special a heat reflecting paint and turned out to be an ideal choice for unattended permanent environmental noise measurements.



### 2.1.4 Contribution to urban planning – first steps

This project is part of long-term noise control campaign, its outcomes were linked to urban planning. The monitoring results provide baseline for future developments, e.g. noise insulation or traffic on the road network should be designed to protect the well-beings of residents.

Locations of new sensitive developments, should be selected based on the results of the noise monitoring network. Areas having excessive noise levels should not be selected for residential developments, only for industrial or commercial purposes.

## 2.2 Assessment of the monitoring results

### 2.2.1 The developed web-based application

Presentation of the results is a key factor in the success of the project. A two-fold system was designed and implemented for this purpose. Detailed and raw data were made available only for authorized personnel whereas general results are shared with the public.

Besides the common terminology employing LAeq, Lmax, Lmin, etc. a Noise Pollution Index was developed and calculated using a web based application. The Dubai Noise Pollution Index (referred as NPI) is based on the well-known Harmonica Index developed during the HARMONICA project in the EU(1). The index was tailored to suit Dubai's local conditions.

The application was developed to display the NPI and to provide better understanding of the noise situation to the public. The index, based on the Harmonica Index, consists of two components a component related to background noise (marked with BGN) and a component related to events, representing the noise peaks (marked with EVT). Adding these components together leads to the NPI which has a scale between 0 and 10.

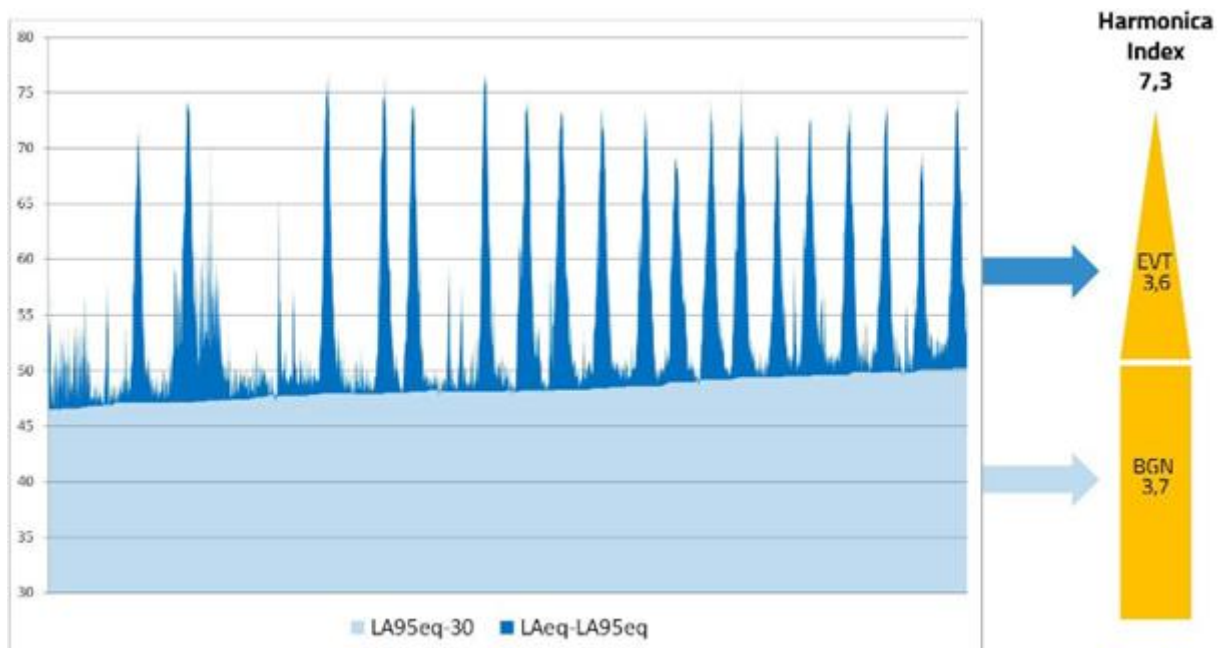


Figure 4. The Dubai Noise Pollution Index

Based on the requirements set out together with Dubai Municipality, the developed webpage was also capable of presenting the assessed Key Performance Indicators and the Dynamic Noise Map of Dubai.

### 2.2.2 Key performance indicators

Besides the parameters and dynamic noise map set out in Chapter 3.1 key performance indicators (referred as KPIs) have been assessed to provide more understandable values, they have been suited to be representative for Dubai conditions.

#### LKZ (LärmKennZiffer)

LärmKennZiffer(2) (LKZ) describes the effects created by noise exposure in a road. It was utilized in many action plans in Germany and throughout the EU. It combines the noise exposures in the road with the number of people affected. The assessed noise indicator is a product of exceeding a limit value of noise disturbances and the people affected, it is high in places where high residential density and high noise level come together.

#### Highly annoyed (%HA)

Studying this indicator(3) synthesis curves were prepared for noise annoyance from aircraft, road traffic and railway noise, with 95% confidence intervals taking into account the variation between individuals and studies. These curves were based on studies examined for which Lden (and Ldn), and the percentage of “highly annoyed” persons (%HA) meeting certain minimal requirements could be derived, augmented by a number of additional studies. The percentage of “highly annoyed” persons (%HA) was defined as a function of noise exposure indicated by Lden.

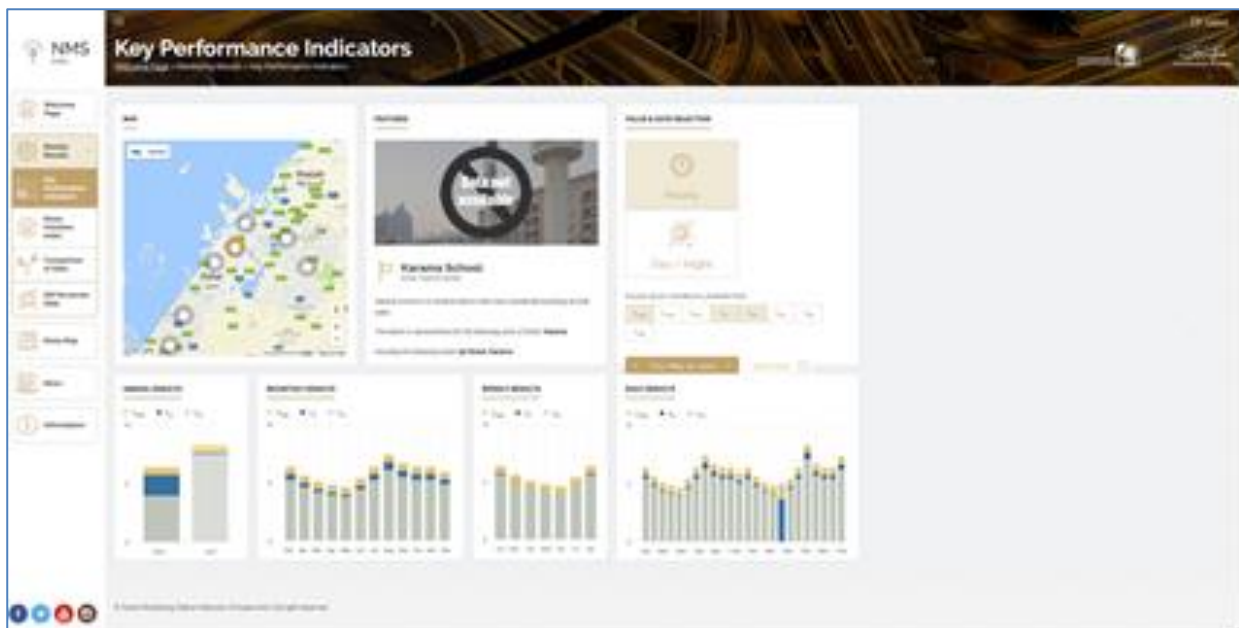


Figure 5. The goal of the publicly available website incl. the results is to inform the public and to support designers

#### Noise and Number Index (NNI)

Originally devised by the Wilson Committee on Noise in Britain(4), the Noise and Number Index is an attempt to measure the subjective noisiness of aircraft. It uses the PNdB as a basis and additionally takes into account the number of aircraft per day (or night) as a key annoyance factor. It must be noted that the NNI is an empirical formula.

### 2.2.3 Use of the results for urban planning for Dubai

Proper urban planning and architectural design can help to reduce the effects of noise. The noise levels inside buildings can be reduced with different passive methods such as noise abatement windows, building walls with high insertion loss. Another way to reduce noise conflicts is to have proper traffic planning. In that case the smart traffic control system working. However, those tools can only be applied cost-effectively if valid and reliable input data is available.

Urban planners and designers in Dubai are now advised to apply the results of the noise monitoring stations for future developments as with the system installed a unique baseline is set up.

Each of the stations' results is specific for an evaluated area. Dynamic noise maps that synchronize with noise monitoring and traffic data illustrate the noise load change, its daily flow, and

the effects of altered traffic or extraordinary events. These results are now available for urban planners and designers to achieve the needed noise comfort in their developments.

Recommendations are as follows:

- Mitigation:  
Immediate action: Traffic control system - which restricts traffic to the road bypassing the city  
Long-term action:  
Simple smart urban planning: more bypass roads and noise walls planning
- Adaptation:  
E. g. Carama school: timetable conversion - tailored to flight overloaded periods

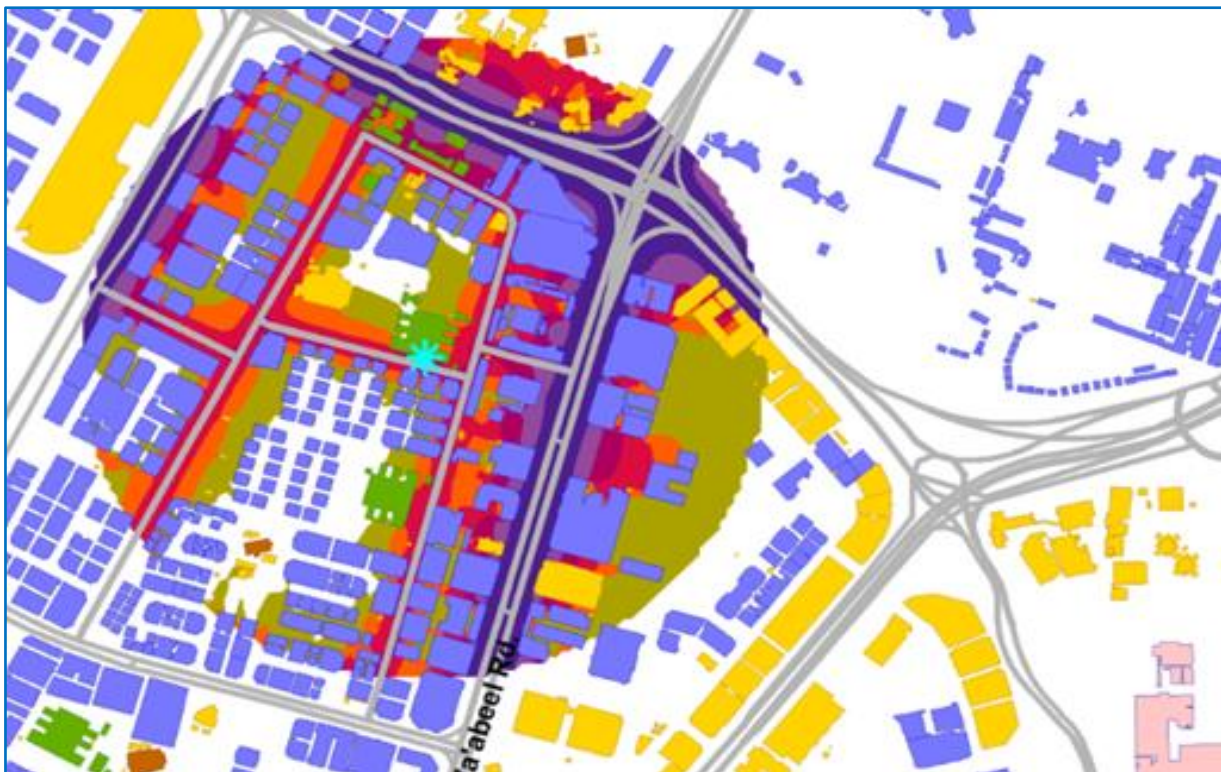


Figure 6. Example of a dynamap “hotspot”

By commissioning more noise monitoring stations, the database could be more accurate and more areas can be covered by the noise monitoring network. This database also contributes to avoid future conflicts; it clearly indicates where not to design further sensitive premises as well as an accurate indication of where noise conflicts are to be solved.

### 2.3 Communication concept

Working with an asset like simplified NPI or the developed dynamic noise map requires lot of communication. At design preparatory phase before decision and after, during design phase with public involvement. Communication is inevitable and it is a priority before and during official proceedings. The ways of providing information are different depending on the target group.

Decision makers - stakeholders of the govt. can be caught to versatile information. What they need to see in order to effectively involve them in the process: opening up economic benefits, political communication channels to people, giving a vision of a mission. They do not have to understand the professional context.

Decision makers need a set of data, e.g. long-term noise monitoring system, quantifiable goals that can be realized. At the same time, the visual experience like the dynamap makes the point convincing.

To do this, the communication path presentations, reports - data warehouse and advantage-benefit recommendations. The expert should think instead of them.

Urban planners and designers need a direct indication of how much they are affected by noise. Data that influences cost planning, spatiality that makes the dimensions of noise acceptable.

For this, the communication path, besides data and reports, is the effectiveness of personal involvement. We speak one language, rowing in the same ship.

In Dubai, it was a success, common thinking became part of urban planning.



Figure 7. The 7Cs of effective communication

(Source: <http://evancarmichael.com/Business-Coach/2493/The-7Cs-of-Effective-Communication.html>)



Population require understanding and engagement. This is the most important way for them. At the same time, the meaning of noise, the essence of change - must be translated into their language in a clear way, repeating the essence as many times as possible.

The noise map is useful, concise, understandable to noise propagation and damping. It is advisable to express the extent of noise in a simple way with a clear indicator: e.g. NPI as we did successfully in Dubai.

The way of communication for residents is primarily oral presentation and media: web surface (dynamap and NPI) applications and environmental awareness recommendations.

Our effective communication in Dubai:

- ✓ Vibrocomp provides continuous support in terms of noise protection and assessment to Dubai Municipality.
- ✓ Dubai has a vision: Developing a Happy and sustainable City.
- ✓ Dubai Municipality and Vibrocomp created a long-term noise monitoring system.
- ✓ Vibrocomp developed a web-based application ad the Dubai Noise Pollution Index.
- ✓ Vibrocomp's developing support urban planners and designers to achieve the needed acoustic comfort in their developments.

### 3. CONCLUSIONS

Noise is becoming a more and more severe issue globally. Dubai Municipality and the authors of this paper are pioneers in the GCC region to handle environmental noise on a strategic level. Conducting awareness raising campaigns and designing strategies, action plans.

Solutions such as noise barriers are yet to be accepted by the public and decision makers in the region, but by utilizing proper urban planning as a major tool for noise mitigation, measures can be taken to significantly improve the noise situation and quality of living in the Emirate. The noise monitoring system, the evaluation and the presentation of the results as described in this paper represent a milestone in delivering unique noise data to support urban planners and designers to achieve the needed acoustic comfort in their developments.

Our vision is providing information to serve awareness raising purposes.

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