OBJECTIVES AND CARRIED OUT ACTIVITIES

Chiara Bartalucci
University of Florence

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Project location and beneficiaries

**Location**

![Map showing the location of Milano and the Provincia di Monza e Brianza.](image)

**Timing**

- Start: 1st September 2016
- Expected end: 30th June 2020
Project location and beneficiaries

**Beneficiaries**

- Municipality of Monza (Coordinator)
- ISPRA - Italian Institute for Environmental Protection and Research
- University of Florence
- Vie en.ro.se. Ingegneria
- Vie en.ro.Se. Ingegneria srl

ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale)
Low Emission Zones (LEZs): urban areas subject to road traffic restrictions to comply with the air pollutants limit values set by the European Directive 2008/50/EC.

Goal: to improve the environmental quality and to reduce health risks

Benefits: road traffic reduction, traffic flows optimization, lower use of cars, enhancing of public transport, social wellbeing.
Differences between LEZs:

- Typologies of vehicles to which access could be denied (heavy-duty vehicles, and/or light duty vehicles, passenger cars, motorcycles and scooters, ...)

- Diverse speed limits

- Different restriction time periods

- ...
LEZs implemented in > 200 cities in Europe.

Many approaches used and absence of a commonly shared legal framework, at EU level.

Project background - LEZ

Green = LEZ

Blue = Access restrictions

http://urbanaccessregulations.eu/userhome/map
- Effects of LEZs implementation widely analyzed

- LEZs recognized as effective measure to reduce traffic-related air pollutants levels

- Effects and **potential benefits** concerning the **noise reduction** in a LEZ **not addressed in a comprehensive manner** yet

- **Noise aspect** **not taken into account** and no specific interventions against noise foreseen and implemented in the LEZs
Project objectives

Final goal: a common and easy-replicable method, and related guidelines, for the identification and the management of Noise Low Emission Zones.

Case study: Libertà district (Monza)

In a range of 30 m from the Viale Libertà almost the 100% of the receivers are exposed to levels > 65 dB(A) during the day and > 55 dB(A) during the night.
Other specific objectives:

✓ adoption of **top-down measures** concerning infrastructural interventions (traffic management - limitation of the vehicles speed and access denied to trucks, road paving substitution, two pedestrian crossings)

✓ reducing the **average noise levels** in the pilot area of Libertà district, with positive complementary effects also on the **air quality** and on the **quality of life**

✓ involving the population in an active management system of lifestyle choices (**bottom-up measures** i.e lessons at schools about noise effects, ideas contests for Noise LEZ picture and logo, questionnaires on perceptions of specific noise impacts, on quality of life, air quality as well social aspects, mobile App to manage voluntary and sustainable actions)
Innovative aspects of the Project

✓ Combined noise and air monitoring

✓ Using of smart noise monitoring systems

✓ Attention not only on noise effects (air quality, health, social well-being, economic aspects, …)

✓ Global index

✓ Public involvement
✓ Public tender for replacement Viale Libertà’s pavement

✓ Road traffic restrictions:
  • Heavy tracks > 3.5 tons (6 months).
  • Heavy tracks > 7.5 tons (after)

✓ Final project for Viale Libertà’s asphalt replacement

Works for asphalt laying started on 17 September 2018
Bottom Up Actions

Public involvement, meetings organization, ideas contest (MONZA)

Administration of questionnaire about health and mobility habits/noise perception - Ongoing
About 200 questionnaires collected so far (February 2018)

Public involvement: environmental aspect (VIENROSE)
Bottom Up Actions

If you interrupt the noise, you'll feel the life.
Bottom Up Actions

Alternating school-work Programs with Carlo Porta Institute:
- 21 students
- 15 meetings
Bottom Up Actions

APP structure

City Games

- Pedibus
- Walking time within the LEZ zone
- Biking time within the LEZ zone

Green actions

Green points
Monitoring activities

Objective: reduction of the average noise levels in the pilot area of Libertà district, with positive complementary effects also on the air quality and benefits on well-being conditions of inhabitants.

- **Noise Monitoring**
  - Traditional equipment
  - Smart low-cost sensors

- **Air Quality Monitoring**
  - EU Directive requirements
  - Passive sampling

- **Quality of life**
  - Questionnaire
Noise Monitoring in pilot area

- **Smart low-cost sensors**
- **Traditional equipment**

Periodic checks to be performed using sound level meters of class I precision

Development of a new smart noise monitoring system (SNMS) as a continuous monitoring network in the ante and post-operam scenarios (1+1 year)

At the end of the project, the prototype will be given for free to the city of Monza that will take care of using it for monitoring activities in the 3 years after LIFE period
The State of the art analysis was based on the following relevant low cost monitoring system experiences:

- DREAMsys
- Smart monitoring networks designed by Ghent University
- SENSEable Pisa
- Life DYNAMAP
- Barcelona Noise Monitoring network
- Low-cost monitoring systems based on smartphone devices – Regional Environmental Agency of Piemont
- ...
Noise Monitoring in pilot area

Results: an **Abacus** on smart noise low-cost monitoring networks fully available at [www.lifemonza.eu](http://www.lifemonza.eu)

### Smart low cost noise monitoring systems

<table>
<thead>
<tr>
<th>特性</th>
<th>单位及测量方法</th>
</tr>
</thead>
<tbody>
<tr>
<td>短期/长期噪音测量</td>
<td>长期噪音测量</td>
</tr>
<tr>
<td>嵌入式PC监控系统/单元</td>
<td>嵌入式PC监控系统</td>
</tr>
<tr>
<td>麦克风及数码信号处理器</td>
<td>MEMS麦克风，1/4英寸凝胶低成本麦克风</td>
</tr>
<tr>
<td>时间基测量</td>
<td>不同值。在大多数情况下，1秒；</td>
</tr>
<tr>
<td>声学动态范围</td>
<td>70 dB</td>
</tr>
<tr>
<td>声学测量范围</td>
<td>不同范围。30(40)-100(110)dB(A)</td>
</tr>
<tr>
<td>声学频谱范围</td>
<td>20 Hz-20 kHz</td>
</tr>
<tr>
<td>楼面噪音值</td>
<td>30-35 dB(A)</td>
</tr>
<tr>
<td>容差</td>
<td>LAeq ±2 dB(A)</td>
</tr>
<tr>
<td>声学指示器</td>
<td>在所有案例中：LAeq, LA10, LA50, LA90。在部分案例中：LA01, LCeq, M60, M70, N60。</td>
</tr>
<tr>
<td>频谱数据</td>
<td>1/3 octave</td>
</tr>
<tr>
<td>校准</td>
<td>期化校准</td>
</tr>
</tbody>
</table>

### 补充特性

- 防水：所有案例中应用
- 连接性：WiFi/3G/4G
- 音频录音可能性：部分案例中应用
- 其他特性：可扩展温度/湿度传感器，空气污染监控传感器，GPS记录等；电池为能量存储。
- PCB尺寸：10mm < x < 10 mm
- PCB形状：优化以避免衍射效应

### 实施区域

- 城市/郊区：城市和郊区区域
- 领土尺度：不同尺寸，从中等规模到大范围；（市区最频繁的尺寸大致为：1.00 km²）
- 站点数量：不同情况。对于区域，多数情况下，从5到20个单位。
Noise Monitoring in pilot area

10 monitoring stations have been installed in the pilot area of Libertà district
Main technical specifications:

- acoustic parameters: overall A-weighted continuous equivalent sound pressure level, LAeq and continuous equivalent sound pressure level, Leq, as 1/3 octave band spectrum data
- timing for data recording: data will be registered 1 second based to permit the recognition of unusual events in the post analysis phase
- timing for data transmission: data will be sent every hour
- data transmission network: 3G

Main electroacoustic specifications:

- floor noise < 35 dB(A)
- frequency response to pure tone at 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1000, 1250, 1600, 2000, 2500, 3150, 4000, 5000, 6300, 8000 Hz within the class I specs ± 1dB
Main hardware specifications:

- controller: low power microcontroller able to perform IIR digital filtering for A-weighted level calculation and FFT for 1/3 octave band level calculation
- power supply: solar panel (max expected size 60cm x 60cm, effective expected size 30cm x 35cm) and battery for energy storage
- sensor type: ¼ or ½ inch low cost microphones with removable rain protection
- possibility of installation: on façade or on streetlight, height 4 m
Two procedures have been applied to verify the noise monitoring system performance:

- Preliminary check (during the first two months)
- Long term check (every four months during two years period)
Procedures to check the performance maintenance

The challenge of the low cost sensors consists of performance maintaining during long term periods. Two time-stability checks, one-week based, are proposed:

1 – a calibration check @ 1 kHz (by using a sound pressure class I calibrator). Requirements for preliminary check: sound pressure level within 0,5 dB from the calibration level

2 – a comparison between LAeq,60s obtained from low cost sensor and class I equipment recording an environmental noise in the range 45/105 dBA. Requirements for preliminary check: difference between the two systems within 1,5 dB(A)
Noise Monitoring in pilot area

18-07-2017 Road traffic measure - calibration 1 minute

Class I microphone  |  Smart noise monitoring system

18-07-2017 Road traffic measure

Class I microphone  |  Smart noise monitoring system
Air Quality monitoring within the pilot area is in progress, according to requirements provided by Directive 2008/50/EC.

Also, the low cost and easy operation of the diffusive sampling technique will be used for a large scale air pollution surveys with a high spatial resolution.

In order to compare the spatial variability of air pollution before and after the NLEZ implementation, \( NO_2 \) and benzene land use regression models in a defined urban area of Monza of about 4 km\(^2\), including the noise LEZ, will be developed.
Monitoring methods and activities tested in pilot area: Survey

**Structure of the questionnaire**

- socio-demographic data
- building (location, noise exposure, time spent at home)
- quality of life in the district (opinion on social, economic and environmental aspects)
- perception about air quality
- perception about noise
- health and life quality
- transport mobility situation
- potential effects of LIFE MONZA project on local system aspects

Questionnaires filled in almost 177, equal to about 31% of the sample (570 expected). Further actions about the questionnaire administration are in progress, in order to guarantee the expected number of compiled copies.
### The global index

<table>
<thead>
<tr>
<th>TYPOLOGY</th>
<th>DESCRIPTION</th>
<th>PARAMETER</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOISE</td>
<td>Average value on the noise LEZ area</td>
<td>Lden</td>
<td>dB(A)</td>
</tr>
<tr>
<td></td>
<td>Average value on the Viale Libertà buffer (30 m)</td>
<td>Lden</td>
<td>dB(A)</td>
</tr>
<tr>
<td></td>
<td>Average value on the Viale Libertà buffer (30 m)</td>
<td>Ld</td>
<td>dB(A)</td>
</tr>
<tr>
<td></td>
<td>Average value on the Viale Libertà 30 m buffer</td>
<td>Ln</td>
<td>dB(A)</td>
</tr>
<tr>
<td></td>
<td>% of people exposed to Lden values &gt; 65 dB(A) in the noise LEZ area</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of people exposed to Lden values &lt; 55 dB(A) in the noise LEZ area</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of people exposed to Lden values &gt; 65 dB(A) in the Viale Libertà 30 m buffer</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of people exposed to Lden values &lt; 55 dB(A) in the Viale Libertà 30 m buffer</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>AIR QUALITY</td>
<td>Particular matter PM10</td>
<td>µg/m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Particular matter PM2.5</td>
<td>µg/m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other air pollutants NO2</td>
<td>µg/m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greenhouse gas emissions CO2</td>
<td>metric tons/year</td>
<td></td>
</tr>
<tr>
<td>SOCIO-ECONOMIC</td>
<td>Commercial activities N° of commercial activities in the noise LEZ</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>People employed in commercial activities N° of people employed in the noise LEZ</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Services activities N° of services activities in the noise LEZ</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>People employed in services activities N° of people employed in the noise LEZ</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>CLIMATE</td>
<td>Areas potentially affected by climate change covered by adaptation measures</td>
<td>km²</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

Contribution of the project to policy implications at National and Local level in terms of:

✓ Harmonization and simplification process among transposition decrees of EU Directives concerning noise and air pollution.

✓ Development of a common method for establishment and management of NLEZ and related guidelines, as a proposal to be adopted by national legislation

✓ More knowledge about impacts and benefits due to NLEZ introduction

✓ Enforcement of the dialogue between public institutions and citizens
Thanks for your kind attention

For further information visit the official web-site: www.lifemonza.eu