NOISE / NEWS INTERNATIONAL

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Environmental Noise & Standards

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Editor's Message

This issue marks both a continuation and a shift. Noise control engineering has long been grounded in measurement, regulation, and compliance. These foundations remain essential. Yet as our cities grow denser, technologies evolve, and public awareness deepens, it is becoming increasingly clear that acoustics cannot remain confined to mitigation alone. The conversation must expand.

In this issue of Noise News International, we explore a broader framing of environmental acoustics, one that moves beyond the decibel as the sole reference point and toward a more holistic understanding of how sound shapes human experience. The articles gathered here reflect a field in transition. They ask not only how we control noise, but how we design, evaluate, and interpret the acoustic environments in which people live and work.

We begin with a conceptual challenge to conventional practice. The idea that soundscapes should be treated as a design parameter rather than a by product encourages us to reconsider long held assumptions. Energy based metrics remain indispensable, but they do not fully capture perception, context, or lived experience. By engaging with soundscape principles and structured frameworks such as the Noise Footprint approach, this issue opens a dialogue on integrating qualitative insight with quantitative rigor.

At the same time, regulatory and policy dimensions remain central. Comparative perspectives on environmental noise governance reveal how different regions approach common challenges. Whether examining global differences in exposure assessment or reviewing construction noise monitoring practices across multiple countries, these contributions highlight the importance of coherent frameworks, enforcement mechanisms, and public transparency. Standards and guidelines are not static documents. They evolve alongside technology, urban form, and societal expectations.

The urgency of these discussions becomes especially visible in rapidly developing regions. Case studies addressing traffic noise, occupational exposure, and urban management in diverse national contexts remind us that acoustic challenges are deeply embedded in local realities. Cultural practices, transportation patterns, and infrastructure constraints all influence outcomes. Effective solutions must therefore be context sensitive, technically sound, and socially informed.

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This issue also turns attention to specific intersections where noise carries complex implications. The paradox of train horns underscores the delicate balance between immediate safety and long term health. Research on youth exposure raises questions about generational vulnerability and cognitive development. Analyses linking acoustic quality to property value demonstrate that noise is not merely an environmental variable but an economic one. Together, these perspectives reinforce that sound influences health, equity, and urban resilience in measurable ways.

Looking ahead, advances in sensing technologies and Artificial Intelligence are redefining what is possible in monitoring and analysis. Directional systems and source specific identification allow for more precise diagnostics and more targeted interventions. Such tools strengthen enforcement and planning, but they also support a design oriented future in which we understand not only how loud an environment is, but what composes it.

As editor, I see this issue as more than a collection of articles. It represents a commitment to widening the scope of our discipline while remaining grounded in technical excellence. My own work has often engaged with the intersection of measurement, perception, and public health, and I am continually reminded that the most meaningful progress occurs when engineering precision meets human context. I hope this edition encourages that synthesis.

Thank you for being part of this community of practitioners, researchers, and policy makers. Your engagement sustains the relevance of this publication and shapes its direction. I look forward to building on this dialogue in future. ■

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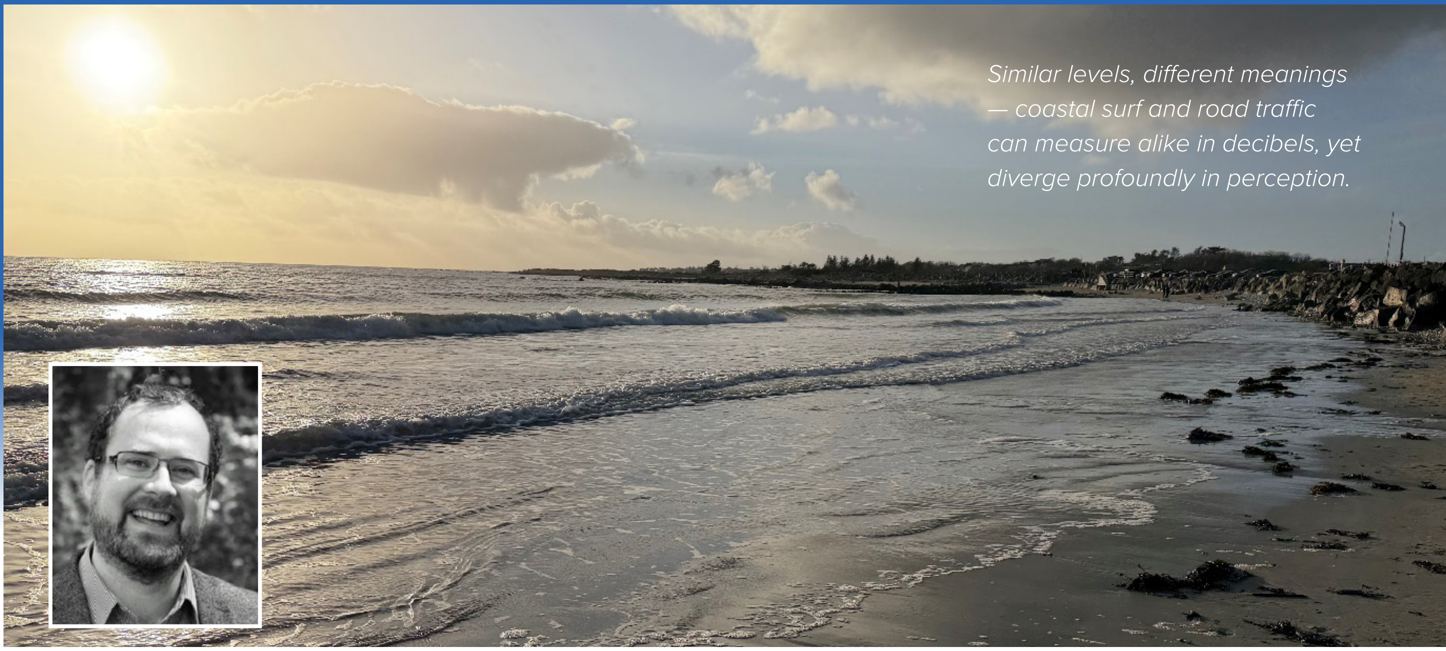

Similar levels, different meanings — coastal surf and road traffic can measure alike in decibels, yet diverge profoundly in perception.

Reframing Environmental Acoustics: Soundscapes as a Design Parameter, Not a By-Product

Prof. Eoin King, *University of Galway, Ireland*

Conventional environmental noise assessment is built on a simple but limited premise: quantify unwanted sound, compare it against thresholds, and mitigate where necessary. This model, effective in identifying harmful exposure, has nonetheless created a structural blind spot in the discipline. By focusing almost exclusively on sound levels, contemporary practice often overlooks the broader acoustic experience within which those levels are embedded.

While this exposure-based paradigm has delivered significant public health protections, its regulatory success has also entrenched an assumption that acoustic quality is reducible to energy metrics. The EU Environmental Noise Directive requires Member States to assess the need for actions on the protection of quiet areas in an agglomeration and in open country. Quiet areas in open country are not determined by sound levels alone, but rather an area, delimited by the competent authority, 'that is undisturbed by noise from traffic, industry or recreational activities', thus introducing a qualitative acoustical definition.

There is growing recognition that future acoustic assessment must evolve from compliance with a numerical limit value to include consideration of the impact of increasing sound levels or changing the character of the sound in existing acoustic environments. The emerging shift does not replace energetic indicators but repositions them within a wider, perceptually informed framework. This is where soundscape principles introduce some operational novelty: they provide a way to describe, evaluate, and design acoustic environments according to function, use, and experience, not only exposure.

This repositioning aligns with the conceptual framework established in the ISO 12913 series, which defines soundscape as the acoustic environment as perceived or experienced and/or understood by people, in context.

The Central Problem: Level-Based Metrics Cannot Define Acoustic Quality

Noise indicators such as L_{Aeq} and L_{den} quantify energy but cannot, by themselves, define the quality or appropriateness of an environment. Two environments may exhibit comparable equivalent continuous sound levels while differing substantially in perceptual character and functional suitability. The sound pressure level of road traffic noise can be approximately the same as waves crashing on a beach; even their spectral profiles may partially overlap, yet the perceptual and contextual meanings of these sounds differ fundamentally. Thus, two sites with identical exposure can differ fundamentally in perceived quality due to spectral content, temporal patterning, masking characteristics, and the intended activity in the space.

This disconnect is more than a theoretical issue, it constrains design. Level-based thresholds can reduce harmful exposure yet fail to improve, or even recognise, the acoustic performance of a space. As long as noise assessment focuses on the reduction of unwanted sound, it remains reactive, addressing deficiencies rather than shaping outcomes. In this sense, conventional practice evaluates compliance rather than performance. What is needed is not a more refined measure of unwanted sound, but a systematic way to articulate desired acoustic attributes.

Soundscapes as Functional Design Criteria

The most significant contribution of soundscape methodology is its repositioning of sound as a design parameter within the built and natural environment. Rather than treating sound as an externality to be controlled, soundscape assessment defines how an environment should perform acoustically, based on its purpose.

For example, a public plaza may require a degree of acoustic liveliness to support social interaction, a green corridor might prioritise natural sound to support restoration and biodiversity, and a transport concourse may need temporal clarity for wayfinding and information. These are not noise control problems; they are acoustic design specifications.

Framing these requirements as performance objectives situates acoustics alongside other environmental design parameters such as thermal comfort, lighting quality, and spatial legibility.

By describing acoustic environments in perceptual terms such as calmness, vibrancy, or continuity, soundscape methods provide vocabulary and metrics that better align with urban design, landscape architecture, health, and user experience. This cross-domain compatibility is a fundamental innovation. Importantly, such perceptual descriptors are not purely subjective abstractions; structured survey instruments and circumplex-based analytical models provide reproducible methods for linking experiential attributes to measurable environmental conditions.

Towards a Resource-Based Acoustic Paradigm

Perhaps the most novel shift introduced by soundscape thinking is the concept of the acoustic environment as a resource. The aim is not silence, but the appropriate acoustic conditions for the intended use of a space. This contrasts sharply with the pollutant model that views all sound as potentially problematic until proven otherwise. A resource-oriented model is proactive, enabling cities to plan for acoustic value rather than merely avoid acoustic harm.

This does not reject the pollutant model but reframes it within a dual perspective: environmental sound constitutes both exposure to be managed, and experiential value to be cultivated.

Integrating Soundscape Methodologies into Technical Practice

To embed soundscape principles within existing assessment frameworks, several methodological steps are proposed:

1. Coupling Energetic and Perceptual Metrics

Physical measurements remain essential, but they are interpreted alongside perceptual constructs derived from established psychoacoustic metrics and soundscape instruments (e.g. the ISO 12913 series on soundscapes). This coupling enables acoustic indicators such as L_{Aeq}, spectral distribution, or psychoacoustic parameters to be analysed in relation to reported perceptual dimensions such as pleasantness or eventfulness.

2. Aligning Acoustic Criteria with Spatial Function

Assessment parameters are defined according to what the environment is intended to support: conversation, recreation, focus, biodiversity, or transit. Functional alignment requires early-stage dialogue between acousticians, planners, and designers to define context-specific acoustic objectives rather than applying uniform level thresholds.

3. Introducing Acoustic Performance Targets

Rather than only limiting maximum levels, performance-driven criteria specify desirable acoustic attributes such as masking effectiveness, temporal stability, or spectral balance.

4. Embedding Assessment Early in Planning

Soundscape objectives are incorporated in the conceptual design phase, enabling integration with materials, geometry, planting strategies, and circulation patterns. Early integration reduces the likelihood that acoustics becomes a late-stage mitigation exercise and instead positions it as a formative design influence.

5. Using Participatory and Observational Data Strategically

Community input and behavioural observations enrich technical assessments without compromising their rigour, and potentially increasing social acceptance.

A Hybrid Assessment Model for the Future

The future of environmental acoustics lies in a hybrid model in which sound level indicators provide the safety baseline and soundscape metrics define the qualitative ambition. In practice, this means that dB metrics will determine compliance and health protection, but soundscape indicators would determine whether a space sounds appropriate.

Such a two-layer framework reconciles regulatory robustness with experiential nuance, offering a structured pathway from exposure control to acoustic performance design. This two-layer system might offer both robustness and nuance, making acoustic assessment not simply a regulatory exercise but a design discipline capable of shaping highquality environments. ■

Developing a noise footprint framework

Angelos Tsaligopoulos, Francesco Aletta, Gianluca Maracchini and Simone Torresin,
University of Trento

Why talk about a "noise footprint" now?

The following question may seem ridiculous. Which is louder: a highway road, a motorcycle or the rider's helmet? A product, a service, or an infrastructure can be noisy when used. Nevertheless, it is also possible that a product may be quiet in use but manufactured under very noisy conditions. Does this mean that you may unknowingly contribute to noise pollution simply by using a product? Is the user the sole party responsible for the noise produced? Noise produced "elsewhere" still matters and can be harmful in the long run and, even if it is not audible to us directly, it may be disruptive to someone else, or to wildlife far away. Environmental noise is the second largest cause of health problems behind air pollution [1] affecting quality of life and environmental integrity. Noise is a global issue, but its assessment remains local and focuses on specific exposure conditions. This approach is crucial for urban planning and noise management but fails to answer a different kind of question: **"who is responsible for noise across complex production and consumption systems?"**. With noise pollution reaching near-epidemic proportions [2], more effective approaches are needed. Instead of treating noise as an unavoidable fact of life and relying on local fixes that ignore deeper causes, a systemic shift is needed, one that aligns noise management with environmental sustainability and moves from reactive control to preventive, holistic strategies. The noise footprint framework can provide such solutions.

What is a footprint and why it matters?

Environmental footprinting has transformed how society discusses responsibility, sustainability and even everyday choices. It stands as a series of sustainability metrics, functioning as diagnostic tools that enable the detection and quantification of environmental and health impacts and support comparisons among products, services and individual actions. Footprints can be classified according to their intended use and the environmental aspect they address, such as water, energy or carbon footprints [3]. Footprints indicate an object dimension describing what the footprint analyses (i.e., "the footprint of…") and a theme dimension that describes the effects or outcomes of the footprint (i.e., "the footprint on …"). They can be classified as inventory-oriented footprints quantifying emissions in absolute terms and as impact-oriented footprints characterizing emission inventories according to their contribution to specific environmental problems

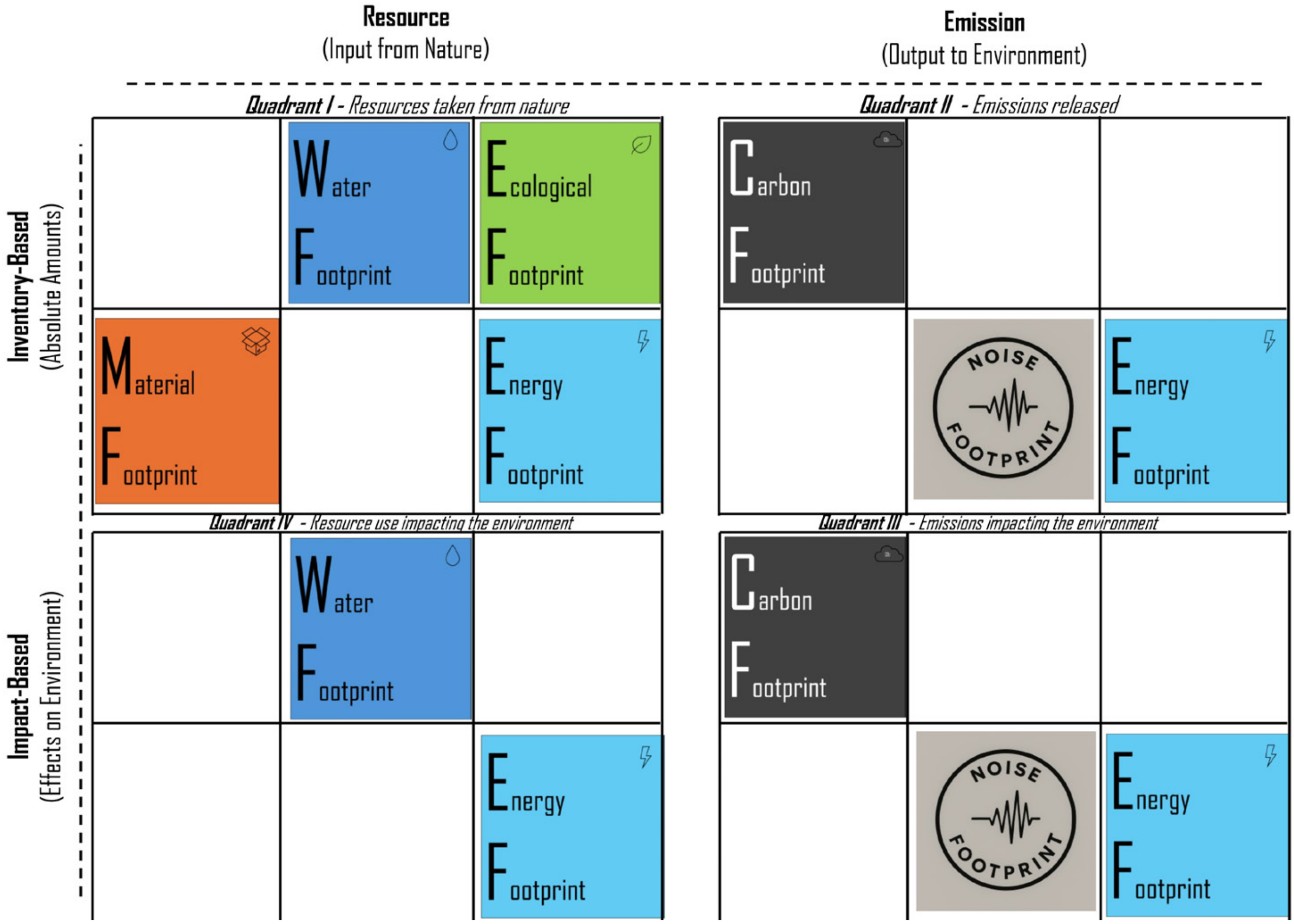

Figure 1

(see figure 1). Additionally, personal footprint calculators can motivate individuals to reduce their environmental impact, serving as awareness tools, yet they may also be perceived as mechanisms for shifting responsibility. Footprinting approaches, especially those applied to products, are often linked to Life Cycle Assessment (LCA), a method that evaluates impacts across all stages of a product or service life, from raw material extraction and manufacturing to use and end-of-life.

What is a noise footprint?

A similar logic is now emerging for noise. The noise footprint aims to extend noise assessment beyond isolated sites and single sources, by embedding noise into the structure of life cycle thinking and supply-chain attribution. The concept of a noise footprint has appeared in literature since the 1970s. It has been used mainly in aviation and underwater acoustics to describe the geographic area affected by noise. However, because the term "footprint" is intuitive, it is often used loosely to imply noise impact without life cycle thinking or broader environmental footprint logic [4]. A unified definition and quantification method are still missing. To this end, the noise footprint is still an emerging measure for assessing and communicating noise impacts. **Instead of focusing only on the noise emitted at a single location, it asks how noise is generated across the entire system that delivers a product or service.** It is a way to quantify the noise burden associated with an activity (such as mobility, construction, industrial production, or consumption), including the processes that enable it. It includes the "use phase" of a product but can also cover noise generated during raw material extraction, manufacturing, transport, installation, operation and end-of-life processes. At the product level, a noise footprint captures source–receiver dynamics and extends across entire supply chains. Rather than a single fixed metric, it is best understood as a structured indicator with two possible levels of resolution: an emission-based core inventorying the sound energy output of interconnected sources, specified by frequency band and relevant spatial and temporal descriptors, and an impact-based extension derived from that core by incorporating who or what is exposed.

Not just noise mapping

A common misunderstanding is to treat the noise footprint as a rebranding of traditional noise mapping. The two approaches are complementary but address different questions. Noise mapping is typically site-specific, exposure-driven and used primarily for regulatory compliance and mitigation planning. The noise footprint embeds responsibility and attribution across a supply chain, identifies noise “hotspots” across different stages of production, and aligns noise with sustainability accounting practices such as trade-offs and compensation [5].

Emerging opportunities

A major opportunity for the noise footprint lies in integrating soundscape thinking. Soundscape research shows that people’s experience of the sound environment shapes well-being, highlighting the value of restorative sound environments and positive auditory experiences [6]. Embedding these perceptual dimensions would allow the footprint to incorporate soundscape interventions as potential offset mechanisms, expanding the framework toward broader health and well-being benefits. The framework can also extend to non-human receptors and indoor environments and complement existing noise reporting, supporting integration of noise into wider sustainability assessments.

Funding

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Comparing the Evaluation of Noise Exposure Impact: United States vs. Europe – Environmental Noise

Jim Thompson, *President, JKT Enterprises*

Environmental noise continues to be a problem despite the best efforts of noise control engineers. There is a sharp contrast between the approach taken in Europe and the US. Maybe there are opportunities to learn from these differences.

Introduction

The approaches taken in the US and Europe to the evaluation and management of environmental noise exposure are quite different. Noise is an increasingly recognized environmental issue that affects public health, urban planning, and quality of life in both regions. The United States and Europe have established frameworks to evaluate and mitigate the impact of noise, but their approaches differ in methodology, policy emphasis, and public engagement. It is time for the US to consider the different approaches taken in Europe and possibly adopt some aspects of what is done there.

Regulatory Frameworks and Standards

In the United States, environmental noise regulation is primarily governed by the Environmental Protection Agency (EPA). The EPA's focus is on environmental noise—such as traffic, industrial, and community noise. The U.S. relies on federal guidelines, but actual regulations and enforcement often fall to state and local authorities, resulting in a patchwork of standards and practices. For all practical purposes the EPA has abandoned the regulation and enforcement of environmental noise limits.

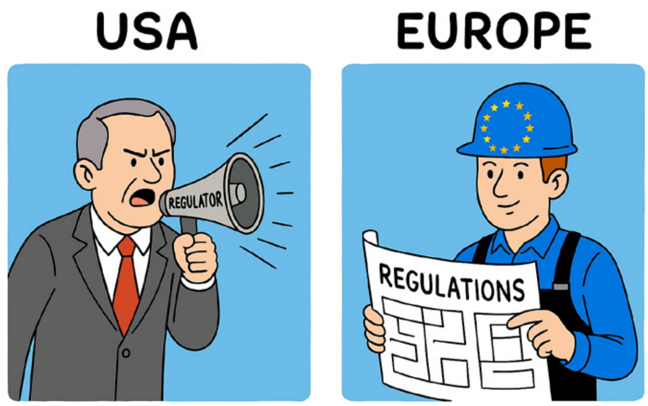
In contrast, Europe has adopted a more unified approach. The European Union (EU) has implemented directives such as the Environmental Noise Directive (END), which set common standards for monitoring and reducing noise across member states. The EU requires cities with populations above certain thresholds to produce noise maps and action plans, promoting transparency and consistent evaluation. European standards often integrate environmental, health, and quality-of-life considerations, with specific attention to vulnerable populations.

Assessment Methods and Health Impact Evaluation

The U.S. evaluation of noise impact is typically quantitative, focusing on decibel levels and their correlation with outcomes such as sleep disturbance. While there is considerable evidence of the health impact of environmental noise exposure, the health impact and the cost to society have not been explicitly addressed in the US.

Because of the lack of national standards and enforcement, local communities are often left to attempt to set noise policies and evaluate environmental noise exposure. This is difficult for most communities requiring the use of consultants and case by case evaluations. Such small scale evaluations often fail to address the broader issue of health impact and societal costs of environmental noise.

Europe takes a broader view, combining quantitative measurements with qualitative assessments of well-being. The World Health Organization's (WHO) European Region has published extensive guidelines on environmental noise, linking exposure not only to hearing loss but also to mental health, cognitive development in children, and overall life satisfaction. European evaluations often include surveys and community input to capture subjective experiences of noise, leading to more comprehensive policy responses. It is not uncommon



to see a European environmental impact assessment that includes estimates of increased illness and deaths and their cost to the community due to increased noise exposure.

Public Engagement and Policy Implementation

In the U.S., public engagement on noise issues is generally reactive, driven by complaints and localized activism. There is less emphasis on proactive education or participatory policy development. Noise abatement measures—such as barriers, zoning laws, and restrictions on nighttime activity—are applied unevenly, depending on local priorities and resources. Too often noise studies and corrective action is taken after a problem is identified. This is not to say there is no preconstruction planning and evaluation. In many cases this is done and steps are taken to reduce noise impact. However, the motivation is

typically to reduce community reaction and not exceed common standards for sleep disturbance.

In Europe, public engagement is embedded in the regulatory process. The EU Environmental Noise Directive requires authorities to consult communities when developing noise action plans. This participatory approach fosters greater awareness of noise issues and encourages collective solutions, such as quiet zones, traffic restrictions, and urban green spaces. In addition, by relating noise to health impacts and costs to the community, the public has a much different perspective than a simple concern about possible sleep disturbance.

What Should the US Do?

I am not saying that the US should just copy the European approach. I know there are many in the US who believe the European models for illness and deaths due to increased noise have not been adequately proven. I also realize taking a precautionary approach with strict limits and headlines about deaths may lead to legal battles and project delays in the US. However, helping the public to understand that excessive noise has real health consequences and providing realistic cost estimates of the impact of noise would help all to make more informed decisions. Being able to realistically relate noise to cost would go a long way to facilitating rational decisions about noise limits and community protection. It is time that we thought about the approach in the US and evaluated the lessons to be learned from our European colleagues. This seems to be part of a rational approach to treat noise as an exposure problems, instead of an annoyance.

The Future

While both the United States and Europe recognize the importance of evaluating and mitigating noise exposure, Europe's more integrated and participatory approach stands in contrast to the fragmented, locally driven system in the U.S. As urbanization and transportation networks continue to expand, understanding these differences is crucial for policymakers and public health professionals seeking to create quieter, healthier communities.

Your Thoughts

I would be interested to hear your thoughts on this topic. Is there a better way to address environmental noise that could be implemented in the US? What is the role of the EPA or the federal government? Should the estimates for increased deaths and health impact costs be incorporated in environmental noise considerations in the US? ■

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Global Best Practices in Construction Noise Monitoring

A comparative review of regulations, methodologies, and emerging trends in seven countries

Dimitri Chamard-Boudet and Christian Fogstad, *Sigicom Inc*
Dr. Stephen Hambric, *Hambric Acoustics*

Abstract

Construction activity is essential to urban development, yet it remains one of the most common sources of environmental noise complaints worldwide. As cities densify and construction projects grow in scale and complexity, the need for robust, transparent, and effective noise monitoring has never been greater.

Despite this shared challenge, countries approach construction noise in markedly different ways - shaped by local regulations, cultural expectations, and historical practices.

Drawing on insights from expert consultants in United States of America, Canada, United Kingdom, France, Germany, Monaco, and Sweden. This article presents an overview of the regulatory landscape, monitoring methods, and emerging best practices shaping construction noise monitoring today.

Context and Methodology

As an international supplier of environmental monitoring systems, Sigicom has a privileged perspective on the specificities not only of regulatory frameworks but also of the ways in which experts address this challenge in different countries. Noting the lack of literature on this topic, as well as the potential value of understanding how experts elsewhere approach similar challenges, we decided to dedicate a workshop at InterNoise 2024 (Nantes, France) to address this topic.

To ensure objective information for this study, independent experts from each country were consulted and provided with a set of questions, such as: ‘What regulations apply?’, ‘What do typical construction specifications include?’, and so forth. They were asked to focus on the majority of projects and to be as representative as possible. The aim is not to compare or rank the various approaches, but rather to open a broader reflection on these rapidly evolving issues.

Although all approaches ultimately aim to achieve the same objective, comparing different international frameworks broadens the perspective and can provide valuable tools, as well as help disseminate effective best practices.

Why Construction Noise Monitoring Matters

Across all markets, experts agree that continuous noise monitoring fundamentally improves construction project outcomes in several ways. It strengthens relationships with neighbors, reduces complaints, minimizes work stoppages, and provides legal protection for project owners. Monitoring also influences on-site behavior; workers become more conscious of noise, scheduling improves, and loud activities are better controlled.

Construction projects specifications now include requirements and limitations to prevent or minimize the discomfort of local residents. Project management in charge of realizing the demolition or construction work commits respecting those rules and regulations. As there may be financial penalties in balance, it becomes natural to control the respect of those terms, and noise monitoring is the only objective judge. But it offers way more than this, and a properly designed monitoring system is providing representative and accurate data. Those data are crucial to identify the incriminated noise sources and design the proper mitigation solution.

In short: **if you can't measure it, you can't manage it**.

A Global Patchwork of Regulations

As expected, regulations governing noise monitoring and compliance remain highly localized, and no universal international standard has yet been established. Existing regulatory frameworks range from broadly qualitative guidance documents to highly prescriptive and quantitatively defined limit criteria.

Germany, Monaco and Sweden have a quantitative regulation, including clear guidelines values:

- Monaco (ruling 2021-107) defines a unique admissible L_{Aeq} value of 85dB(A) for every situation. It adds one nuance on the Interval duration: 5 minutes when measurement is made in the neighborhood or 15 minutes if done in the construction site.
- Sweden (NFS 2004:15) and Germany (AVV Baulärm) state some guidelines values, adapted to the activity types (e.g: residential, commercial facilities, schools, hospitals, etc.) and different time periods.
- Example from Sweden: Guideline value for a residential area on weekdays / daytime, measured outdoor at the facade = 60 dB(A)
- NFS 2004:15 also gives some tolerance to adapt to the context or to the exceedance duration (e.g: if exceedance is less than 5 minutes per hour, permitted levels are raised by 10dB)
- German AVV Baulärm introduces a specific criterion dedicated to construction noise: the L_{AFTeq} value (Note: L_{AFT} is the L_{max} recorded on 5s interval. L_{AFTeq} is the energetic average of the L_{AFT} during day and night periods). This text being from 1970, the guideline values are often below the present noise background levels and get impossible to respect (e.g: L_{AFTeq} < 50dB(A) in area with only residential buildings).
- In such cases, the project management team often defers to a precedent-setting court ruling, which established the limits at 70 dB during daytime and 60 dB at night.

On the other side, France and UK have a more qualitative regulation.

- French Public Health code (Article R1336-10) states how a noise disturbance can be characterized: *"No compliance with the construction agreed operations time or the equipment used [...] The lack of appropriate precautions to limit noise from the construction site [...] Abnormally noisy behavior [...]*
- Those would be complemented in the project specifications with the "Environmentally regulated facility" regulation *(Order of 23 January 1997 on the limitation of noise emitted into the environment by installations classified for environmental protection)* stating a maximum emergence value in neighbor's property (5dB(A) on day time and 3dB(A) at night) and maximum noise values on construction site property.
- UK legislation focusses on best practicable means and gives guidance for the determination of noise limits. It is generally based upon the present ambient noise level and an admissible emergence like in France.

In the United States of America, the main national regulation focuses on protecting workers, not members of the public. The Occupational Safety and Health Administration (OSHA) Standard 1910.95 [1] specifies a permissible exposure limit. This is complimented by many local ordinances across the country showing a wide range of approaches, from vague and qualitative in some cities to one of the best known being enacted in New York City in 2012 [2]. This text defines noise limits from construction in neighboring regions, particularly during the night and early mornings.

The Federal Highway Administration (FHWA) Highway Construction Noise Handbook (August 2006) guides state transportation agencies on measuring, predicting, and mitigating highway construction noise, including a user's guide for the Roadway Construction Noise Model (RCNM). FHWA has also developed a construction noise screening tool (RCNM 1.1) and a construction noise model that is included in all versions of the Traffic Noise Model (TNM). Neither software is required for use on Federal-aid projects; however, they can be used for the prediction of construction noise during the project development, final design, and construction phases.

Table 1 summarizes the applicable regulation in each country, states if noise limits are specified and if project specifications refer to those texts.

Where to Measure: A Country-by-Country Comparison

Depending on the limitation criterion (e.g: emergence value at neighbor's facade, maximum level on site boundaries, etc.), sensor location will be adapted. Countries with guidelines values often try to measure at neighbors' location.

This has an impact on how the unit can be installed and the performance it needs to have (mounting, autonomy, resistance...).

Most common sensor placement:

- **USA:** Most often at the site boundary, or sensitive receptors
- **Canada & UK:** Most often at the site boundary
- **France:** Site boundary and neighbor's property (or light poles) are both common
- **Germany & Monaco:** Prefer measurements at the neighbor's property, often in front of windows
- **Sweden:** Façade measurement is the norm

Table 1

Country	Regulation applicable to construction site noise	Dedicated to construction?	Does it specify noise limits?	Does project specifications refer to local regulations?
USA National	OSHA 1910.95	Yes	Yes, but only for workers	No
USA Local	Many, all with varying requirements and monitoring/ enforcement	Sometimes	Sometimes	Yes
Canada	No national regulation Typically covered in city by-laws	-	-	No – noise monitoring specifications are project based
UK	Control of Pollution Act 1974 Local authority policies BS8233: Part 2 (guidance only)	No	Yes – local guidance usually does, CoPa does not	Yes – frequently include projects-based noise limits; particularly on infrastructure projects
France	Environment code Article RS571-50(Noise Law 92-1444) Public health code article R.1336-10 Local by-laws "ICPE" 23 January 1997 order	No, but referred to	No, but may state an emergence limit	Yes – however, needs to be complemented with a noise document specific to each project
Germany	AVV Baulärm Bundes-Immissionsschutzgesetz (Federal Emission Control, Act)	Yes	Yes	Yes – but noise limits often refer to the "70//60 dB(A)" court rule
Monaco	Ministerial Ruling n0 2021-107 from February 2021 Ruling to limit working hours	Yes	Yes	Yes
Sweden	NSF 2004:15 Local binding regulations	Yes	Yes	Yes

One common point across all markets is that practical on-field constraints - access, safety, urban density - often lead to compromises. In most of the studied areas, a deviation from the initial plan is often accepted as long as the proper correction calculation is performed.

What to Measure: Noise Criteria and Parameters

Whether specified by locally applicable regulations or because they arise from the customary practices of local acousticians, the noise criteria vary in all countries. Table 2 below provides the most frequently used noise parameter for construction site monitoring.

Despite the differences, several trends emerge:

- L_{Aeq} is the most frequent criterion. Long L_{Aeq} (day / night,…) enables the project to manage its allowed noise dose along the day, still tolerating some short louder periods – difficult to avoid on those types of projects. This often comes in combination with a Short L_{Aeq} to keep a representative picture of the noise level evolution during the day. The interval duration is not fixed but a consensus emerges to consider a L_{Aeq} no shorter than 5 minutes.
- Three countries (Germany, Sweden and UK) set limits on Lmax values during night period. This is to consider than even a short noise can be highly disturbing at night time, waking people asleep or creating stress.
- Germany is the only country in this study to have a criterion specific to construction noise (L_{AFTeq}). Local experts acknowledge that this may lead to confusion and make it more difficult to properly assess the levels – as it can't be compared to noise values on other applications.
- France and Monaco require to monitor 1/3 octave bands as spectral emergence and absence of pronounced tonality - because of their high annoyance effect - need to be verified too.
- Audio recordings is required in all areas. This tool remains the best to determine the noise source and conclude on construction site responsibility.

Table 2

	Most commonly measured noise parameter on construction sites							
Country	**Long LAEq (Day/Night – Specific time period)**	**Short LAEq (X sec. min)**	**Rolling LAEq (X sec. min**	**Lmax limits**	**LAFTeq**	**Spectral (1/1 or 1/3 octave bands)**	**Statistics (L90 / L10….)**	**Audio recordings**
USA (NYC, only)	Yes (Specified as 'Slow')	-	No	Yes	No	Yes	-	Yes
Canada	Yes (day/night)	Yes L_{Aeq} 10 minutes	No	Yes	No	No	Yes L_{10}	Yes
UK	Yes (day/evening/night)	Yes L_{Aeq} 5,10 or 15 minutes	No	Yes Nighttime	No	No	No	Yes
France	Yes (day/night or multiple periods)	Yes L_{Aeq} 5,10 or 15 minutes	Yes	No	No	Yes	No	Yes
Germany	Yes (day/night)	No	No	Yes Nighttime	Yes Day/ Night	No	No	Yes
Monaco	No	Yes L_{Aeq} 5 or 15 minutes	Yes	No	No	No	No	Yes
Sweden	Yes (day/evening/night)	No	No	Yes Nighttime	No	No	No	Yes

CONSTRUCTION SITE FENCE / PROPERTY LIMIT

LIGHT POLES (PUBLIC AREA)

SURROUNDING FACADES / WALL

NEIGHBOR'S PROPERTY

The Data Challenge: Volume, Storage, and Interpretation

Measuring noise 24/7 with inappropriate settings can generate large data quantity that doesn't always bring project management benefits. Data storage impact, communication cost, data processing, and calculations are among the difficulties that can be created by this downside.

Several factors have a direct impact on the quantity of data: measured criteria, interval duration, hardware used, threshold for audio recording, etc.

The number of audio recordings is certainly the main reason for extreme situations with several GB of data processed every month. One of the reasons could be that the audio recording trigger value is often not specified in the project specifications. In some countries, consultants would use the L_{Aeq} limit to trig a recording – potentially leading to hundreds of audio clips per day.

- France and Canada may produce hundreds of audio clips per day
- Monaco, with its generic high limit of 85dB(A), generates fewer alerts
- A single sound level meter can exceed 10 GB of data per month

Consultants note that reviewing every audio file becomes impossible on large projects. This is driving rapid adoption of AI-based audio classification and smarter alerting systems.

The Impact of Monitoring on Project Outcomes

Experts from all the countries studied agree on the benefits provided by noise monitoring and consistently report the following gains:

- reduces complaints
- prevents unnecessary work stoppages
- improves neighbor relations
- supports transparent communication
- helps verify or dismiss noise related claims
- encourages quieter onsite behavior

For all those reasons, monitoring is no longer seen as a burden and is increasingly viewed as best practice that simplifies project management.

Field monitoring also provides the required input data to recalibrate the noise calculation models and helps design the required treatments.

Emerging Trends and Innovations

Although noise monitoring around construction sites has existed for several decades in some countries, recent advances in the technologies employed, together with the evolving expectations of both experts and residents, are driving rapid evolution within the entire sector.

Key Trends

- **Web platforms** enabling real-time public communication
- **More sophisticated noise limits** with multiple time periods and variables to adapt to the specific contexts

- **Battery optimized, wireless monitoring stations** for long-term deployments with minimal on-site maintenance
- **AI-powered audio recognition** to classify noise sources

These innovations are reshaping how consultants, contractors, and authorities manage construction noise. The cost reduction of the monitoring stations, and their improvement in terms of installation capacities - autonomous, wireless... - allows to increase the number of measuring points on each project. This helps get a clear picture of the situation and measure it at every sensitive point.

Conclusion

Construction noise monitoring is now widely recognized as a standard practice at the global scale. Despite significant variations in regulatory approaches, ranging from qualitative recommendations to strict quantitative limits, the core objectives are shared:

- protect communities
- support responsible construction
- ensure transparency
- reduce conflict
- improve project efficiency

Every country relies on its own methodology, shaped by local context and expectations. Yet the global trend is clear: better data, better communication, and better technology produce better projects!

As cities continue to grow, the industry will benefit from ongoing collaboration, shared best practices, and continued innovation in monitoring tools and methodologies.

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- Canada: Chapter 591 of the City of Toronto Municipal Code

UK

- The Control of Pollution Act 1974: Sections 60 and 61
- BS5228: Code of practice for noise and vibration control on open construction site - Part 1 Noise

France

- Noise Law n°92-1444 from December 1992
- Public Health code
- Order of January 1997 relating to the limitation of noise emitted into the environment by installations classified for environmental protection

Germany

- Bundes-Immissionsschutzgesetz – Federal noise Immision Act
- AVV Baulärm (August 1970)

Monaco

- Ministerial ruling 2021-107 from February 2021 relative to construction noise

Sweden

- Swedish Environmental Protection Agency's general advice on noise from construction sites (NFS 2004:15) ■

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Typical traffic condition on Indian streets. (source: author)

Road Traffic Noise, Public Health, and the Urgent Case for India

Dr. Manish Manohare, *Assistant Professor, Indian Institute of Technology, Delhi*

Noise pollution is increasingly recognised as a major environmental determinant of health. While air pollution receives sustained policy attention, environmental noise remains comparatively under-prioritised despite mounting scientific evidence of its impact. Road traffic noise, in particular, has emerged as one of the leading environmental stressors in urban settings. In global burden assessments, it ranks second among environmental risks in terms of health impact in many developed regions (World Health Organization [WHO], 2011).

India's rapid urbanisation, expanding vehicle fleet, and heterogeneous traffic systems have created complex and high-intensity acoustic environments. Yet systematic assessment of noise-related health burden in India remains limited. Understanding the scale of risk requires first examining what global evidence reveals about the relationship between noise and health.

Noise and Health: The Scientific Evidence

The health impacts of traffic noise are broadly classified into auditory and non-auditory effects. Auditory impacts include noise-induced hearing loss, tinnitus, hyperacusis, and speech interference. Sustained exposure above 85 dB for prolonged durations can cause permanent hearing impairment. However, in environmental contexts, the more pervasive impacts are non-auditory (Figure 1).

Chronic exposure to traffic noise activates stress-response systems. Repeated stimulation of the autonomic nervous system and the hypothalamic-pituitary-adrenal axis leads to elevated cortisol levels, increased blood pressure, endothelial dysfunction, and long-term cardiovascular strain (Babisch, 2014; Münzel et al., 2018). Over time, this physiological activation increases the risk of hypertension, ischaemic heart disease, stroke, and metabolic disorders.

The World Health Organization estimates that more than two billion people worldwide are exposed to environmental noise above 55 dB, a level associated with adverse health outcomes (WHO, 2018). In Europe, environmental noise contributes annually to approximately 61,000 disability-adjusted life years (DALYs) due to ischaemic heart disease, 45,000 due to cognitive impairment in children, 903,000 due to sleep

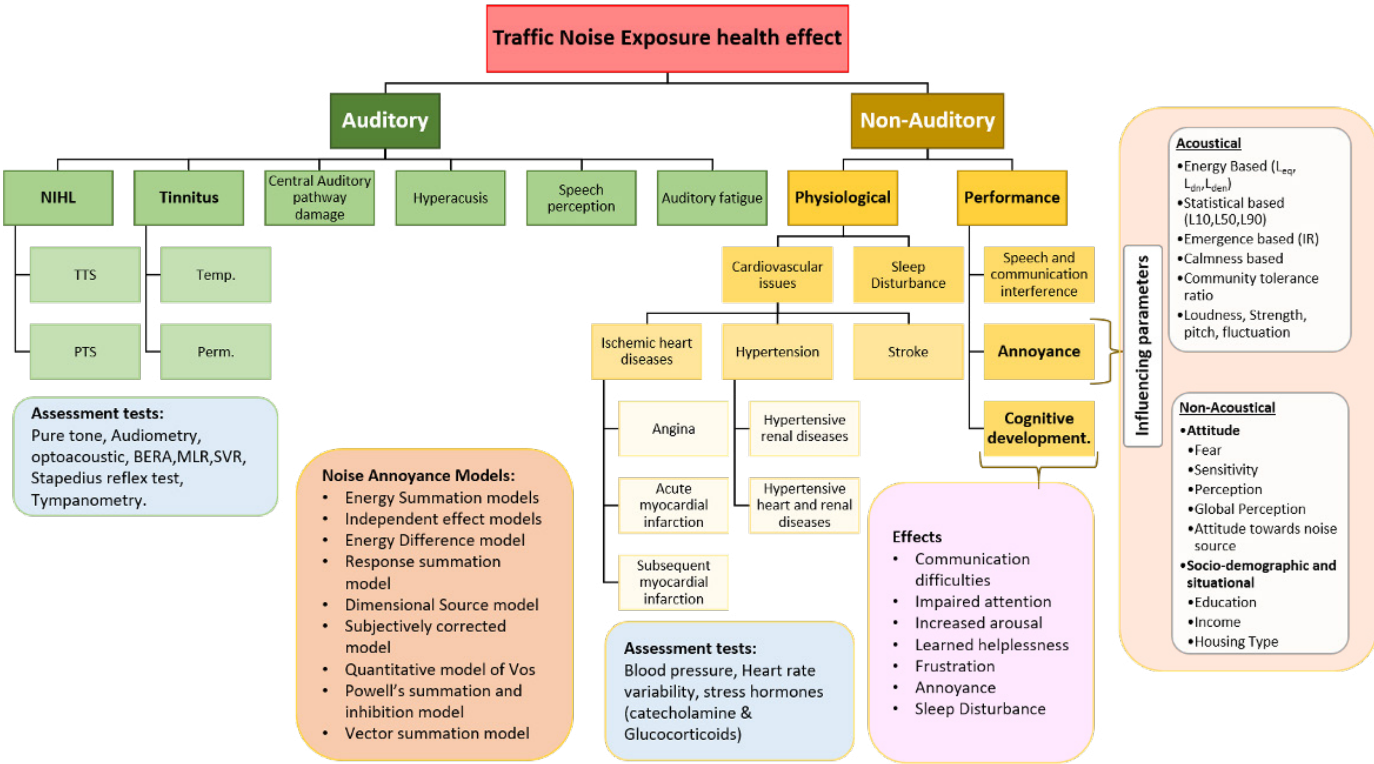

Figure 1: Traffic Noise and its Health impact (Image adopted from Manohare, M., Rajasekar, E., Parida, M. & Vij, S. (2022). Bibliometric analysis and review of auditory and non-auditory health impact due to road traffic noise exposure. Noise Mapping.)

disturbance, and 654,000 due to annoyance (WHO, 2011). The European Environment Agency estimates around 10,000 premature deaths annually linked to environmental noise exposure (European Environment Agency [EEA], 2020).

Sleep disturbance is a particularly important pathway. Night-time noise exposure above 55 dB has been linked to fragmented sleep architecture and reduced restorative sleep (WHO, 2009). Chronic sleep disruption contributes to obesity, diabetes, impaired immunity, and reduced cognitive performance. Evidence also suggests that even small reductions in environmental noise can yield measurable health benefits. In Madrid, a 1 dB reduction in traffic noise was associated with 200 to 300 fewer deaths annually from cardiovascular and respiratory causes (Recio et al., 2016).

Exposure-response relationships have been fundamental in quantifying these risks. Schultz (1978) first synthesised social surveys to model the relationship between noise exposure and community annoyance. Miedema and Oudshoorn (1998) later refined these relationships using the Lden metric to estimate the percentage of highly annoyed populations. These models underpin modern noise policy and burden-of-disease calculations in Europe.

The scientific consensus is therefore clear: environmental noise is biologically active, cumulative in effect, and associated with measurable health outcomes.

Severity of the Noise Scenario in India

If European cities, operating under regulated traffic systems, experience such burdens, the implications for India are significant. Indian urban traffic differs fundamentally from homogeneous Western systems. It is characterised by heterogeneous vehicle fleets, irregular acceleration and braking patterns, minimal lane discipline, and pervasive horn usage. These features create highly variable, impulsive, and spectrally complex sound environments.

The United Nations Environment Programme identifies road traffic as the dominant contributor to urban noise in Indian cities. Several studies recorded peak levels in cities such as Moradabad (114 dB), Kolkata (89 dB), Jaipur (84 dB), and New Delhi (83 dB) substantially exceed WHO recommended thresholds and India's Central Pollution Control Board (CPCB) limits. CPCB guidelines prescribe 65 dB(A) for commercial areas and 55 dB(A) for residential areas during daytime, yet violations are frequently documented.

Figure 2: Noise measurement in New Delhi, (source: author)

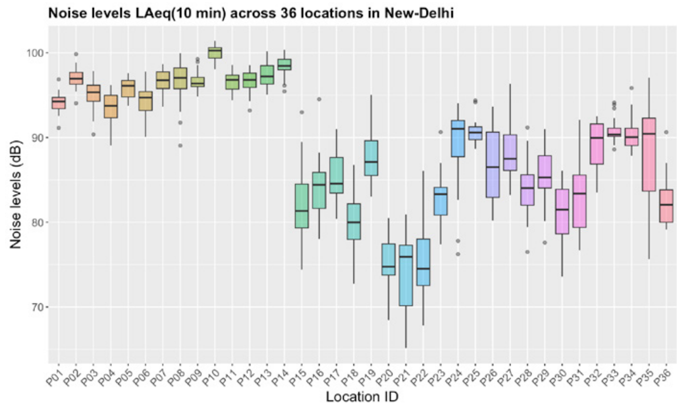

Figure 3: Noise levels across different location in New-Delhi, India (source: author)

Community-level studies illustrate the magnitude of exposure. Agarwal and Swami (2011) reported equivalent continuous sound levels between 73 and 86 dB(A) across surveyed locations in Delhi. Within this population, 52 % reported frequent irritation, 46 % reported hypertension, and 48.6 % reported sleep disturbance. These prevalence rates suggest that noise exposure may be contributing significantly to cardiovascular and stress-related conditions in Indian cities.

In addition to previously reported surveys, daytime field measurements conducted by the author across multiple arterial and sub-arterial streets in New Delhi (Figure 2) show that most monitored locations recorded equivalent sound levels well above CPCB permissible limits (Figure 3). The spatial distribution of these measurements highlights persistent exceedance across commercial corridors and mixed residential zones, reinforcing the chronic nature of urban exposure conditions in the capital city.

Importantly, conventional energy-based metrics such as LAeq may not adequately capture the health-relevant characteristics of heterogeneous traffic noise. Research in Indian contexts demonstrates that psychoacoustic parameters such as loudness, sharpness, and roughness may better explain perceived annoyance and physiological response (Manohare et al., 2022). Experimental studies incorporating psychophysiological monitoring have observed measurable reductions in heart rate variability during exposure to heterogeneous traffic noise, indicating autonomic imbalance and stress response activation.

Short-term exposure studies further reinforce these findings. Environmental noise can trigger immediate physiological responses including increased heart rate and skin conductance (Rylander, 2004; Li et al., 2023). Individuals with high noise sensitivity show amplified responses under identical exposure conditions (Stansfeld et al., 2021). These findings are particularly relevant in dense Indian urban environments where populations are exposed not only during transit but continuously in residential settings located directly adjacent to arterial roads.

Despite these indicators, India lacks comprehensive longitudinal cohort studies linking traffic noise exposure to cardiovascular morbidity or mortality. Noise mapping efforts often rely on adapted European prediction models that may not fully represent heterogeneous traffic dynamics. Consequently, national burden estimates remain uncertain.

Policy and Intervention Pathways

Addressing noise pollution in India requires a multi-layered approach spanning research, regulation, planning, and public awareness.

First, India-specific noise emission and propagation models must be developed. Heterogeneous traffic systems require prediction frameworks that account for mixed vehicle categories, acceleration variability, and horn events. Without accurate exposure mapping, prioritisation and intervention planning remain weak.

Second, systematic urban noise monitoring networks should be established. Continuous monitoring, rather than periodic spot measurements, can provide actionable data for municipalities and regulatory agencies.

Third, vehicle noise emission standards must be strengthened and enforced. This includes regulation of horn design and usage. Transitioning toward electric mobility, particularly in public transport and two-wheeler segments, offers long-term noise reduction benefits at urban speeds.

Fourth, urban planning policies should incorporate acoustic considerations. Setback distances for residential developments near major corridors, façade insulation standards, and barrier designs must be integrated into development control regulations.

Fifth, health surveillance systems should incorporate environmental noise exposure metrics. Integrating noise exposure into cardiovascular and metabolic disease research will allow more accurate burden estimation and targeted interventions.

Finally, public awareness is essential. Noise is often perceived as an unavoidable by-product of urban life. Framing it as a preventable health risk can catalyse behavioural change, including reduced horn usage and community-driven monitoring initiatives.

Conclusion

The global evidence is unequivocal: road traffic noise contributes to cardiovascular disease, sleep disturbance, cognitive impairment, and hearing loss. In India's dense and heterogeneous urban environments, exposure levels frequently exceed recommended thresholds. Emerging national research indicates measurable physiological stress responses under such exposure conditions.

Noise pollution is not a minor urban inconvenience. It is a structural environmental health risk. As India continues to urbanise and motorise, the acoustic burden will intensify unless addressed through coordinated scientific, regulatory, and planning interventions.

Recognising noise as a public health priority is the first step. Acting upon it with data-driven policy and context-specific solutions is the necessary next step.

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Urban Noise Management in Ecuador: From Citizen Complaints to Noise Maps

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Noise is easy to ignore by day. At night, it becomes personal. Ecuador's 2015 rules opened the door to noise mapping. Now maps must become action.

A city is supposed to soften at night. The light changes, voices fade, and the body prepares for rest. Yet in many Ecuadorian neighborhoods, the calm never fully arrives. A motorbike accelerates outside. A bus brakes hard at the corner. A horn cuts through the dark. Sleep becomes a struggle.

When this happens repeatedly, people adjust. They close windows and switch rooms. They wake up tired and carry it into school and work. And, sooner or later, someone reaches a limit and decides to report it.

That is how noise management has often worked in Ecuador: complaint, inspection, warning, and sometimes a fine[1]. This work matters, because it protects people in the moment. Complaints are not a map of exposure. They show where frustration is loudest, not where risk is highest. They also depend on who feels safe to complain, who has time, and who expects a response.

So Ecuador has been building a second lane alongside enforcement: noise mapping. Mapping turns sound into a living landscape. It shows where noise concentrates, where quiet exists, and how many people are exposed specially at night, when the cost is paid in sleep.

A Decade of Rules—And Too Many Noisy Nights

Ecuador's national framework for environmental noise has been in force since 2015. It does more than set permissible levels. It also assigns responsibility. In particular, it places the duty to elaborate environmental noise maps on municipal governments once they reach a population threshold. It also frames the first stage around the main roads, where traffic often dominates.

Ten years is enough time to learn a hard lesson: a rule is not the same as a system. Rules define limits and methods. A system adds routines, capacity, budgets, and follow-up. It makes progress repeatable, even when administrations change. That is why the question is shifting from

1 https://ambato.gob.ec/municipio-de-ambato-refuerza-control-y-prevencion-de-contaminacion-acustica/

“Should we map?” to “How do we map, act, and validate outcomes?”

Table 1 lists municipalities above 250,000 inhabitants. It also shows that the country already has local experience to learn from.

Note: * indicates a commissioned noise map. ‡ Research academic project

City	Population in 2022	Year Noise map commissioned
Guayaquil *	2.746.403	2020
Quito Metropolitan District *	2.679.722	2019‡, 2025
Cuenca *	596.101	2012 – 2024
Santo Domingo	441.583	-
Ambato *	370.664	2019
Portoviejo	322.925	-
Machala	306.309	-
Durán	303.910	-
Manta	271.145	-
Riobamba	260.882	-
Loja *	250.028	2022

Table 1. Municipalities above 250,000 inhabitants (Census 2022)

What a noise map really is

A noise map is not just a “pretty picture.” It is a decision tool. Because it is spatial, it can connect three issues: health, mobility, and economics.

In Ecuador today, three approaches appear most often, and they are increasingly combined. Some projects use predictive traffic modelling. They estimate noise across a grid using road data, traffic volumes, speeds, and the share of heavy vehicles, and then they check results with field measurements[2]. Other projects start from measurements at many points and use GIS methods to estimate values between locations[3]. A newer approach adds sensor networks, so trends can be tracked over time[4]. That makes it easier to ask a question that matters to residents: did the street become quieter after an intervention?

Health begins at night

Noise becomes urgent when it enters the home, and it becomes serious when it enters the night. Night-time noise disrupts sleep and recovery. Attention and learning suffer. Mood changes. Safety can suffer. Over time, health risks rise.

That is why mapping should not stop at decibels. It should translate sound into exposure: who lives above key thresholds, and how many people are likely to face high annoyance or sleep disturbance. Once a city can see those patterns, the debate changes. It moves away from “who is complaining?” and toward “who is being exposed?”

Mobility has a sound

The hopeful part of this story is that urban noise is not fate. It is design, behaviour, and policy.

Traffic noise is shaped by more than vehicle counts. It depends on stop-and-go flow, heavy vehicles, speed, road surface, and street geometry. In dense corridors, reflections can amplify what people hear at street level and inside homes. Because of this, mobility policy can deliver a noise dividend.

Speed management near residential areas can reduce peaks and improve safety. Heavy-vehicle routing or time windows can protect sleep. Smoother intersections can reduce harsh acceleration and braking. And stronger public transport can reduce vehicle volume in sensitive areas. In short, noise can become a mobility performance metric.

Quiet has economic value

Noise is an urban externality. The person generating it is not always the person paying its cost. The cost shows up as stress, poor sleep, and reduced productivity. It also shows up in health.

Ecuador already has evidence using willingness-to-pay methods, showing that residents value noise reduction. This does not mean quiet should become a luxury[5]. Rather, willingness-to-pay evidence —one estimate suggests roughly US$12 per household per year to reduce traffic-noise annoyance— can help decision-makers compare options and justify budgets, especially where exposure is highest[6].

2 https://doi.org/10.1016/j.cstp.2018.12.006
3 https://jcaa.caa-aca.ca/index.php/jcaa/article/view/4155
4 https://ierse.uazuay.edu.ec/proyectos/mapaRuido/
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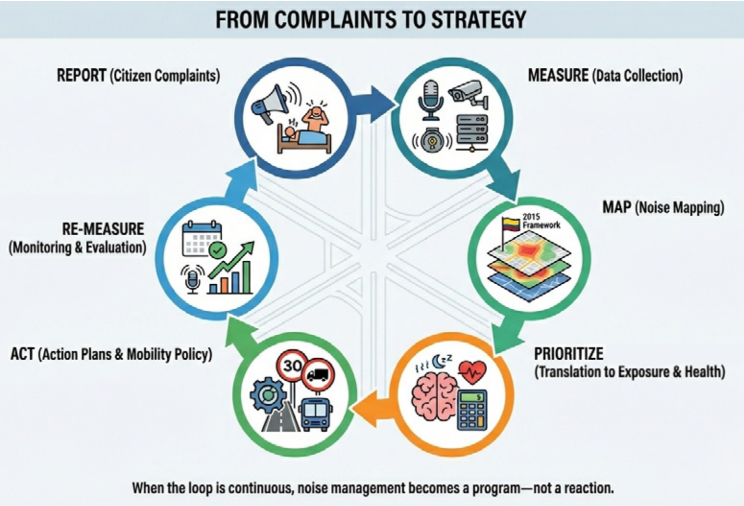

Figure 1. Closing the loop for better noise management.

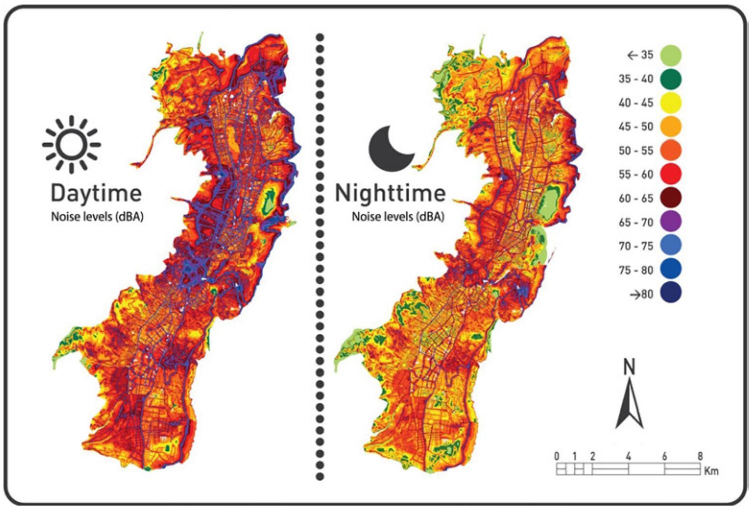

Figure 2. Traffic noise map of the urban area of Quito. Research project 20192

Strengthening the 2015 framework: from rules to a system

Ecuador's next challenge is to move from reactive enforcement toward a preventive system. Important gaps remain in standardization, enforcement consistency, and technical training. For that reason, noise maps should not become an end in themselves. They should trigger measurable action plans.

In the near term, Ecuador needs a unified national approach. The goal is practical: align planning across cities, standardize technical instruments, and strengthen coordination between national and local authorities. At the same time, capacity must grow. Training pathways, and clear protocols are essential, especially when decisions affect homes, schools, and hospitals. Transparency and public participation should be built in from the start.

Equally important, the map-to-plan conversion should become legally obligatory. Action plans would set priorities, budgets, timelines, and responsible institutions, and they would be reviewed on a regular cycle. They should include a catalogue of measures—from quieter pavements and acoustic screens to time limits for noisy activities—plus health and social impact evaluation and shared financing.

Finally, Ecuador's next mapping cycles should broaden their scope. Traffic is a sensible starting point. Yet updates should increasingly represent other dominant sources, including industrial activity and leisure and entertainment, so the map reflects the lived soundscape of a city, not only its roads.

If Ecuador strengthens these pieces, the story becomes coherent. Enforcement protects people today. Mapping protects people tomorrow. And action plans, updated and monitored, can help the city give the night back to its residents. ■


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Road Traffic Noise as an Environmental Reality in Algerian Cities

Dr. Boulemaredj Ali, Dr. Meribai Amine Mehdi, *Université Badji Mokhtar de Annaba, Algeria*

Cities are designed to allow for mobility so that industries can function, people can commute, and goods can move around. Traffic is a sign of economic vitality, but when mobility devolves into uncontrollably loud noise, the city starts to lose something vital: tranquility.

Road traffic noise is frequently considered as irritation, it is actually a persistent environmental contaminant. Although it doesn't leave any outward signs like air pollution, it permeates homes, schools, and hospitals on a daily basis. Environmental noise is a significant public health concern, according to the World Health Organization, which also links prolonged exposure to auditory and non-auditory effects. This problem has gotten worse in Algeria due to the country's rapid urbanization and rising car ownership.

Legal Framework Background

Since the 1980s, Algeria has created a significant body of laws pertaining to public health and the environment. Road traffic laws contain clauses pertaining to vehicle compliance, and executive decrees specify the highest permissible noise levels. More recently, state rulings prohibiting the movement of loud sports cars and big-engine motorcycles at night were enacted by local governors.

A number of wilayas addressed public complaints in 2023 and 2024, like the state Decision No. 2485 and 2486 in Annaba that targeted sports vehicles and motorcycles larger than 125 cm^3, especially those with modified exhaust systems. As a deterrent, temporary impoundment was implemented. These actions send a clear message that excessive noise is no longer acceptable in urban settings. However, the crucial question still stands as to whether reactive limitations by themselves can result in long-lasting change.

Reactive Control Limitations

Extremely noticeable behaviors like abrupt acceleration and modified exhaust systems intended to enhance sound are addressed by nighttime bans. Road traffic noise, however, is not limited to these cars. The overall sound burden is increased by aggressive driving, loud car audio systems, heavy trucks passing through residential areas, and poorly maintained buses.

Another challenge is measurement. Without conducting a systematic on-site decibel verification using calibrated sound level meters, the term "noisy vehicle" is frequently used. Thus, legal robustness and consistency are compromised when enforcement relies heavily on auditory judgment.

Road noise is also a continuous environmental exposure shaped by traffic density, vehicle speed, road surface materials, and urban layout. Restricting circulation during specific hours may reduce peak disturbance, but it does not resolve daytime exposure or structural planning issues such as major traffic corridors running alongside dense housing.

From Implementation to Prevention

The response must go beyond fines if road traffic noise is considered an environmental pollutant. Better planning, measurement, and prediction are necessary for prevention.

Predictive analysis is now more widely available thanks to digital online tools, like Environmental calculator RIGO, CoRTN and the NZTA road noise calculator, which permit planners to make sound level estimates based on distance, surface type, traffic volume, and speed. These tools are frequently open-access and reasonably friendly-user. By incorporating them into municipal planning, authorities would be able to foresee acoustic effects prior to the implementation of infrastructure decisions.

Additionally, noise mapping ought to become standard procedure. Targeted action, such as lowered speeds, better road surfaces, or clever barriers, is made possible by identifying acoustic hotspots. Lowering speed limits in residential areas can greatly reduce perceived annoyance and overall exposure, according to international experience.

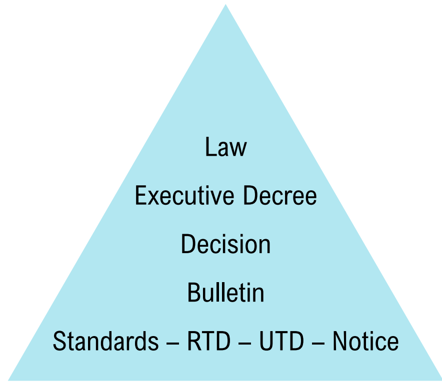

Figure 1. regulatory texts hierarchy in Algeria (Authors)

Systems for inspecting vehicles are equally important. One of the most severe causes of peak noise events is still illegal exhaust modifications. Instead of responding after a disturbance occurs, strengthening acoustic compliance within routine technical inspections would address the issue at its root.

Learning from Innovative Monitoring: The Medusa Example

Technology can increase the accuracy and fairness of enforcement. Bruitparif created "La Méduse," an acoustic monitoring system, in Paris. This gadget locates and detects extremely noisy cars in real time by combining cameras and directional microphones. The source can be

Table 1. Overview on Algerian national regulation on road noise control

Regulation title	Source	Date
Executive Decree No. 93-184 relating to noise emission thresholds	JORA, No. 50	published in July 1993
Law No. 01-14 concordant with the organization, security and policing of road traffic	JORA, No. 46	published in August 2001
Law No. 03-10 relating to environmental protection within the framework of sustainable development	JORA, No. 43	promulgated in July 2003
Executive Decree No. 03-410 setting out thresholds for emissions of smoke, toxic gases and noise from motor vehicles	JORA, No. 68	published in 2003
Executive Decree No. 04-381 on road traffic rules	JORA, No. 76	published in November 2004
Law No. 17-05 amending and supplementing Law No. 01-14 of August 2001, corresponding to the organization, security and policing of road traffic	JORA, No. 12	promulgated in February 2017
State Decision No 1123	Wali of Algiers	Published in 23^{th} April 2023
State Decision No 2485	Wali of Blida	Published in 23^{th} April 2023
State Decision No 2586	Wali of Annaba	Published in 23^{th} April 2023
State Decision No 1497	Wali of Setif	Published in 20^{th} April 2024

accurately identified when predetermined thresholds are exceeded.

Subjectivity would be decreased in Algerian cities by using similar strategies. Automated acoustic detection systems have the potential to assist in identifying offenders and supplement conventional patrols. Especially in cities with a shortage of human resources, such technology increases transparency and makes enforcement more data-driven.

The Rise of Artificial Intelligence

Artificial intelligence is having a wider effect on how we manage the environment. AI systems can look at big data sets that include traffic flow, vehicle types, speed, weather, and the shape of the city to help control noise. Machine learning models can predict when, where and how much noise peaks are likely to happen by looking at past patterns.

Because of this ability, the authorities can expect problems instead of waiting for complaints. AI-driven noise maps can update dynamically instead of remaining static for years. This flexibility is very important in cities that change quickly.

When combined with acoustic sensors, AI can tell the difference between normal traffic noise and unusual sounds, like modified exhaust bursts or very fast acceleration. It gives monitoring systems like the Medusa model more analytical intelligence. Urban planners can also use AI simulations to see how changes like slowing down traffic or changing its route will affect the sound before they happen. Regulation is not replaced by artificial intelligence, but it makes it stronger by making it more accurate and efficient.

Bridging Law and Urban Reality

Algeria's laws show that they know that noise from vehicles on the road is a public issue. Recent decisions by the state show that they are listening to people, but there is still a gap between what the law says and what people hear every day.

To close this gap, we need measurable standards, calibrated equipment, predictive tools, new ways to monitor sound, and better ways to include sound criteria in city planning. Web-based calculators can help in predictions. Automated systems can empower the enforcement. AI can aid with planning for the long term,

Figure 2. La Méduse device deployed in Ile-de-France municipality (BruitParif)

and more thorough vehicle inspections may stop serious violations.

Noise from transportation means doesn't have to be a cost of development, it can be measured, changed, and predicted gradually. To manage it well, we need to move from isolated restrictions to a preventive and data-driven approach. As a whole and without blocking mobility, urban tranquility can be achieved and public health won't be compromised in Algerian cities.

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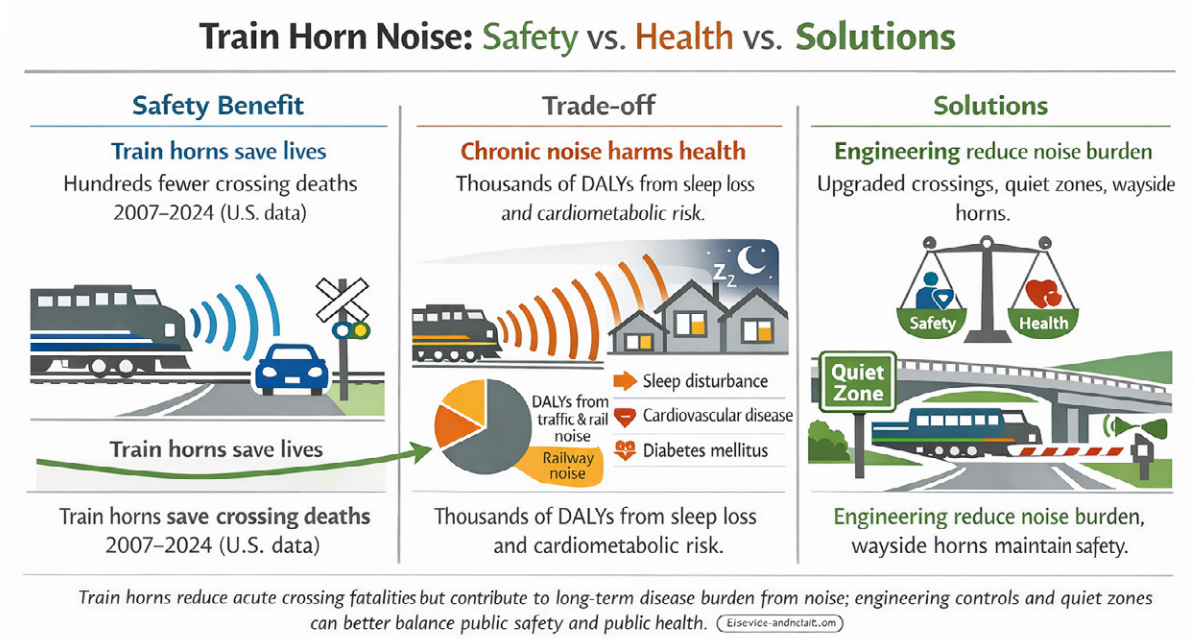

Train Horns Save Hundreds of Lives, Yet Kill Thousands from Noise Exposure

Douglas J. Leaffer, *PhD, PE, WELL Sound Advisory, International Well Building Institute*

Abstract

Fatalities at US railroad crossings decreased by several hundred (2007-2024), attributable in part to Federally-mandated train horns at crossings. Yet sleep disturbance from railway noise contributes significantly to the burden of disease, causal to thousands of disability-adjusted life years (DALY). Significant associations between rail noise and sleep disturbance, diabetes mellitus (DM), and cardiovascular disease mortality are well-cited in the epidemiological literature. Many communities have updated their crossings for safety or built over or under to deconflict road and train traffic. Far more rail crossings need upgrades to keep the community safe and allow for quiet zones to be established. Despite some improvement in rail crossing safety statistics, the estimations of DALY attributed to road traffic and railway noise indicates a significant contribution to the disease burden. More research is needed to support a balance of community safety and public health equities of these factors.

Introduction

The Train Horn Rule was created following an increase in US train collisions in the late 1980s at certain highway-rail grade crossings where nighttime whistle bans had been established, according to the Federal Railroad Administration (FRA)[1]. In 1994, Congress ordered the FRA to enact federal regulations requiring train horns to be sounded at all public highway-rail grade crossings, of which there are over 200,000 in the US. By 1996 a vehicle-train crash occurred in the US nearly every 90 minutes. Further, at those crossings where train horns were not sounded (including gated crossings), motorists suffered an 84 percent increased likelihood of being hit by a train [2].

Thirty years on, evidence presented by the National Safety Council (NSC) is clear: fatalities at railroad crossings decreased (2007-2024), attributable in part to implementation of Federally-mandated train horns[3]. Despite this favorable trend, sleep disturbance from railway noise contributes significantly to the burden of disease, causal to thousands of disability-adjusted life years (DALY), according to a leading occupational

Deaths in railroad incidents, United States, 2007-2024									
						Employees on Duty		Passengers on Trains	
		Highway-Rail Crossing Incident?		Occuring In Other Than Highway-Rail Crossing Incident		At Highway-Rail Crossing?		At Highway-Rail Crossing?	
Year	Total	No	Yes	Trespassers	Other	No	Yes	No	Yes
2007	851	512	339	470	42	16	1	5	0
2008	804	514	290	457	57	23	3	24	0
2009	695	447	248	416	31	16	0	3	0
2010	735	474	261	441	33	20	0	3	0
2011	681	435	246	399	36	15	6	2	4
2012	669	438	231	405	33	15	1	5	0
2013	702	470	232	427	43	13	1	6	0
2014	767	505	262	469	36	10	0	4	0
2015	749	512	237	450	62	11	0	10	5
2016	761	506	255	468	38	14	0	2	0
2017	817	546	271	505	41	11	0	9	0
2018	793	536	257	499	37	16	1	6	0
2019	849	558	291	530	28	8	1	1	0
2020	729	535	194	506	29	8	2	2	0
2021	849	617	232	578	39	10	1	6	0
2022	906	631	275	601	30	10	0	3	4
2023	967	722	245	690	32	6	1	1	0
2024	954	691	263	663	28	5	3	1	1

Source: Federal Railroad Administration, compiled on July 14, 2025.
Note: Passenger cases include all circumstances, including getting on/off standing trains, stumbling aboard trains, assaults, train incidents, crossing incidents, etc.

Table 1 Deaths in US Railroad Incidents (2007-2024)[3]

health study. Significant associations between rail noise and sleep disturbance, diabetes mellitus (DM), and cardiovascular disease mortality are well-cited in the epidemiological literature.

The train noise problem nevertheless continues to present public health risk, as do the public safety issues at rail crossings. In 2024, of the total 954 deaths reported by the National Safety Council (NSC), 27% occurred at rail-crossings. This article examines the safety and health statistics and presents suggestions for balancing of the public safety and public health equities for protection of human lives.

Methods

We reviewed National Safety Council (NSC) statistics on US deaths and non-fatal railroad incidents (2007-2022) and epidemiological data from several recent (2017 – present) occupational and environmental health studies and meta-studies detailing contributions of road traffic and railway noise to the burden of disease and to disability-adjusted life years (DALY). Statistics from these studies were evaluated to frame a more complete assessment of the factors, both positive and detrimental, affecting safety and health outcomes of persons involved in rail-crossing incidents and others chronically exposed to railway noise.

Results

Table 1 presents a summary of year-over-year fatalities in US railroad incidents, 2007-2024. Despite pronounced interannual volatility, deaths at railroad crossings increased modestly from 851 (2007) to 954 (2024), corresponding to a long-term average rate of approximately +0.7% per year. More recently, from 2020 to 2024, fatalities at highway-rail crossings increased by an average annual rate of 8% (NSC), while overall (total) deaths increased nearly 3% on average in the ten years since 2015.

Figure 1 presents long-term trends in both deaths and nonfatal injuries in US railroad incidents over the same time period (2007 -2024). The ratio of railroad-related deaths to nonfatal injuries and illnesses is about 1:7. Of the 3,494 nonfatal occupational railroad injuries and illnesses reported in 2024, 76 were attributed to highway-rail crossing incidents. Nonfatal injuries totaled 6,542, a 3% decrease from the 2023 revised total of 6,768. From 2023 to 2024, fatalities at highway-rail crossings increased 7%, while fatalities involving other types of incidents decreased 4%. Trends for both deaths at railroad crossings (-1.5%) and injuries and illnesses (-2%) at crossings have minimally decreased since 2007.

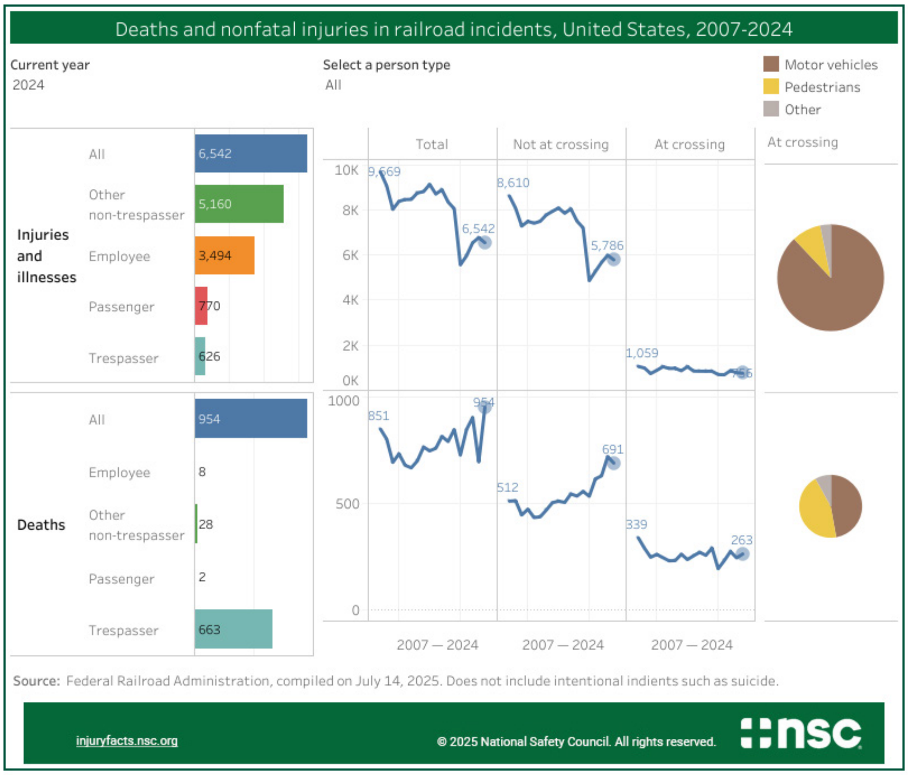

Figure 1 Deaths and nonfatal injuries in US railroad incidents (2007 -2024)[3]

Despite slight reductions in acute fatality rates at rail crossings, collateral train horn noise exposure has led to substantial long-term adverse health outcomes. Numerous references in the environmental and occupational health and epidemiological literature point to associations of transportation noise with adverse health effects. The number of disability-adjusted life years (DALY) attributed to traffic noise in Sweden, a country where the health effects of environmental noise are well-studied, was estimated to be 41,033 years, with 36,711 DALY (90%) related to road traffic and 4,322 (10%) related to railway traffic. The most important contributor to the disease burden was sleep disturbances, accounting for 22,218 DALY (54%), followed by annoyance, 12,090 DALY (30%), and cardiovascular diseases, 6,725 DALY (16%). The Swedish study concluded road traffic and railway noise contribute significantly to the burden of disease in Sweden each year [4].

Other morbidity effects of rail noise are well documented. According to Smith et al. (2022), noise-induced sleep disturbance is additionally a key risk factor for diabetes mellitus (DM)[5]. Vienneau et al. (2024), showed that aircraft, followed by railway noise leads to the greatest sleep disturbance, comparing transportation noise source exposures [6]. In a 2024 meta-analysis cohort study by Vienneau et al. in *Environmental Health* (2024) examining long-term exposure to transportation noise and disease, the authors cite a Canadian study by Shin, et al. (2020) - the first study on railway noise exposure demonstrating a link with DM mortality - however the association is small (Shin et al., 2020) [7]. A Swiss study of associations of exposure to transportation noise with sleep and cardiometabolic health additionally found that railway noise was mainly associated with lower sleep efficiency (β = -0.15, 95 %CI: -0.23, -0.06) and increased metabolic risk (β = 0.14, 95 %CI: -0.05, 0.32) in 527 healthy Swiss adults aged 20-89 years (Wicki B, et al, 2025) [8]. Vienneau et al. reported, based on a nationwide cohort from Switzerland, hazard ratios (HRs) of 1.029 (95% CI 1.024–1.034) and 1.013 (95% CI 1.010–1.017) for the association between road traffic and railway noise and cardiovascular disease mortality, respectively (Vienneau et al., 2022) [9].

Discussion

What can be done to mitigate the deleterious health effects of train noise while maintaining the protective safety benefits of train horns at highway-rail grade crossings? Federal Railroad Administration (FRA) regulations were developed to provide a consistent approach nationwide to enable local jurisdictions to establish quiet zones without compromising safety[10].

While many communities have updated their crossings for safety or built over or under to deconflict road and train traffic, far more rail crossings need upgrades to keep the community safe and allow for quiet zones to be established (NLC) [11]. A US federal study ongoing since 2014 has shown that deaths do not rise when quiet zones are created, enabling trains to cross intersections without blowing their horns [12]. Alternatively, some cities have implemented wayside horns, which sound at the crossing, not on the trains, limiting noise pollution. Establishment of quiet zones and other engineering controls are recommended for community review, where feasible. Yet the environmental noise exposure health effects remain pervasive. More research is needed to support a balance of community safety and public health equities of these factors.

Conclusion

The train noise problem nevertheless continues to present a public health risk, as do the public safety issues. Recent statistics from 2020 to 2024 show that fatalities at highway-rail crossings increased by an average annual growth rate of 8%, despite Federally-mandated train horns (NSC). Trends for deaths at railroad crossings (-1.5%) and injuries and illnesses (-2%) at crossings have minimally decreased only modestly since 2007. Despite some improvement in rail crossing safety, the estimations of DALY attributed to road traffic and railway noise indicates a significant contribution to the disease burden, in particular concerning sleep disturbance and annoyance, but also with regard to diabetes mellitus (DM) and other risk factors of cardiovascular disease. The trade-off between protecting public safety at crossings with ubiquitous train horns or establishment of quiet zones proffers a 'Hobson's choice' – save hundreds of lives in the next few years or kill thousands over the ensuing decades.

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Bhanu Chaudhary Dr. Bhaven N Tandel

The Sound of Duty: Can a 'Dose-Capped' Algorithm Save India's Traffic Cops from Deafening Intersections?

Bhanu Chaudhary, Dr. Bhaven N Tandel, *Sardar Vallabhbhai National Institute of Technology, Surat*

Dateline: India; Tier 2 City

For the millions navigating India's chaotic intersections daily, the blare of horns, the roar of trucks, and the screech of brakes are just part of the urban fabric. But for the traffic police officer standing in the middle of that symphony for eight to twelve hours a day, it's an occupational hazard with a measurable cost: their hearing.

A growing body of evidence from Indian cities—from Surat and Nagpur to Chandigarh—paints a worrying picture. Traffic police are showing alarming rates of noise-induced hearing loss, tinnitus (a persistent ringing in the ears), and stress-related symptoms. Studies routinely find intersection noise levels breaching the 65 dB(A) limit set for commercial areas, often spiking into the mid-90s due to a uniquely Indian phenomenon: a chaotic, heterogeneous mix of vehicles where honking is not just an alert, but a primary mode of communication.

"The problem is that we are trying to manage a 21st-century health risk with a 20th-century roster system," explains a traffic management expert familiar with the new research. "An officer's exposure is currently left to chance, depending on which intersection they're posted to on a given day. We need to treat noise like a pollutant we can measure and cap."

The solution is as innovative as it is logical: treat duty rostering as an "exposure-allocation problem." Instead of rotating personnel arbitrarily, they have developed a "dose-capped rotation" algorithm designed to ensure no officer's cumulative noise exposure exceeds a safe daily limit, while still ensuring every junction is manned.

This approach moves beyond the traditional—and often ineffective—reliance on personal protective equipment (PPE), such as earplugs, which can be impractical for officers who need to hear traffic and communicate. It aims to tackle the hazard at its source by managing the time spent in it.

The Indian Noise Cocktail

The acoustic environment of an Indian intersection is a world apart from its Western counterparts. In many developed nations, strategic noise mapping and action plans are common, and traffic streams are relatively homogeneous with stricter lane discipline. India's Noise Pollution (Regulation and Control) Rules, 2000, provide ambient limits, but enforcement and systematic action planning are inconsistent.

The reality on the ground is a "heterogeneous" stream where two-wheelers, auto-rickshaws, overloaded trucks, and cars jostle for space. This friction, combined with frequent stop-go movement at signals, creates a sound profile dominated by peak events.

"Horn honking isn't just a background irritant; it's a major contributor to the total noise dose," notes a recent field study from Nagpur. The research found that honking can add 2-5 dB(A) to baseline traffic noise and, in some conditions, can spike common noise indicators by double digits. That's the difference between a "borderline" shift and a "hazardous" one.

How the 'Dose-Capped' Model Works

The proposed model is a sophisticated, data-driven roster. Its core principle is borrowed from industrial occupational safety: the daily noise dose.

First, every traffic post (intersection) is categorised based on its "dose rate." Using portable sound level meters like those shown earlier, authorities would measure two key metrics:

- L_{Aeq}: The average energy-equivalent sound level over a period
- L_{max}: The maximum peaks caused by honking or sudden acceleration

A high-exposure post (e.g., a large, clogged intersection with heavy truck traffic) might have an hourly "dose rate" equivalent to 40% of an officer's safe daily limit under standards set by bodies like the US National Institute for Occupational Safety and Health (NIOSH). A medium post might be 10%, and a low post (like a quiet side street) might be just 2-3%.

The algorithm, which can be implemented initially as a simple spreadsheet tool, then builds an 8-hour shift block by block. Its goal is to assign officers to posts so that their cumulative dose remains below 100%. It prioritises fairness, ensuring the burden of high-exposure posts is shared equitably.

A worked example with four officers shows the logic in action. To cover one high-exposure post for an entire 8-hour shift without exceeding the dose cap, the model automatically distributes the "high post" hours. In the example schedule, each officer spends only 2 hours at the loudest intersection, then rotates through medium- and low-noise posts or performs low-exposure relief duties for the rest of their shift.

“The beauty of the algorithm is that it makes the staffing problem visible,” the expert explains. “If you don’t have enough officers to cover a high post for 8 hours without someone going over the cap, the model flags an ‘infeasibility.’ It’s a management signal that says, ‘You either need more staff, or you need to reduce the noise at that intersection itself.’”

A Six-Month Roadmap to Quieter Duty

Implementing such a system doesn’t require an overnight complete overhaul. The proposal outlines a pragmatic six-month pilot program that could be rolled out in any major Indian city.

Phase 1 – Measurement (Months 1-2): Create a “post library” for a specific traffic zone. Use portable sound meters to measure L_{Aeq} and peak levels during peak and off-peak hours, and classify each post as High, Medium, or Low exposure using gradient maps like the one shown earlier.

Phase 2 – Modelling (Month 3): Run the dose-capped algorithm to generate a draft roster. Simultaneously, conduct baseline health screenings (audiometry tests and stress questionnaires) for all participating officers.

Phase 3 – Pilot Operations (Months 4-5): Train supervisors and roll out the new rotation. Log any exceptions caused by VIP movements or incidents.

Phase 4 – Evaluation (Month 6): Re-measure noise levels and re-screen the officers’ hearing. Compare the results against the baseline to quantify the intervention’s effectiveness.

The key stakeholders extend beyond the police department. It requires coordination with municipal bodies (for potential intersection redesign) and state pollution control boards, creating a multi-agency approach to a public health issue.

From Feasibility to Force Multiplication

The biggest anticipated barriers are not technical, but operational. Staffing shortages are a reality in most Indian cities. The algorithm might reveal that, to truly protect personnel, a zone needs 20% more officers, or that the only way to keep officers safe at a particular intersection is to implement engineering controls—such as better signal timing or enforced no-honking zones—to lower its baseline dose rate.

Furthermore, resistance from within the ranks is possible if the rotation is seen as unfair. The solution, proponents argue, is transparency. If every officer can see that the roster is generated by a formula designed to evenly distribute the acoustic burden, acceptance is more likely.

The integration of modern sound measurement technology, data analytics platforms, and a deep understanding of local traffic conditions creates a holistic approach that respects both the professional demands on traffic police and their fundamental right to a safe working environment.

“We’re not just talking about protecting hearing,” we conclude. “Chronic noise exposure is linked to hypertension, stress, and sleep disturbance. By implementing a dose-capped rotation, we acknowledge that the health of the person directing traffic is just as important as the traffic they direct. It’s about building a smarter, safer, and more sustainable system for the people who keep our cities moving.” ■

Environmental and recreational noise exposure in youths

Sergio Mora Camargo, *student, Monterrey Institute of Technology and Higher Education (ITESM)*

Youths in Latin America are particularly exposed to high levels of noise in their daily environment and their recreational activities. Students on buses with earphones, gaming with friends, nightclubs, concert crowds, hours at day in traffic and loud sport events are just some of the examples of noisy situations that surround them everyday. Even though several Latin American countries aim to prevent noise-related effects, the applicability of these norms and the availability of awareness programs remain insufficient to ensure proper care. As described on Figure 1, based on our survey done on 324 youths in Mexico aged 18-30, main activities youths are exposed to are car traffic (77-83.7%), nightclubs (40-43.1%) and rock concerts (33.9-36.6%). As reported by M-Cam et al. (2025), overexposure to these activities may yield to potential health effects, mainly affecting hearing, concentration and stress ones, although other studies also link immunological, cardiovascular and neurological disorders related.

According to Jo et al. (2024), occupational noise prevention and awareness measures begin at the engineering control, followed by administrative control and personal protective training. However, in environmental and recreational contexts, prevention and awareness measures are more complex, as they depend on local regulations for specific activities and the population's attitude towards specific noise sources, which are more difficult to control, measure and improve.

What Young People Think About Noise?

They exist some qualitative instruments as the Youth of Attitude to Noise Scale Use (YANS), a 19-item reflecting positive and negative attitudes towards noise, depending on the scale values. YANS evaluates four domains; youth culture, concentration, daily noises and intent to improve their environment. Another used instrument is the Hearing Symptom Description (HSD), which aims to measure some auditory symptoms associated with noise exposure such as ear pain, sensitivity, tinnitus. These questionnaires have been used in youths of few Latin American countries to determine their beliefs about noise exposure. In Chile, E. Fuentes-López (2023) et al. concluded, similarly to Bohlin et al. (2011), that behaviors of exposure to auditory risk are a common characteristic of the youths. It has also been reported that men are most

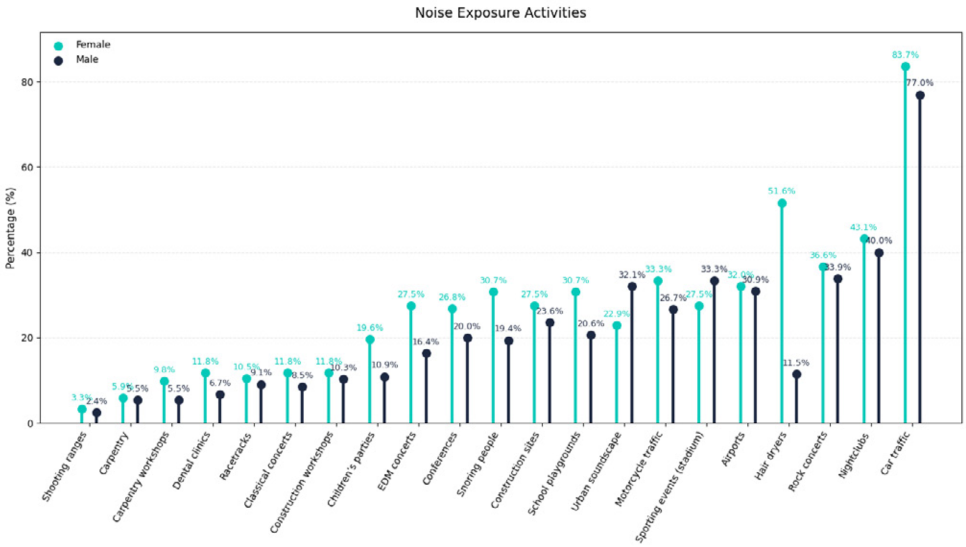

Figure 1 Percentage of noisy activities youths are exposed to by genre (n=319, 1.08:1 male-female ratio).

likely to reflect positive attitudes to noise exposure than women. Although on our study's preliminary results show there was no evident difference between men and women on YANS domains as seen in Figure 2. These highlights the gap between noise exposure and perception, enhacning the need of educational interventions.

Do Young People Really Know the Risks?

But do young people really understand the problem? Do they truly know the risks? Even when they are aware of them, are they conscious about the real impact on their lives? And, knowing this information, do they really care?

Many teenagers must think they are far from living the consequences of being overexposed, or may feel like it would never change their lives, underestimating how it would affect in the long-term the way they perceive their environment. Reactions like "I didn´t know the effects of being exposed to high noises like concerts or clubs" or "I had no idea of the impact, I think it is important to know it to prevent any accident", were common when asking about their instrument's feedback. Our awareness instrument includes some interactive videos and simulations about hearing loss, tinnitus as some of the risks associated with long term noise exposure. It also highlights the benefits of hearing protection and long-term prevention.. This initiative aims to generate awareness not only by knowing potential effects, but to let them see the role of environmental and recreational noise activities using audiovisual materials as examples. Demonstrative noise soundscapes on the instrument took into account a bibliographic analysis of the sound sources as exemplified on Table 1. References and other soundscapes' descriptions included on the instrument can be found in https://github.com/sergiomcam/Internoise_1074726_Annexes.

What Can Be Done? Small Changes, Big Impact

In the absence of adequate policies, regulations and their applications, perhaps the best strategy is to stay informed and inform others. This regulatory gap places greater responsibility on individuals and educational initiatives. Being aware of how exposure time and intensity may affect our mental and hearing performance can help individuals in making better decisions. The approach of developing this instrument does not aim to discourage participation in activities with potential environmental or recreational noise but rather to promote safe exposure. A sample version of the instrument can be found in https://hearingnotion.aidaform.com/noise-awareness-questionnaire. The goal is not to avoid the experiences, but to monitor noise duration and levels. Environmental and recreational noise is poorly regulated in Latin American countries and occurs continuously in our daily lives, even without being noticed. By understanding this, we hope young people become more proactive in caring about themselves and others.

Preventing this can help to improve or at least maintain our hearing, psychological, cardiovascular, neurological and immunological health. In this way it has been found in our pilot tests that young people wearing ear protection, such as ear plugs, is strongly associated with better knowledge and understanding of noise and their consequences, rather that the perceived amount of noise they are exposed to as shown in Figure 3. Thus, more information should be given to youths about what environmental and recreational noise exposure categories are (with clear descriptions), which the main risks are(with examples) and how to prevent them (with practical tips on their daily lives). Practical tips include guidance from the OSHA *If you need to raise your voice to*

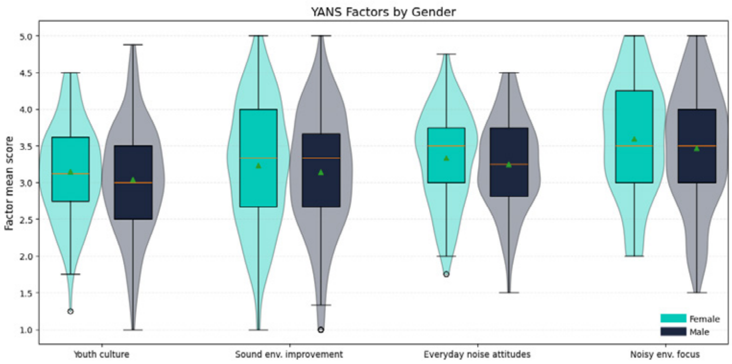

Figure 2 YANS domains by genre in 5-point likert scale (n=319, 1.08:1 male-female ratio).

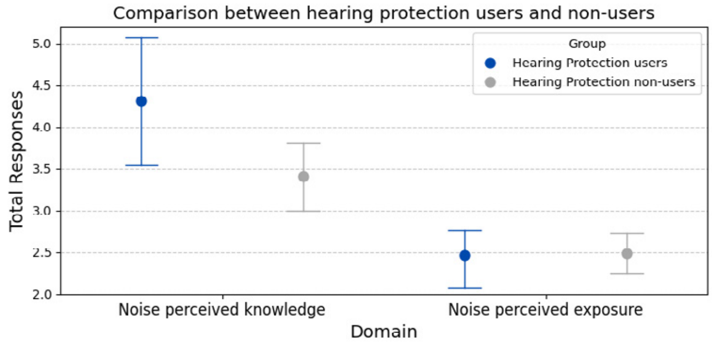

Figure 3 Pilot test of the Hearing Notion Awareness Instrument of perceived knowledge and perceived exposure compared in hearing protection users and non-users (n = 54).

speak to someone 3 feet away, noise levels might be over 85 decibels (dBA), NIOSH indicates *If you likely have to shout to be heard by someone 3 feet away, noise is reaching 95 dBA*, and the WHO recommendation of *setting your device's volume level to no more than 60% of maximum*. Recommendations on carrying reusable earplugs if attending or living near concert halls, clubs, stadiums, car races, etc could reduce noise exposure without affecting sound quality, even some noise cancelling earphones can be helpful.

Young people do not always choose which activities to be exposed to, but they can definitely choose how to protect themselves. Generating real consciousness can help society to present less health problems related to hearing and psychosocial issues in the short and long term. We can do a lot for the most exposed population to care about their health today and tomorrow, generating prevention strategies and keeping them aware of noise's role nowadays.

Author details

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He is a member of the Acoustical Society of America (ASA) and the Audio Engineering Society (AES), where he also serves on the Hearing and Hearing Loss Prevention Committee. He has co-founded companies in audio processing, game development, and auditory health, combining technical innovation with business management.

Sergio has presented at AES conferences, Talent Land, and universities in the US and Spain, and has received travel grants from ASA and I-INCE. His Ph.D. research involves developing neuroaudiological software, auditory discrimination tools, and processing of audio and biosignals. He has completed clinical rotations in otorhinolaryngology centers, gaining experience in audiological assessments, electrophysiology, hearing aid calibration, and cochlear implants. ■

Table 1. Noise soundscapes brief analysis description

Noise soundscape	**Characteristics brief analysis**
Car Traffic	Environmental soundscape with noise levels from 70 to 100 dBA and peaks over 120 dBA, spanning 50 Hz to 10 kHz, leading to stress, sleep disturbances, and cardiovascular issues. Simulated from a sidewalk perspective with overlapping traffic layers to replicate urban density.
Nightclub	Depending on perspective, this soundscape can be recreational, environmental, or occupational. With noise levels from 90-105 dBA and frequencies between 30 Hz to 4 kHz, it causes NIHL, tinnitus, and long-term auditory damage. Built with bass-heavy music and crowd sounds, using EQ, spatial panning, delay, and reverb.
Rock concert	Rock concert spaces that reach 102 dBA for 15 minutes, with the highest points exceeding 120 dB(C) and the most prominent energy content between 63 Hz and 4 kHz, contribute to NIHL, stress, and mental fatigue, enhanced by low bass output and necessitating protective sound procedures.

Noise Pollution, Property Value, and Sustainable Mitigation

A Technical Review of Environmental and Economic Impacts

Patrick Harkins, *RMP Global*

Environmental noise is widely recognized as a growing infrastructure and public health concern. Beyond annoyance, sustained exposure to transportation and industrial noise has measurable economic consequences and documented physiological impacts. A growing body of research demonstrates that chronic environmental noise affects residential property values, cardiovascular health, sleep quality, and community perception. Addressing these impacts requires technically sound mitigation strategies grounded in acoustical science and lifecycle sustainability principles.

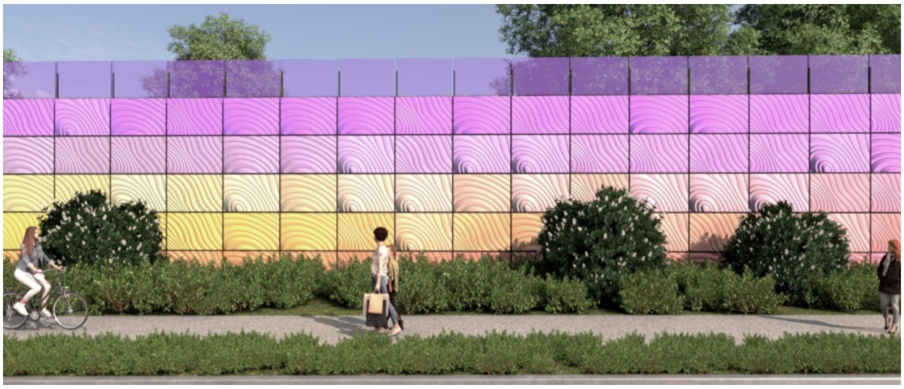
Noise and Residential Property Value

The relationship between environmental noise exposure and residential property value has been extensively examined using hedonic pricing models. These models isolate environmental variables within real estate markets to quantify value impacts (Rosen, 1974; Nelson, 1982).

Meta-analyses of transportation noise studies consistently report a Noise Depreciation Index (NDI) of approximately 0.5–1.0% reduction in property value per additional decibel (dB(A)) increase in sustained environmental noise (Nelson, 2008; Bateman et al., 2001). In high-exposure conditions—such as properties adjacent to highways or rail corridors—total value reductions may range from 5% to 20%, depending on visual intrusion, duration of exposure, and community context (OECD, 2018).

The Federal Highway Administration (FHWA) recognizes that transportation noise can create "substantial adverse effects" on adjacent land uses when exposure exceeds established activity criteria (FHWA, 23 CFR Part 772). These economic impacts are closely tied not only to overall sound pressure levels but also to frequency composition and nighttime exposure.

Research shows that nighttime noise above 45 dB(A) is strongly correlated with sleep disturbance and perceived annoyance (WHO, 2018), factors that significantly influence residential desirability.



Health Implications of Environmental Noise

The World Health Organization's Environmental Noise Guidelines (2018) classify transportation noise as a major environmental health risk in developed nations. Chronic exposure has been associated with:

- Increased risk of ischemic heart disease
- Hypertension
- Elevated cortisol levels
- Sleep disturbance
- Cognitive impairment in children

The WHO recommends reducing long-term average road traffic noise below 53 dB Lden and nighttime levels below 45 dB Lnight to mitigate adverse health outcomes.

Mechanistically, environmental noise acts as a stressor, activating the hypothalamic–pituitary–adrenal axis and sympathetic nervous system (Babisch, 2014). Even when individuals report becoming "accustomed" to noise, physiological stress responses may persist.

Low-frequency noise presents particular mitigation challenges. Due to longer wavelengths, low-frequency sound diffracts more readily over obstacles and penetrates building envelopes more effectively than higher-frequency sound (Bies & Hansen, 2009). As freight and logistics activity increases, understanding frequency-dependent behavior becomes essential for effective mitigation.

Acoustic Fundamentals and Mitigation Mechanics

Environmental noise mitigation is often conceptualized through the Source–Path–Receiver model (FHWA, 2011). While source reduction (e.g., quieter pavements, vehicle standards) and receiver protection (e.g., building envelope upgrades) are viable approaches, barriers primarily interrupt the transmission path.

When a barrier obstructs the direct line of sight between source and receiver, it creates an acoustical shadow zone. The resulting reduction, known as insertion loss (IL), depends on barrier height, length, placement, and material performance (Maekawa, 1968; FHWA, 2011).

However, three physical mechanisms limit effectiveness:

- **Diffraction** – Bending of sound over the barrier top
- **Flanking** – Sound wrapping around barrier ends
- **Transmission** – Sound passing through the barrier material

Barrier geometry is therefore critical. FHWA guidance indicates that placing barriers closer to either the source or receiver typically maximizes acoustical benefit.

Material performance is commonly evaluated using:

- **Sound Transmission Class (STC)** — quantifies resistance to airborne sound transmission (ASTM E90)
- **Noise Reduction Coefficient (NRC)** — quantifies absorptive performance (ASTM C423)

In transportation corridors, reflective barriers may redirect sound toward opposing receivers. Incorporating absorptive treatments can reduce reflected energy and improve net community benefit (FHWA, 2011).

Sustainability and Lifecycle Performance

Modern infrastructure projects increasingly evaluate noise mitigation not only by acoustical performance but also by environmental impact. Lifecycle assessment (LCA) methodologies consider embodied carbon, material sourcing, manufacturing emissions, service life, and end-of-life disposition (ISO 14040).

Long service life significantly reduces environmental burden. Barriers designed to perform for 50+ years lower replacement frequency and reduce cumulative embodied emissions. Reduced maintenance requirements further decrease environmental impact over time.

Recycled material integration also plays an expanding role. Diverting post-consumer or post-industrial materials into durable infrastructure applications can reduce landfill demand and lower virgin material extraction. When engineered properly, recycled-content wall systems can maintain structural performance and acoustic ratings comparable to traditional materials.

From a sustainability perspective, total cost of ownership—including durability, maintenance cycles, and recyclability—often outweighs initial installation cost in long-term infrastructure planning (OECD, 2020).

Aesthetics and Community Integration

While technical metrics determine acoustic performance, community acceptance influences overall project success. Studies in environmental psychology suggest that visual integration moderates perceived noise annoyance (Gidlöf-Gunnarsson & Öhrström, 2007). Architecturally refined surfaces and context-sensitive design can therefore enhance both functional and perceptual outcomes.

Noise mitigation infrastructure that integrates visually with surrounding landscapes supports broader property value stabilization goals.

Conclusion

Environmental noise pollution is both an economic and public health issue supported by decades of empirical research. Hedonic pricing analyses demonstrate measurable reductions in residential property value with increasing noise exposure, while epidemiological evidence links chronic exposure to cardiovascular risk and sleep disturbance.

Effective mitigation requires technically grounded barrier design informed by acoustical science, including geometry optimization, transmission resistance, and absorption management. Increasingly, sustainable lifecycle performance and recycled material integration are central to infrastructure evaluation.

Mitigating environmental noise is not solely about reducing decibel levels. It is about protecting community value, improving long-term health outcomes, and delivering durable, sustainable infrastructure aligned with contemporary environmental standards. Organizations such as RMP Global are working within this framework — combining engineered acoustic performance, long-term durability, and responsible material integration — to support infrastructure solutions that balance environmental, economic, and community priorities.

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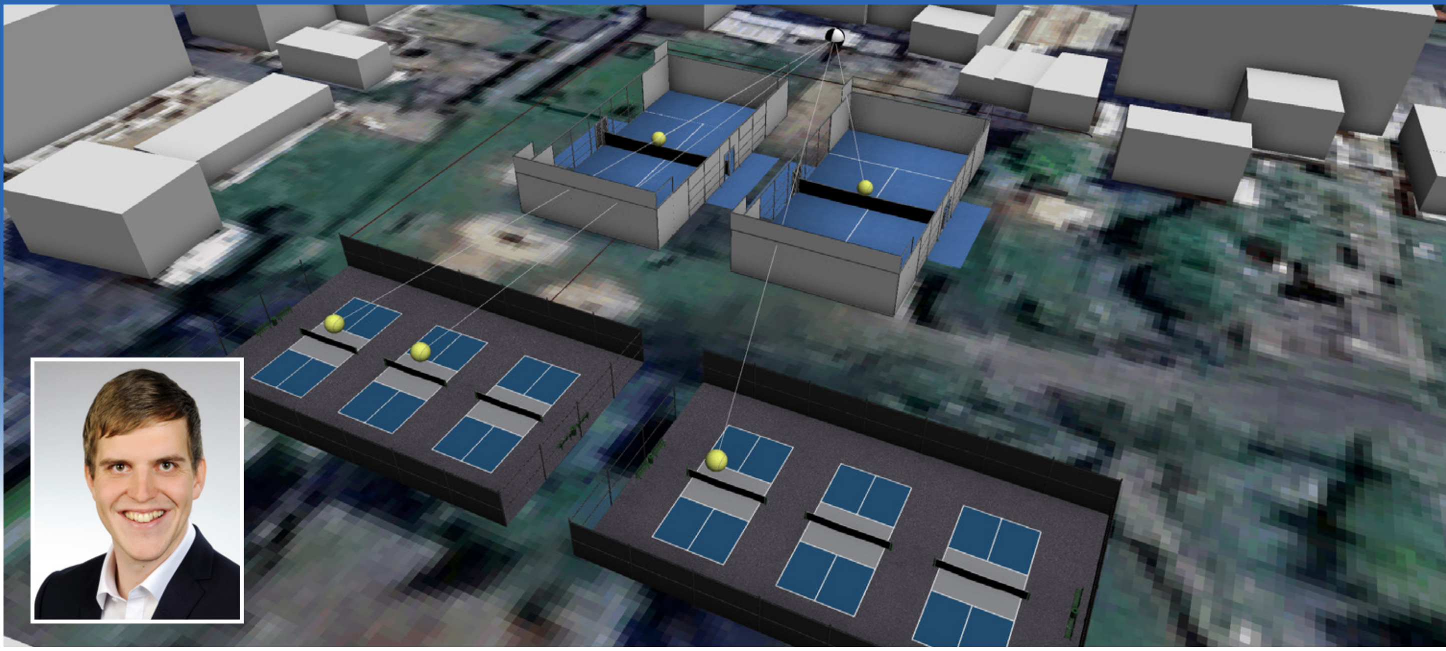

Racket Sports and Environmental Noise: Assessing and Predicting Impulsive Noise from Tennis, Padel and Pickleball

When Trends Meet Urban Development – Drivers Behind the Growing Demand for Acoustic Assessments of Racket Sport Facilities

Alfons Geltinger, *Senior Software Consultant at DataKustik GmbH*

Padel and pickleball are among the fastest-growing racket sports worldwide. As new facilities are developed, often in urban or suburban areas, residential and other noise-sensitive uses are frequently located in close proximity to the courts. At the same time, existing tennis facilities are being expanded or converted, for example by adding additional courts. Measurements show that, under typical operating conditions, padel and pickleball can produce higher sound emissions than tennis. In particular, the impulsive nature of ball-strike noise can lead to acoustic conflicts. As a result, noise assessments are often required during site selection, permitting, and the design of mitigation measures.

A Practical Gap in Assessment and Prediction

For tennis, established emission models and assessment procedures have been available for many years. For padel and pickleball, however, suitable emission data and a consistent approach for multi-court or mixed operation were not previously available. This gap complicated reliable noise predictions as well as the targeted design of structural and operational mitigation measures.

What Makes These Sounds Special? Impulsive Ball-Strike Noise

Noise from tennis, padel and pickleball is primarily characterized by ball-strike events. The impulsive character of these sounds is clearly visible in the level–time history, as illustrated in the diagram below using the L_{AFmax} signal measured at an active padel court. Individual strikes generate pronounced level peaks that differ significantly from continuous or steady noise sources.

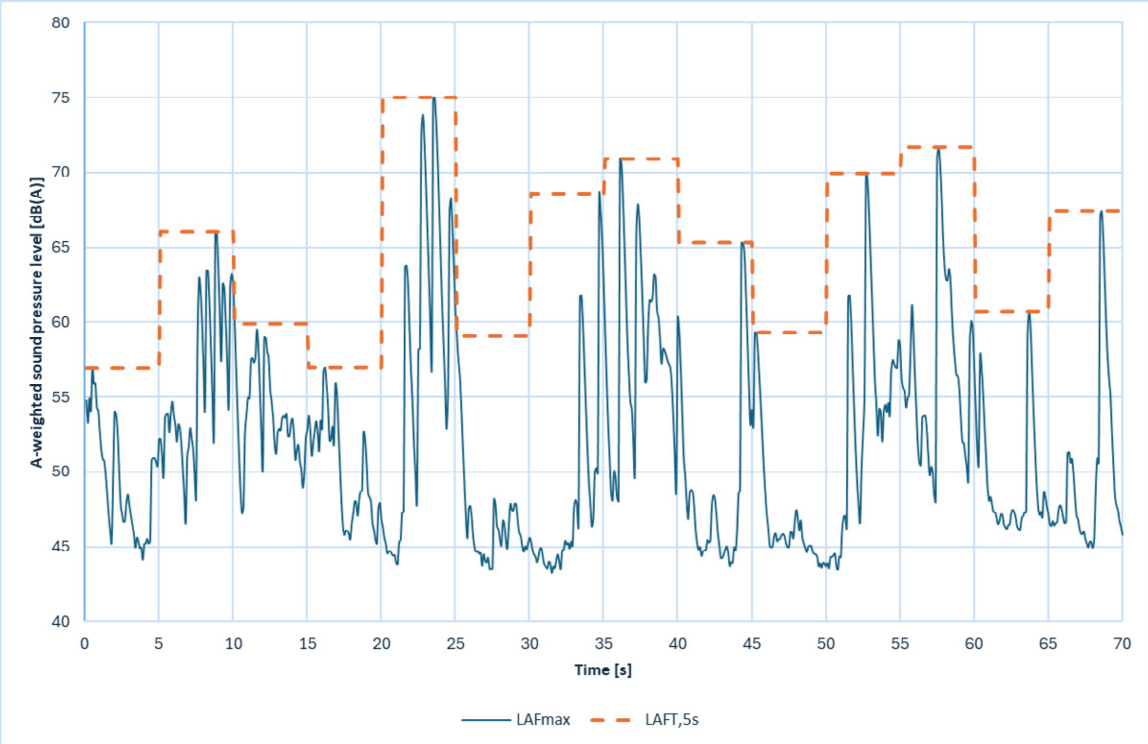

Figure 1. Level–time history of ball-strike noise at an active padel court showing L_{AFmax} and $L_{AFT,5s}$ evaluation.

Assessment of Impulsive Noise

Environmental noise assessment internationally often follows the general principles of the ISO 1996 series. For a given receiver location, an A-weighted equivalent continuous sound level is determined over defined assessment periods and, where necessary, adjusted for specific noise characteristics.

For impulsive sounds, ISO 1996-1 provides general corrections for impulsiveness. In practice, however, the degree of impulsive character varies significantly depending on the sport and the number of courts operating simultaneously. Event-based evaluation methods therefore provide a particularly illustrative approach. Measurement studies from the United States provide an example of an event-based evaluation approach. In a NOISE-CON 2023 study on pickleball, L_{AFmax} was evaluated in consecutive 5-second windows, and the maximum value in each window was taken as the representative value for that entire 5-second interval. A comparable principle has been established in Germany for approximately 30 years through the 5-second maximum level procedure ($L_{AFT,5s}$); see the $L_{AFT,5s}$ trace in the diagram. With appropriate emission data, the tennis-based method (VDI 3770) can be extended to padel and pickleball, including multi-court and mixed operation.

Emission Models for Tennis, Padel and Pickleball

For predicting impulsive racket sport noise, sport-specific emission parameters are used to represent both peak levels and event frequency. L_{WAFmax} describes the maximum A-weighted sound power level of a single ball strike. k_{sp} represents the fraction of 5-second intervals in which at least one impulse from the respective source occurs. From these parameters, a time-weighted equivalent emission value $L_{WAT,eq}$ can be derived, representing the average emission contribution of one active court.

Table 1. Sport-specific emission parameters for tennis, padel and pickleball

Sport	Sources per Court	$L_{WAFmax,i}$ (ball strike)	k_{sp}	$L_{WAT,eq}$ per source
Tennis	2	95	0.3	90
Padel	1	100	0.5	97
Pickleball	1	102.5	0.5	99.5

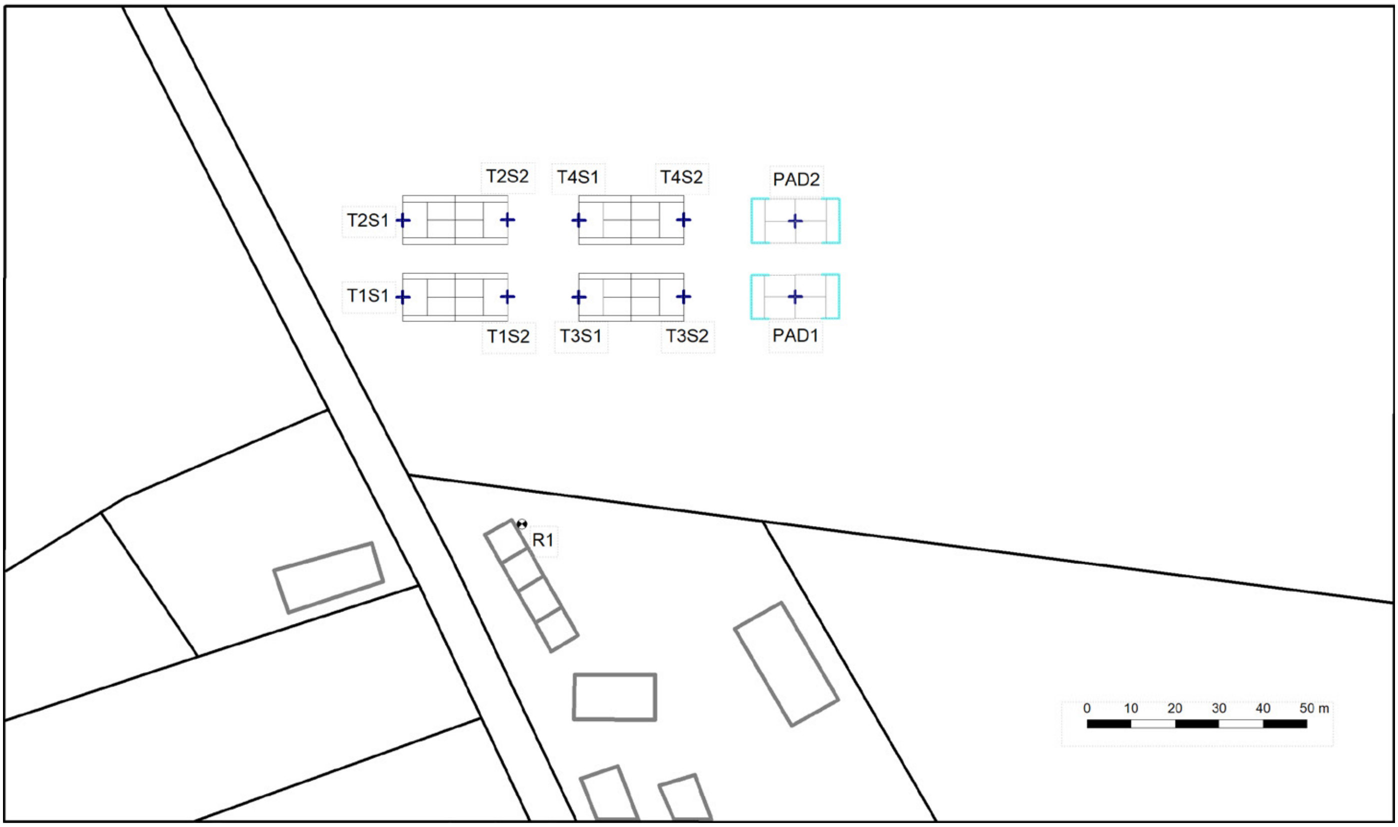

Figure 2. Example multi-court facility and receiver location R1 used for applying the 5-second maximum level procedure.

The 5-Second Maximum Level Procedure for Impulsive Racket Sport Noise

Assessment is performed in 5-second time windows and reflects two key effects:

- Impulses of one source occur only in a fraction of the time windows (e.g., rally pauses, side changes), described by the sport-specific time share k_{sp}.
- Within a 5-second window, only the dominant impulse is considered, multiple impulses within the same window are not energetically summed.

For a given receiver location, sources are ranked according to decreasing relevance. The ranking is obtained from a preliminary calculation in which each source is assigned its maximum sound power level $L_{WAFmax,i}$ and its contribution at the receiver is determined. The effective time share is then assigned stepwise:

$$k_n = (1 - s_{n-1}) \bullet k_{sp}$$

$$s_n = s_{n-1} + k_n \quad s_0 = 0$$

The corresponding level correction is:

$$\Delta L_n = 10\log_{10}(k_n)$$

and the time-weighted sound power level of source n becomes:

$$L_{WAFTeq,n} = L_{WAF,max,n} + \Delta L_n$$

The resulting emission values are then propagated to the receiver using the selected sound propagation model and energetically summed.

Simplified Approach

As a simplified screening approach, each source can be assigned its equivalent emission value $L_{WAT,eq}$ from Table 1, without further correction. Because this approach does not account for the 5-second time-window logic or the temporal exclusivity of impulses, it tends to overestimate sound levels in multi-court operation.

Example Application

The assessment principle is applied to a facility with four tennis courts and two padel courts (see the figure above). Receiver R1 is evaluated during a period with simultaneous operation on all courts. Sources are ranked according to their relevance at the receiver. Within each 5-second interval, only the dominant impulse contributes fully, while lower-ranking sources are considered proportionally. For this configuration, the equivalent 5-second maximum level is approximately 50 dB(A). Using the simplified approach, where emissions are energetically summed without time-window logic, the rating level at R1 is overestimated by more than 4 dB. The example shows that while the simplified approach may be suitable for preliminary screening, it is only of limited use for defining mitigation measures or operational restrictions in multi-court operation.

Implementation in Prediction Software

Because source ranking and effective sound power levels depend on the receiver location, manual calculation becomes impractical for multiple receivers. In CadnaA, a quality-assured software implementation in line with ISO/TR 17534-3, the existing “tennis source” object has therefore been extended with emission data for padel and pickleball. After selecting the sport type, the software automatically performs source ranking, time-share allocation and the corresponding sound power level corrections, followed by noise prediction for individual receivers and grid calculations, enabling efficient and reproducible assessments.

Special Case: Roofed Facilities and Complex Geometry

For complex geometrical conditions, particularly roofed courts or configurations with horizontal or inclined elements, standard environmental noise models such as ISO 9613-2 may not adequately represent multiple reflections between ground and roof surfaces. In such cases, an appropriate propagation model that can account for multiple reflections in such geometries (e.g., an energy-based particle method implemented in specialized tools such as CadnaR) may be required. The event- and time-share-based assessment method described above remains applicable regardless of the propagation model used.

Conclusion

The expansion of racket sport facilities is increasing the need for acoustic assessments. The critical factor is the impulsive, event-driven character of ball strikes, which varies with sport type and the number of simultaneously active courts. Extending the established 5-second maximum level procedure (VDI 3770) from tennis to padel and pickleball enables consistent representation of impulsive evaluation levels in multi-court and mixed operation. Simplified equivalent-level approaches may lead to systematic overestimation and are therefore better suited for screening than for defining mitigation measures. Implementation in prediction software allows automated, reproducible calculation of source ranking, time-share allocation and propagation, significantly reducing effort in practical assessments.

Author Details

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Advancements in Remote Noise Monitoring: How Directional Sensing, AI, and New Metrics Are Transforming Acoustic Analysis

Marek Kovacik, *Sales Manager, Scantek, Inc.*

Across a wide range of industries, the need for more intelligent, automated, and context-aware monitoring continues to accelerate. Traditional sound level meters, while accurate in measuring levels, fall short in revealing where noise originates, which noise is relevant, and how to separate meaningful acoustic data from the clutter of complex urban soundscapes. Recent innovations demonstrate how emerging tools like directionofarrival detection, machine-learning classification, and new metrics such as Partial Leq, are pushing noise monitoring into a new era of precision and automation.

Smarter Sensing Using Directional Technology

At the center of this transformation is the evolution of time-difference-of-arrival (TDOA) directional devices. Unlike traditional microphones, these small, multi-microphone arrays determine and classify the 3D direction of a sound source by using cross-correlation between microphone signals to compute its angle of arrival.

Studies examining TDOA directional devices in both controlled test rooms and realworld environments highlight their capability to reliably identify dominant noise sources, even in indoor spaces with minimal reflective surfaces. When placed in noisy environments with mixed sources, the devices consistently pinpointed arrival angles that matched observers' notes.

Using a noise monitoring management system, several independent TDOA sectors of interest can be defined in both the vertical and horizontal planes. In combination with a calibrated measurement microphone, the system enables advanced data processing, including selecting whether values from other sectors should be included in the total background noise, or excluded so that only relevant noise levels are reported using the Partial Leq metric (as discussed in more detail below). This system allows users to generate reports that summarize the noise contribution from each directional sector over a given period.

AIDriven Noise Event Identification

Another major innovation reshaping noise monitoring is the application of machine learning for automatic sound classification. Systems incorporating this technology can automatically categorize recorded audio events captured during environmental monitoring. The goal is to differentiate between noise produced by the activity being studied and noise from unrelated sources. Such systems may entirely operate within the noise monitoring management system's workflow, using existing measurement data and audio recordings.

The system allows users to define source labels that focus on the events relevant to the analysis for a particular project. By default, all labeled events are considered part of the activity, unless the user specifically marks them as non-activity.

Recorded events that haven't been trained or explicitly categorized are classified as unknown. By design, unknown events are treated as part of the activity. This method eliminates the need to classify every potential sound, allowing the analysis to concentrate on excluding only those sources that are known to impact the results and do not belong to the activity being studied. If a more detailed classification is required, additional source categories can be introduced and trained as needed, but this level of detail is optional and project-dependent.

At the start of a project, the AI model is trained using representative audio samples chosen by the user and assigned to the appropriate source labels. In practice, only a small number of samples is needed for reliable classification, though more can be added if desired. This project-specific training enables the AI model to quickly adjust to the unique acoustic conditions of each site. Unlike generic pre-trained models, classification is based on sounds that occur within the project, ensuring the results accurately reflect local conditions, operating patterns, and source characteristics.

Such models can be retrained at any stage of the project to accommodate changes in source labels or classification criteria. This flexibility allows the model to adjust when new activity types are introduced or when more detailed source categorization is needed, ensuring the classification remains relevant and accurate throughout long-term monitoring projects.

By using a remote noise monitoring management system and directional classification using a TDOA device, automatic sound classification can not only determine the type of sound, but also where it's coming from and how it should be treated for inclusion in noise assessment metrics.

Figure 1: TDOA directional device attached to the bottom of an outdoor Class I microphone protection kit.

Separation of Levels using Partial Leq

Environmental monitoring has traditionally struggled with residual noise, which can mask or contaminate measurements of a target source. Standards such as ISO 19962 prescribe methods to remove or correct irrelevant contributions, but these require detailed knowledge of unwanted events, information that is nearly impossible to gather manually during longterm unattended monitoring. The introduction of Partial Leq, a new metric proposed in recent research, rethinks this problem by automatically classifying and replacing irrelevant noise samples with projectspecific values. When combined with directional classification using a TDOA device, or automatic classification of recorded noise events using AI, Partial Leq enables more accurate estimates of a source's true contribution, especially in complex settings where multiple sources continuously overlap.

Combining Directional Acoustics with AI Intelligence

Together, these technologies highlight a clear direction: the integration of automated directional and event classification with new analytical metrics is reshaping the potential of noise monitoring. As cities keep growing, construction activity accelerates, noise monitoring systems must evolve from passive loggers into intelligent diagnostic instruments. Cloud-based measurement management systems like Norsonic's NorCloud, TDOA directional devices such as Norsonic's Noise Compass, and AI-powered automatic sound classification tools like Norsonic's NoiseTag will be the tools enabling professionals to measure more accurately and diagnose more clearly.

The best part? These technologies are no longer dreams of wish lists. They're here, real, and available as turnkey solutions (no deep pockets required).

Scantek, Inc. serves as the North American office for Rion-Norsonic, delivering advanced sound and vibration measurement instrumentation, software, and accredited calibration.
More information on Noise Compass, NoiseTag, Partial Leq, and the research behind these tools can be found on Norsonic's website: www.norsonic.com ■

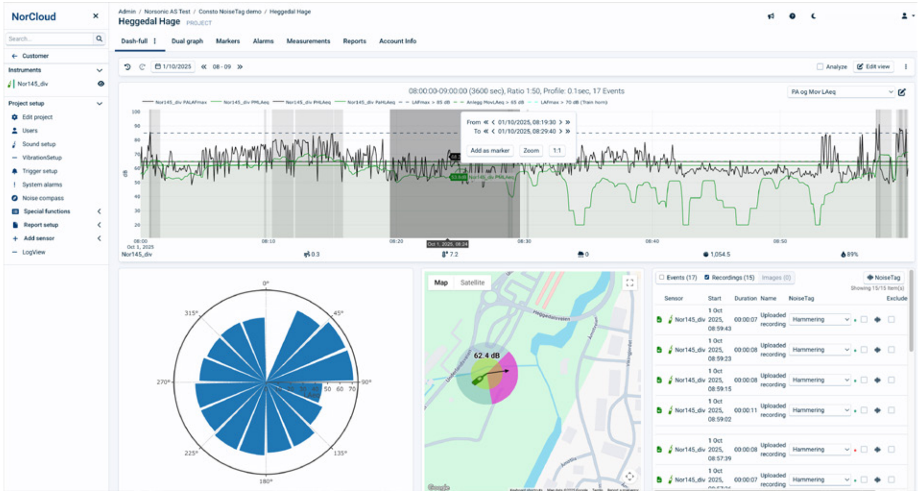


Figure 2: Automatic sound classification alongside noise level data inside of a remote noise monitoring management system for a noise monitoring site.

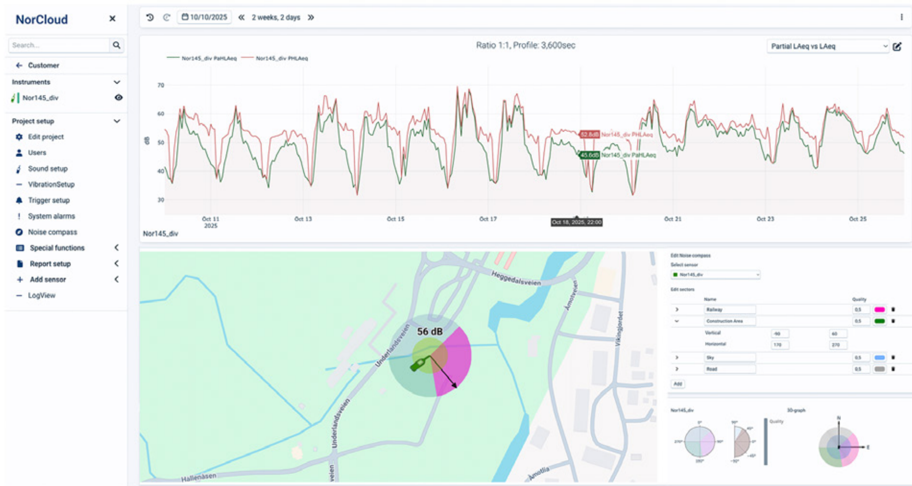
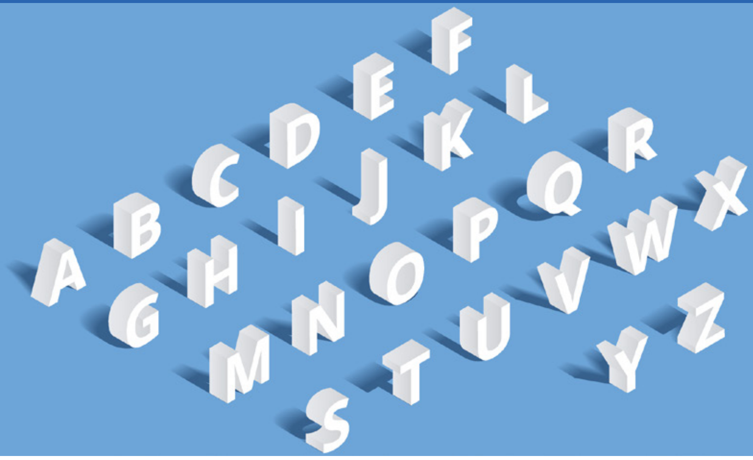


Figure 3: Separation of noise levels using Partial Leq inside of a remote noise monitoring management system calculated from time-difference-of-arrival sectors at a noise monitoring site.



Editor's Note: We are republishing Eric Ungar's Acoustics from A to Z and Stig Ingemansson's Noise Control: Principles and Practice from previous NNI issues as part of our initiative to include more educational articles. Their lessons are just as valid today. Look for more in future issues and on noisenewsinternational.net.

Acoustics from A to Z

Eric E. Ungar

I have often expressed amazement about how much one can understand about vibrations from studying the simplest of all the conceptual vibrating systems – namely, a mass connected to a spring, possibly with an added damping element. Of course, some of the utility of the mass-spring model stems from the fact that the behavior of any mode of a dynamic system corresponds to that of an equivalent mass-spring system. But why is a simple mass-spring assemblage an appropriate representation of anything that can vibrate?

The answer is that such an assemblage incorporates an element that can store kinetic energy and one that can store potential energy – and an interchange between potential and kinetic energy is at the core of any vibration. Let's consider the simplest situation of free (unforced) vibration of a spring-mass system. If the mass deflected from equilibrium and released with zero velocity, then it initially has no kinetic energy, but there is potential energy stored in the spring. The spring accelerates the mass, giving it kinetic energy, but losing some of its potential energy in the process. This goes on until the mass reaches the equilibrium position, where the spring's potential energy storage is zero and all of the energy of the system is kinetic. As the mass moves further, it deflects the spring, causing energy to be stored in it, but giving up a corresponding amount of kinetic energy. And so on.

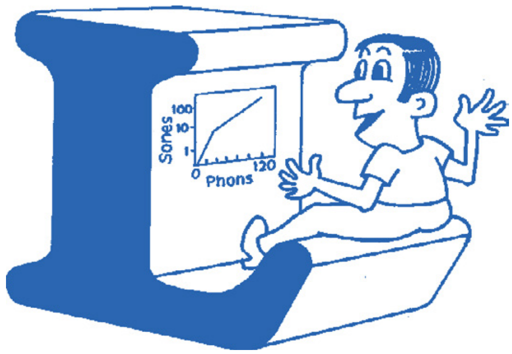
A few years ago Sound and Vibration magazine and I offered a prize to that reader who would give me the best physical explanation (that is, without the use of

KINETIC is the energy
That always works in synergy
With energy that is potential.
Both of them are quintessential
For unforced periodic motion.
We sometimes fail to grasp this notion.

mathematics) of why a simple undamped mass-spring system has a definite natural frequency. Although S&V gave away the prize, I was not entirely satisfied with the explanation. So, here is mine. Can you challenge or improve upon it?

A system has a natural frequency if, as it vibrates in absence of external forces, it takes the same time to complete each cycle. Because the total energy (the sum of the kinetic and the potential energy) in an undamped freely vibrating system is constant, the instantaneous magnitude of the potential energy determines the corresponding instantaneous magnitude of the kinetic energy. This now implies that whenever the mass passes a given location (measured in terms of displacement from equilibrium) it does so with the same velocity. This velocity establishes the time interval it takes for the mass to move from one point to the neighboring one. Therefore, the mass always takes the same time to move from one point to any other point and it always takes the time for the entire round-trip it makes in a cycle. In other words, all cycles have the same period and thus the same frequency.

The foregoing argument, incidentally, is not limited to linear springs, but also applies to springs with nonlinearites. For nonlinear springs, the natural frequency depends on the amplitude, as determined by the initial displacement and velocity. Why is the natural frequency of an undamped mass-spring system with a linear spring (a spring whose deflection is proportional to the applied force) independent of the amplitude? Borrowing from the language of textbooks: this is left as an exercise for the reader.



The LOUDNESS of a sound we hear
Tells how intense it may appear.
For simple or for complex tones,
One measures it in phons or sones.
But how we do perceive a sound?
Depends on what else is around.

Loudness refers to the subjective evaluation of a sound. A 3 dB change in sound pressure level (which corresponds to a doubling or halving of the sound power) results in a barely perceptible change in the perceived loudness. A 10 dB increase in the sound pressure level (which corresponds to a tenfold increase in the sound power) is judged as doubling the loudness. According to Bies and Hansen [1] if one started with 100 trombone players behind a screen, all doing their best, and if 99 of them leave, the audience would perceive a loudness reduction by a factor of four. Advertisements that claim a 99% noise reduction for similar scenarios "are written by the uninformed for the ignorant."

One 'sone' is defined as the loudness of a 1-kHz tone at a sound pressure level of 40 dB. A 1-kHz tone at N sones is N times as loud as this 40-dB tone. A 10 dB increase in the sound pressure level results in doubling of the loudness in sones. Plots of the frequency variations of the sound pressure levels that correspond to a given loudness are called "equal-loudness contours," which are labeled by 'phon' numbers. All points on such a contour correspond to the same perceived loudness; thus, a 40 phon tone at 60 Hz sounds just as loud as a 40 phon tone at 8000 Hz, even though the related sound pressures may be quite different. For pure tones, the sone and phon measures are simply related, but for more complex sounds the situation becomes more phoney [2] Methods for estimating the loudness of sounds that are not pure tones are discussed by Small and Gales [3] for example.

'Masking' – interference in the perception of one sound by the presence of another sound – may make communication difficult. And, it may constitute a critical safety issue, for example, where construction noise may mask an alarm signal or where a pedestrian's earphones may mask the sound of an oncoming car. Sound masking may also have beneficial effects, some of which are realized by the installation of sound masking systems in open-plan offices in order to eliminate the distractions caused by neighboring conversations. Unfortunately, the masking needed to cover up the rock music from a neighboring apartment would have to be so loud that it would lead to more insanity than the music itself.

---

[1] Engineering Noise Control, D. Bies and C. H. Hansen, Unwin Hyman Ltd., 1988.

[2] David Towers of HMMH, an experienced punster, felt the need to top my "phon number" and "phoney" wordplay. His comment: "To each his sone!"

[3] "Hearing Characteristics," A. M. Small, Jr., and R. S. Gales; Chapter 17 of Handbook of Acoustical Measurements and Noise Control, C. M. Harris, Ed.; McGraw-Hill, Inc., 3rd Edition, 1991. ■

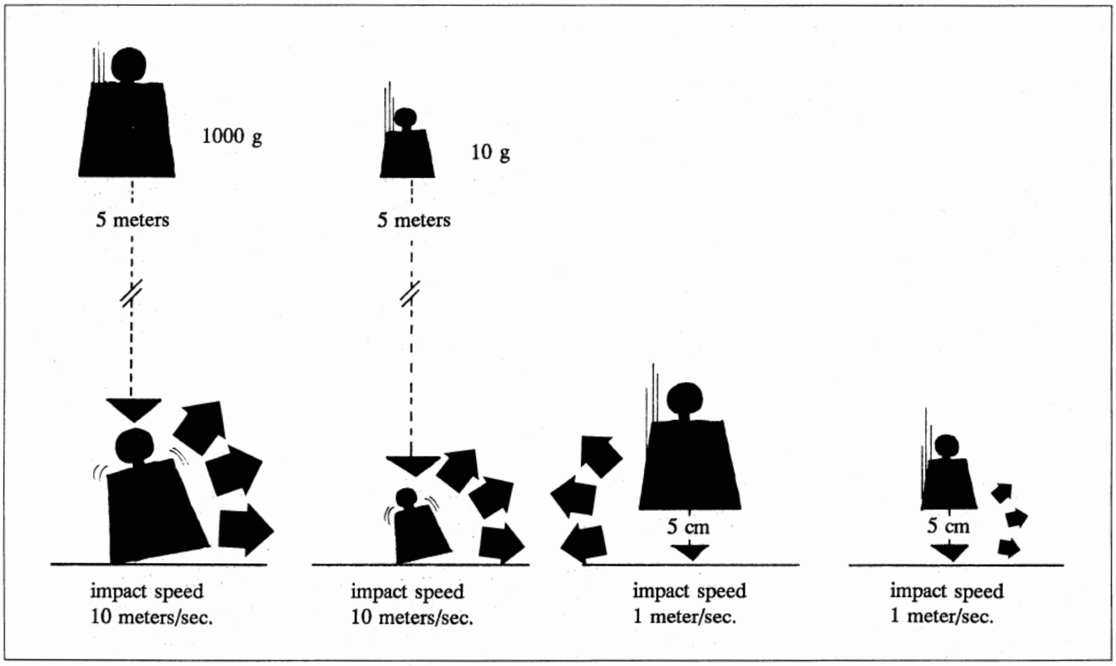
Stig Ingamansson's Noise Control: Principles and Practice

B5 – Sound from Vibrating Plates – Size and Thickness

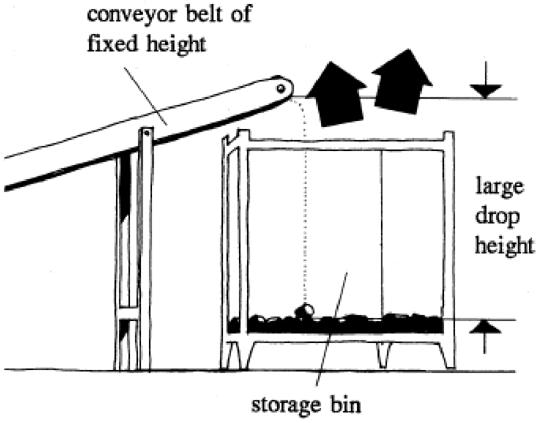
LIGHT OBJECTS AND LOW SPEED PRODUCE THE LEAST IMPACT NOISE

When a plate is struck by an object, the plate vibrates and makes noise. The sound level is determined by the weight of the object and its striking speed. If the drop height of an object is reduced from 5 meters to 5 centimeters, or if the weight is reduced from 1000 g to 10 g, the sound level drops by about 20 dB.

Principle

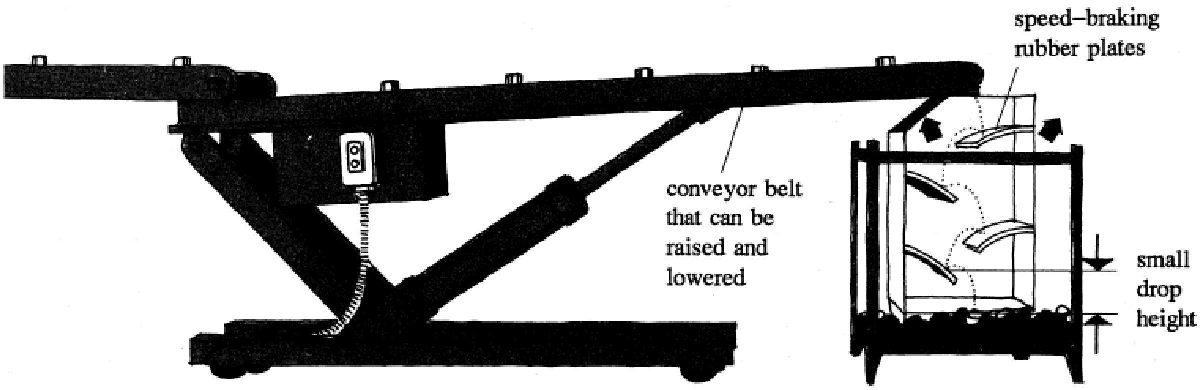


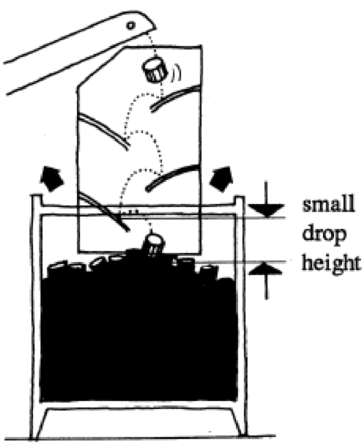
Application of materials handling



Example

Steel parts are transported from a machine to a storage bin. When the bin is empty, the drop height is large and the noise is loud.





Control Measure

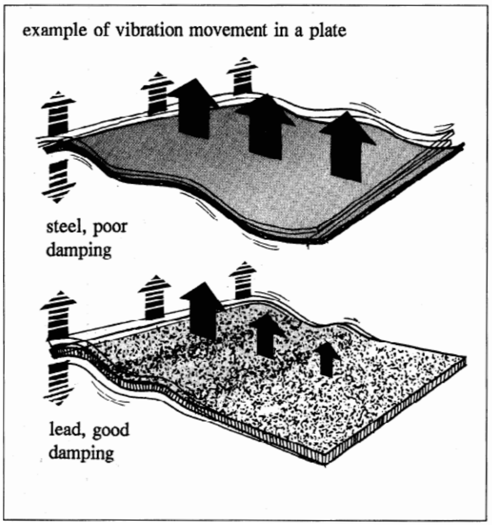
A hydraulic system is installed so that the conveyor belt can be raised and lowered. The belt ends in a drum equipped with rubber plates to break the fall of the parts. The drum is raised automatically

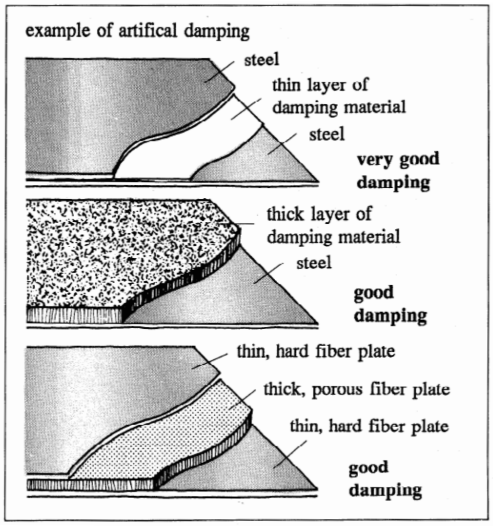
B6 – Sound from Vibrating Plates – Size and Thickness

A DAMPED SURFACE PRODUCES LESS SOUND

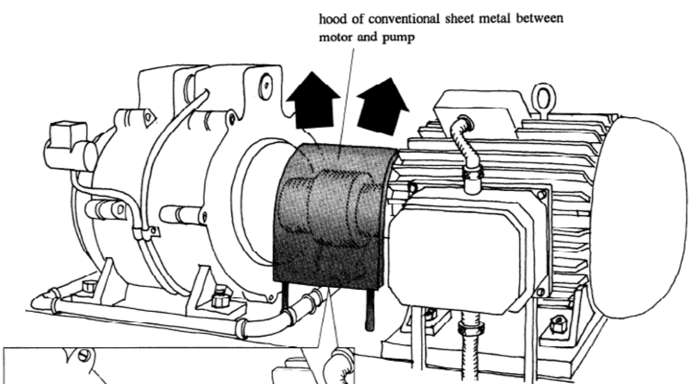
As vibration moves across a plate, it gradually decreases as it travels, but, in most plates, this reduction is rather small. In such cases, the material is said to have low internal damping. Internal damping in steel, for example, is extremely poor. Good damping can be achieved by adding coatings or intermediate layers with better internal damping.

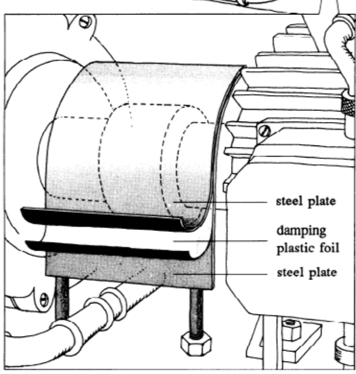
Principle





Application of hoods and protective covers





Example

The loudest noise from a pump and motor comes from the coupling guard made of ordinary sheet metal.

Control Measure

The noise level was reduced by constructing the coupling guard of damped sheet metal.

The **"Fantastic Acoustics"** series is a unique blend of comics and science featuring Kylfa, a bat specialized in acoustics, and Solomon, a funny elephant. It is a collaboration between artists and research students from four Québec universities - Université de Sherbrooke, École de Technologie Supérieure, McGill and Université du Québec à Rimouski. To learn more about this series, visit https://doi.org/10.1121/2.0002008.

Downloadable PDFs in French and English are available at https://en.fantastiqueacoustique.net/home

WHAT IF WE RETHINK OUR CITIES THROUGH SOUND?

Have you ever avoided walking through a park just because it was noisy? Or avoided opening your windows because they overlook a busy road? The most common approach to noise pollution in cities is to try and reduce it once people have complained.

Yet sound, if well thought out, can be positive : the sounds of nature, conversation or music can help to recharge batteries, bring people together as a community, and even stimulate creativity.

Thinking about sound as an integral aspect of urban design, and not just as a nuisance to be reduced after the fact, can also help ensure that our cities are more pleasant, attractive and inclusive.

Take a stroll through our park and discover a few ways of thinking about sound in the city.

Team members

Students at McGill University

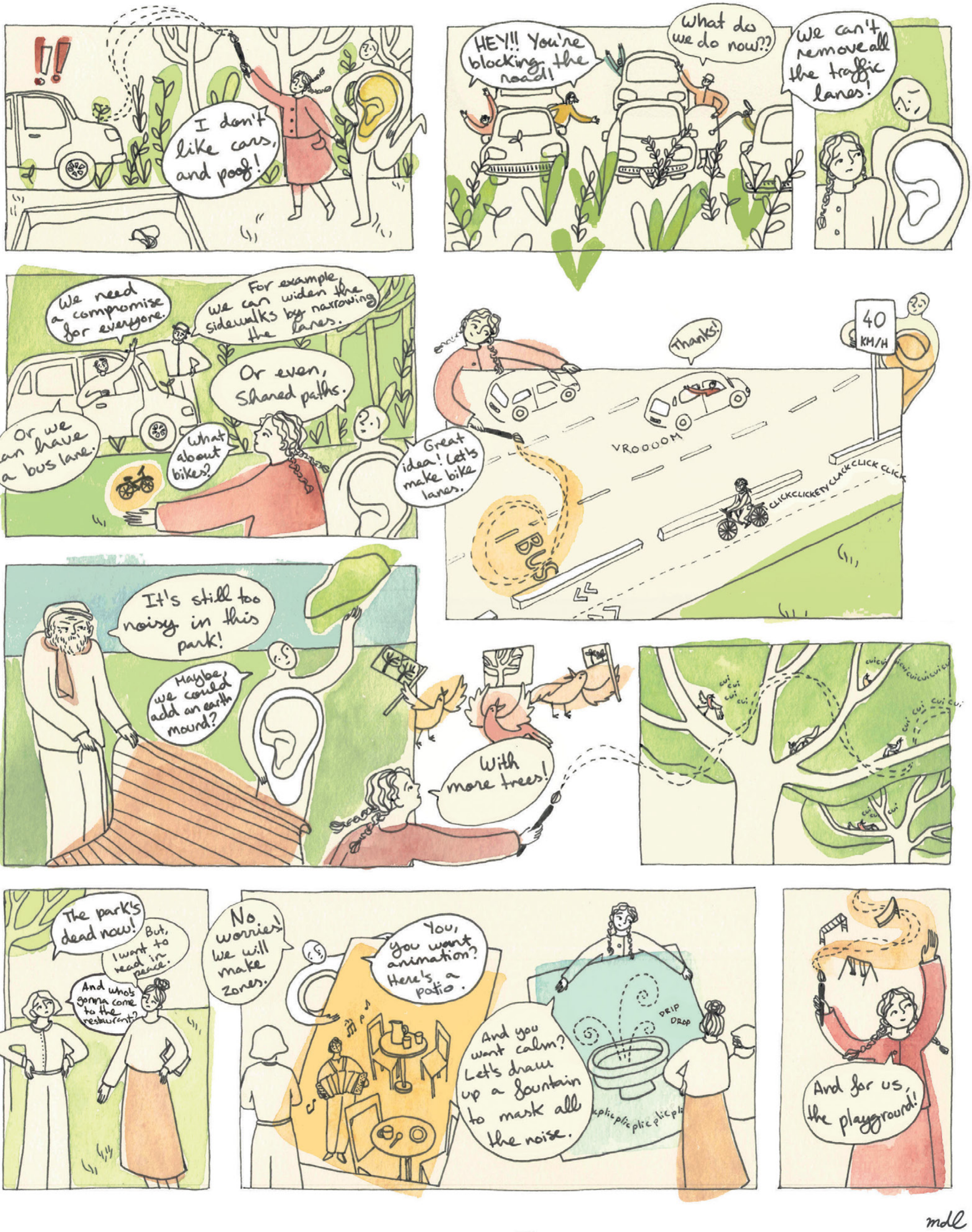
- Christopher Trudeau
- Valérian Fraisse
- Cynthia Tarlao



Artist/Cartoonist

- Madeleine Guastavino


WHAT IF WE RETHINK OUR CITIES THROUGH SOUND?
SKETCHING A SOUND ENVIRONMENT
Dad! Can I go to the park?
Y-CLACK CLICKET
CLACK CLIKETY
VRROOOOOM
VROOOOOM
VRROOOOM
VRROOOOM
RESTO
Yes, be careful, I'll be right there!
Yeah, see ya.
VROOOO
But, where is everyone?
NOISE
It's because of all this noise!
How unbearable. If only we could do something...
Hmmm I may have an idea!
There, I know!
Let's just redesign the city!
mdl


!!
I don't like cars, and poof!
HEY!! You're blocking the road!
What do we do now??
We can't remove all the traffic lanes!
We need a compromise for everyone.
For example we can widen the sidewalks by narrowing the lanes.
Or even, shared paths.
Or we can have a bus lane.
What about bikes?
Great idea! Let's make bike lanes.
Thanks!
40 KM/H
VROOOOM
BUS
CLICKCLICKETY CLACK CLICK CLICK
It's still too noisy in this park!
Maybe we could add an earth mound?
With more trees!
cui cui cui
The park's dead now!
But, I want to read in peace.
And who's gonna come to the restaurant?
No worries! We will make zones.
You, you want animation? Here's a patio.
And you want calm? Let's draw up a fountain to mask all the noise.
DRIP DROP
plic plic plic plic plic
And for us, the playground!
mdl


wow, what's happening here?
Dad! Listen!
The road supports alternative mobilities and reduces traffic noises.
Encourages conversations and add life.
RESTO
VRROOOM
Adds music and animates the space.
Bike lanes
CLICK CLICK CLICK CLIK CLIK
The wall shields from the train noise
CLICKETY-CLACK CLICKETY-CLACK
40 km/h
speed limit
cui cui
bla bla
MEETING ZONE
ARRÊT
VRROOOMMMM
The fountain adds natural sounds and masks traffic noises.
The greenery fosters biodiversity and natural sounds.
CLICKETY CLICK CLACK
The sidewalk promotes walking and human sounds
plic plic
20
CALM ZONE
cui cui cui cui
VRROOOOM
VRROOOM
BUS
Shields from traffic noise.
WOOF WOOF
WOOF WOOF
20
hahaha
PLAYGROUND
shared paths
WHAT RESEARCH TELLS US
The way our cities are planned centers on visuals and uses and can lead to unpleasant, monotonous and even harmful sound environments. Integrating how cities are sonically experienced, by involving communities, can foster more appropriate sound environments.
mdl

Acknowledgments

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Conferences

Below is a list of congresses and conferences sponsored by International INCE and INCE-USA. A list of all known conferences related to noise can be found by going to the International INCE website (www.i-ince.org).

- **JULY 9–11, 2026**
  NOISE-CON 2026
  Long Beach, California

- **AUGUST 9–12, 2026**
  INTER-NOISE 2026
  Adelaide, South Australia

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