



LIFE E-VIA AND LIFE SNEAK PROJECTS OUTCOMES: EXAMPLES OF COMBINED STUDY AND APPLICATION ACTIONS FOR NOISE MITIGATION IN URBAN AREAS IN THE CITY OF FLORENCE

Chiara Bartalucci^{1*} Raffaella Bellomini¹ Sergio Luzzi¹
Arnaldo Melloni²

¹ Vie en.ro.se. Ingegneria, Florence, Italy

² Comune di Firenze, Italy

ABSTRACT

Like most European cities, the city of Florence is affected by high noise levels negatively impacting human health and wellbeing. For several years now, the municipality has been working to improve citizens' quality of life, implementing noise abatement strategies. Among those the municipality is pursuing, in this paper objectives and results of LIFE18 E-VIA and LIFE20 SNEAK projects, co-funded under the European LIFE Programme, are described.

According to WHO guidelines (2018), measures such as road surface and/or tyre improvements should be tested; both projects focus on reducing noise in densely populated urban areas: LIFE E-VIA tackles noise from road traffic focusing on a future perspective in which electric/hybrid vehicles will be a consistent portion of flow, testing optimized solutions for reducing noise and Life Cycle Cost (LCC) with respect to actual best practices; LIFE SNEAK aims at reducing noise inside urban areas, where tram and traffic noise and vibration superpose, by means of low-noise/vibration surfaces and retrofitting solutions having LCC comparable to those of standard surfaces.

Keywords: *noise mitigation, traffic noise, outreach activities*

*Corresponding author: chiara.bartalucci@vienrose.it

Copyright: ©2023 Bartalucci C. et al. This is an open-access article distributed under the terms of the Creative Commons Attribution 3.0 Unported License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

1. INTRODUCTION

Noise represents a major environmental problem, especially in urban areas. A growing body of research has highlighted the detrimental effects of exposure to high levels of noise on human physiological and psychological health and wellbeing. As an illustration, the European Environmental Agency (EEA) report “Environmental noise in Europe – 2020” [1] points out that at least 20% of the population during the day-evening-night period, and 15% during the night-time period, are estimated to be exposed to high levels of road traffic noise.

A wide array of actions and strategies is being implemented to reduce traffic noise in populated areas. Indeed, it is increasingly acknowledged that in order to reduce noise pollution a combination of measures needs to be implemented, including for example urban planning measures, the improvement of road surfaces and noise barriers installation. Noise policies aiming at reducing noise exposure are based on recent scientific evidence and data on exposure and increasingly seek the collaboration of private and public actors at different governance levels (e.g. transport and health sectors).

Over the past decades, the city of Florence has realized several noise mitigation interventions.

Florence had been one of the first cities to comply with the requirements of Italian national legislation about noise, providing in early 2000 the acoustic zoning and the Noise Reduction Plan. Moreover, it was one of the first agglomerations to fulfil the European Directive on Environmental Noise (END - 2002/49/EC), performing the strategic noise mapping and the consequent Action Plan to organically tackle acoustic criticalities and preserve quiet areas. In the past years several actions

have been performed, like the introduction of LEZs, noise barriers, paving of low noise surfaces, windows substitution aimed at protecting sensitive receivers and realization of three tramway lines. Moreover, the implementation of two additional tramway lines and of three tramway lines' extension is foreseen.

The Municipality of Florence has a long-lasting experience in European funded projects regarding noise pollution and its control and reduction especially projects co-funded by the LIFE programme, such as LIFE HUSH “Harmonization of Urban Noise reduction Strategies for Homogeneous action plans” (2010-2013) and LIFE QUADMAP (2011-2014) “Quiet Areas Definition and Management in Action Plans”. In detail, the HUSH project contributed to the harmonization of the Italian National and European legislations, regarding urban noise management tools, allowing a definition of coherent procedures able to comply the commitments introduced by National laws and by the Environmental Noise Directive 2002/49/EC (END). The QUADMAP project developed a guideline for the selection analysis and management of Quiet Urban Areas. The developed methodology was tested in 10 pilot areas including 6 schoolyards in Florence (Italy), where acoustic and non-acoustic interventions were implemented generally leading to an improvement in the evaluation from experts and in the increasing of citizens satisfaction as regards acoustic benefits.

In this paper the results of two projects recently co-funded by the European LIFE programme, LIFE18 E-VIA and LIFE20 SNEAK projects are described and discussed. They share the common aim of implementing innovative noise mitigation interventions in urban areas focusing on the reduction of noise at source. Outreach activities carried out by these projects will be also presented.

2. NOISE MITIGATION INTERVENTION: INSIGHTS FROM TWO LIFE PROJECTS

2.1 The LIFE E-VIA project

The LIFE E-VIA project “Electric Vehicle noise control by Assessment and optimisation of tyre/road interaction” [2] addressed the problem of road traffic noise, focusing on a future perspective in which electric and hybrid vehicles will be a substantial portion of the traffic flow in our cities. The main objective was to test an optimised solution for reducing noise in very populated urban areas focusing on

tyre/road interaction and combining low noise road surfaces with the development of tyres for electric vehicles.

The project was coordinated by the Municipality of Firenze and involved as partners the Mediterranean University of Reggio Calabria, Continental GmbH, Vie en.ro.se Ingegneria, University Gustave Eiffel and I-POOL. It started in July 2019 and concluded in January 2023.

In the initial project phase, a test road surface was built in Nantes where two pavement mixtures - selected through specific analysis - and different EV types and tyres were tested to identify the optimal combination for noise reduction. Following the tests results a pilot case in Florence was implemented with the construction of two road surfaces, an optimised and a reference one. Here further testing both in the ante-operam and in the post-operam scenario were carried out.

Project partners also estimated the noise mitigation efficiency and potential of tyres, road surfaces and traffic through a life-cycle and a life-cycle cost analysis. Furthermore, the rolling noise coefficients were calculated according to the EU CNOSSOS model for the EV fleet in order to define guidelines on the application of the project's results.

LIFE E-VIA also raises people's awareness of noise pollution and health effects explaining the opportunities provided by EVs through specific dissemination and promotional events, also investigating people perception regarding noise in terms of soundscape methodology.

According to acoustic measurements performed one year after the intervention in the pilot street in Florence a reduction of 4.4 dB(A) in the night period from 10 p.m. to 6 a.m. has been measured. This benefit affects about 2.000 residents of the pilot area. This result is in line with the findings of the survey conducted to assess noise perception of the residents. Data collected during the survey campaign showed that after the realization of the interventions the intensity of traffic noise has decreased and the quality of the soundscape has improved. Specifically, a significant majority of respondents (77%) positively assessed the effects of the re-paving with the optimized asphalt [3].

2.2 The SNEAK project

In recent years, many cities have introduced tramway systems as a sustainable alternative for urban mobility and to reduce traffic congestion in the city centers. Consequently, tram provides a supplementary noise source in urban contexts. The tram is often seen as an environmentally friendly means of transport as a low emission and silent vehicle. However, complaints from

residents living close to the tramway lines prove that it may lead to annoyance due to generated noise and vibrations. Squeal noise produced during tram ride in curve is one of the main source of noise [4]. Preliminary tests performed on the Florence tramway [5] showed peaks in the 2500-5000 Hz range.

The LIFE SNEAK project – “optimized Surfaces against Noise And vibrations produced by tramway track and road traffic” [6] aims to contribute to tackle these issues through the use of a combination of “quiet pavements” to mitigate air-born noise by rail-wheel and pavement-tyre interactions, and technical solutions to reduce squeal noise due to contact between the tram rail and the wheel. The project is coordinated by the Municipality of Florence in partnership with Italian Universities and companies.

The pilot project that will be implemented in Florence has the following main objectives : i) laying down a “quiet pavement” in busy street close to the city center (via La Marmorata, where a tram line will be built) for vibro-acoustic mitigation, combining the positive effects of the use of recycled materials and innovative technologies; ii) designing and evaluating the effectiveness of the bogie skirts to be applied to the tram that will pass through the street.

In the early phase of the project state-of-the-art analysis has been carried out, concerning possible measures to perform noise reduction with specific attention to noise due to wheel-rail contact and “squeal noise” phenomena [7]. Ante-operam activities for the complete characterization of the selected site for the pilot case in Florence have been also performed. Measurements regarding i) noise, ii) traffic flows and iii) vibrations inside buildings were carried out in the period February-April 2022 at two representative spots (Figure 1). Perceptive survey aimed at understanding how residents, workers in the area perceive noise due to road traffic in the ante-operam scenario was also performed. Once the pilot interventions are completed, consisting in the designing and laying of a low emission asphalt to mitigate air-born noise and the reduction of tram noise due to contact between the rail and the wheel through a system of sound-absorbing panels to be applied on the tram (bogie skirts), post-operam measurements and perceptive survey will be carried out following the same procedure applied for the ante-operam scenario. This will allow a direct comparison of the results obtained in order to verify the effectiveness of the interventions and to prove the possible existence of correlations between objective and subjective measurements.



Figure 1. Noise measurement spot in the pilot street (LIFE SNEAK)

3. OUTREACH ACTIVITIES

Raising awareness on acoustic pollutions and its effects and seeking community engagement are growingly acknowledged as key cross-cutting approaches to foster community acceptance of the abovementioned interventions/measures and promote cooperation in tackling traffic noise as a shared problem.

In particular, outreach activities meant to engage a large audience and to bring to the general public knowledge on noise pollution and city noise abatement policies and interventions have been put in place by both projects presented in this paper. In the frame of these activities, specific emphasis has been given to the communication of the negative impacts of traffic noise and of the benefits of the innovative developed measures for noise mitigation to ensure awareness of the projects aims and goals. An additional goal of the communication strategy has been to increase knowledge, skills and competencies of policymakers. Beyond the dissemination of information, engaging stakeholders and citizens in a two-way dialogue have been considered crucial for effective outreach activities.

In the frame of the LIFE E-VIA project, surveys residents, soundwalks experiences and interviews on an electric taxi were organised and carried out in the pilot area in Florence by Vie en.ro.se Ingegneria (Figure 2). These activities involved almost 200 citizens. In particular, their aim was twofold: i) assess the benefits of repaving a stretch of road

with optimised low-noise asphalt, from the point of view of the subjective perception of the residents (see results in section 3.1 and in [3]) and ii) involve citizens in the intervention, raising awareness on the effects of traffic noise and on the positive outcomes of effective noise interventions at the sound source.



Figure 2. Soundwalks with citizens (LIFE E-VIA project)

In addition, an **open contest** for high school students was organized to raise awareness on the relations between electric mobility and noise pollution reductions and empower students to engage in discussion on related topics, even if they are not directly impacted by an intervention. Specifically, students were involved in training activities in collaboration with the Università degli Studi Mediterranea di Reggio Calabria, partner of the project. During the experience, students were asked to develop a proposal for the optimal "EV sound" (low-speed issue), in compliance with the UN Regulation N.138 (Acoustic Vehicle Alerting Systems).

As mentioned in section 2.2, in the frame of the LIFE SNEAK project, questionnaires have been administered to conduct a perception survey among affected citizens before and after the interventions carried out in the pilot street close to the city center of Florence (Figure 3). The ante-operam questionnaire was distributed to people living, working or studying in buildings that overlook the street. Four different people's categories were identified: i) students and ii) school workers of a High School, iii) residents and iv) people who work in proximity of the street (e.g. shopkeepers, employees in hotels or other activities). Participants to the survey were

informed about the project aims and planned interventions. Data collected through the ante-operam questionnaires will be analysed and discussed comparing them to the post operam survey to be carried out by the end of 2023. A report which will be delivered by December 2023 and made available in the project website [6].



Figure 3. Questionnaire distribution (LIFE SNEAK)

The project also foresees informative lessons to students attending a High School located near the pilot area. Lectures will focus on auditory and extra-auditory damage related to excessive noise exposure. In addition to frontal lessons, students will conduct practical experiences that are expected to stimulate their curiosity and enhance learning. Furthermore, common approaches and disseminations actions have been carried out by both projects, including:

- use of comprehensible language, tailored to the public and receivers of each specific communication project action to attract the interest of citizens stakeholders and policymakers;
- use of social media channels (e.g. Facebook, Twitter and LinkedIn) as powerful dissemination platforms;
- publication of scientific papers and participation in conferences to share technical results with the scientific community;
- publication of reports to inform the general public about projects progress, results and outputs;
- press-release;
- organization of workshop and events to disseminate methods applied, results and lessons learned (Figure 4);
- Networking activities with other UE funded projects on the same topics.



Figure 4. LIFE E-VIA final event in the frame of the EXPO MOVE (Florence, October 2022)

A special emphasis was also put on stakeholders engagement. As an illustration the launch event of the LIFE SNEAK project was held in May 2022 in Rome was attended by about 80 participants from several stakeholders as local administrations, PTOs (public transport operators), PTAs (public transport authorities), manufacturers, industry, and universities representatives as well as consultants.

4. CONCLUSIONS

The positive progress, results and outcomes of the concluded LIFE E-VIA project and the ongoing LIFE SNEAK project demonstrate that a partnership is a highly valuable model to ensure a good balance of knowledge and competences for the design and successful implementation of noise mitigation interventions. The partnership approach combined with networking and outreach activities have been crucial to achieve projects objectives. Communication and interaction with citizens and local communities also play a key role in these endeavors and should focus not only on informing citizens when affected by an intervention that will lead to a change in noise exposure but also on raising awareness on the noise pollution issue and engage them in the planning and implementation of solutions.

5. ACKNOWLEDGMENTS

This work was carried out in the frame of the LIFE E-VIA project (LIFE18 ENV/IT/000201) and the LIFE SNEAK

(LIFE 20 ENV/IT/000181), both cofounded by European Commission in the frame of Life Programme.

6. REFERENCES

- [1] EEA (2020) Environmental noise in Europe EEA Report No 22/2019
- [2] <https://life-evia.eu/>
- [3] R. Bellomini, C. Bartalucci, G. Iannuzzi, S. Luzzi, G. Torelli “Il progetto LIFE E-VIA: risultati di un'indagine sulla percezione del soundscape”, 48 *Convegno Nazionale Associazione Italiana di Acustica*, Matera, 2022.
- [4] M. Pallas, J. Lelong, R. Chatagnon, “Characterisation of tram noise emission and contribution of the noise sources” *Applied Acoustics* vol. 72, n. 7, pp 437-450, 2011.
- [5] D. Casini, M. Masi, A.R.-: il rumore della nuova tramvia di Firenze: analisi dell'emissività nel primo anno di esercizio. n.d
- [6] <https://www.lifesneak.eu/>
- [7] F. Borchì, M. Carfagni, L. Governi, L. Puggelli, F. Buonamici “Stato dell'arte riguardo al rumore prodotto dal tram ed alle possibili soluzioni di mitigazione del fenomeno dello “squeal noise”: il progetto LIFE – SNEAK” 48 *Convegno Nazionale Associazione Italiana di Acustica*, Matera, 2022