NOISE/NEWS INTERNATIONAL

Volume 29, Number 2
2021 June

A quarterly news magazine and online digital blog published by I-INCE and INCE-USA

- Updates on INTER-NOISE 2021
- Machine relocation: How to predict floor vibration
- Phenomena study on the health benefits of noise abatement
- NOISE/NOTES with noise news from around the world

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A quarterly news magazine in PDF format with an Internet supplement published by I-INCE and INCE-USA

Volume 29, Number 2 **2021 June**

Features

Departments

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NOISE/NEWS INTERNATIONAL

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I-INCE

The International Institute of Noise Control Engineering (I-INCE) is a worldwide consortium of societies concerned with noise control and acoustics. I-INCE, chartered in Zürich, Switzerland, is the sponsor of the INTER-NOISE Series of International Congresses on Noise Control Engineering, and, with the Institute of Noise Control Engineering of the USA, publishes this quarterly magazine and its blog. I-INCE has an active program of technical initiatives. It currently has fifty-one member societies in forty-six countries.

INCE-USA

The Institute of Noise Control Engineering of the USA (INCE-USA) is a nonprofit professional organization incorporated in Washington, DC, USA. The primary purpose of the Institute is to promote engineering solutions to environmental noise problems. INCE-USA publishes the technical journal *Noise Control Engineering Journal* and with I-INCE publishes this quarterly magazine and its blog. INCE-USA sponsors the NOISE-CON series of national conferences on noise control engineering and the INTER-NOISE Congress when it is held in North America. INCE-USA members are professionals in the field of noise control engineering, and many offer consulting services in noise control. Any persons interested in noise control may become an associate of INCE-USA and receive both this magazine and *Noise Control Engineering Journal*.

NNI and Its Online Supplement

www.noisenewsinternational.net

The PDF and blog versions of *NNI* allow for links to references, articles, abstracts, advertisers, and other sources of additional information. In some cases, the full URL will be given in the text. In other cases, blue text will indicate the presence of a link. The *NNI* blog contains additional information that will be of interest to readers, such as the following:

- The current PDF issue of *NNI* available for free download
- Links to previous PDF issues of *NNI*
- An annual index of issues in PDF format
- A conference calendar for upcoming worldwide meetings
- Links to I-INCE technical activities and I-INCE technical reports

From the President of I-INCE: INTER-NOISE 2021 and the Future of Congresses

As I write this column, we are entering the home stretch for INTER-NOISE 2021. Abstract submissions were very robust and registrations are trending in a way that mean the INTER-NOISE 2021 will be a very successful virtual congress. I hope you will participate enthusiastically.

The Organizing Committee has done a very good job. It wasn't clear that the Congress would be virtual until about last November. While the Committee was faced with a significant number of decisions and revisions to their original plans, they were fortunate to have enough time and prior experience to develop a high-quality virtual congress with many features that should help participants to participate fully in the technical elements of the congress and enjoy some virtual social events with networking as well. It will be interesting to learn what worked and what didn't work at INTER-NOISE 2021 and how that informs future congresses.

After INTER-NOISE 2020, the I-INCE Board conducted a survey of participants to get feedback on their experiences and preferences for future congresses. A majority of the survey respondents expressed a preference for in-person congresses in the future. But a substantial minority said they prefer on-line congresses. Reasons for their preference were the substantial cost and time saved from not traveling as well as the flexibility to view presentations on their own schedule (including viewing more presentations than are possible for the in-person format). It will be interesting to see if participants feel the same after INTER-NOISE 2021.

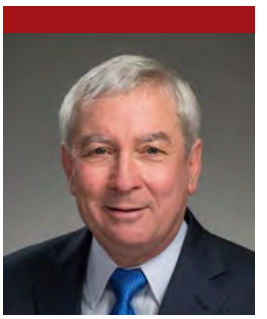
If so, given the large percentages with preference for each format, one could say that the results argue for a future "hybrid" conference format where on-line participants are able to see papers and presentations and participate in some networking activities with the in-person participants. However, to date the challenges of the hybrid format make it the most challenging, most expensive, and highest risk option. In addition, as I-INCE discovered in both 2020 and 2021, the time zones of international on-line participants offer only brief opportunities where participants from around the world are likely to be available at the same time. So, while travel expense and time argue for a hybrid international congress, the time zone challenges remain a significant obstacle.

However, as with many things the pandemic forced upon us that are not going away, I also believe that our INTER-NOISE format will be changed going forward. Much depends on the infrastructure changes that will be available to us. Universities that were forced to move educational delivery to on-line and hybrid modes now have the audio-visual infrastructure available to host hybrid congresses. It wasn't long ago that INTER-NOISE congresses were hosted at universities. Is that possible again? Will traditional congress venues see market pressure to add audiovisual infrastructure to their offerings such that showing presentations live or recording them will be straightforward and relatively inexpensive? INTER-NOISE is not the only congress where these same pressures are present. Some major congress hosts have reported significant increases in registrations when an on-line version was possible. Will these market pressures be enough to make hybrid congresses routine and widespread?

While logistically it is hard to imagine a fully hybrid international congress with a large number of synchronous activities, I would not be surprised to see a "mild hybrid" congress format emerge where on-line participants receive an "enhanced" Proceedings that could include recorded presentations and a virtual exhibition as well as on-line synchronous access to session discussions and an assortment of on-line networking events. I hypothesize that this mild format in its mature form wouldn't be a substitute for in-person attendance, but would have its own character, advantages, and followers.

It will be interesting to follow how this all plays out. We'll learn a lot at INTER-NOISE 2021 and we'll be interested in your feedback.

Bob Bernhard
President, I-INCE



Bob Bernhard

Editor's View

Welcome to the June 2021 issue of *Noise/News International*.

In this issue we learn about a brand-new professional society in Ireland (the Association of Acoustic Consultants of Ireland), which was founded less than two years ago, and earlier this year formally became the EEA membership society for the Republic of Ireland. We also hear from SoundPLAN, who write to tell us about a newly developed Room Acoustics module, while Eric Ungar returns with a tutorial describing what happens when a vibration-producing machine is to be moved. We also remember the life of one of the founders of INCE-USA, Jim Chalupnik, with a contribution from Ulf Sandberg.

This issue also includes a review of NOISE-CON 2020, which was held as an online event in late 2020. I thoroughly enjoyed the event, and with the success of NOISE-CON 2020 I do wonder if there is a place for hybrid online/in-person events in the future. While nothing can replace those face-to-face meetings or random chats over a cup of coffee, I was very impressed with how simple it was and how smoothly it all ran. On the back of this I'm really looking forward to INTER-NOISE 2021 in August, which of course will mark the 50th International Congress and Expo on Noise Control Engineering.

As I'm writing this, some parts of the world seem to be getting over the worst of the pandemic, whereas others are still fighting. I hope wherever you are in the world that you are safe, and the end of the pandemic is near, and someday we will all return to normal, or the new normal, whatever that may be.

I hope you enjoy this issue of *NNI*, and don't forget to listen to our companion podcast, The Noise/News, available wherever you get your podcasts.

Eoin A. King, PhD

Eoin A. King

NOISE/NOTES

Eoin A. King, *NNI* Editor

NNI is on Facebook and Twitter. We try to keep our readers informed with noise news from all across the globe by highlighting interesting research and projects. Here is a roundup of some of the stories that have been making headlines. Follow @NNIEditor to stay up to date with all noise-related news!

UECNA Launch Aviation Briefing

UECNA (Union Européenne Contre les Nuisances Aériennes/European Union against Aircraft Nuisance) is the only Europe-wide organization that represents airport communities at the European Parliament, the European Commission, and the International Civil Aviation Organization. UECNA also aims to support these communities with expert advice and the sharing of best practice and information through their network: https://www.uecna.eu/. In May they launched their first *Aviation Briefing*, a newsletter to keep readers informed of aviation developments at a European level.

European Green Deal

The European Commission recently adopted the EU Action Plan "Towards Zero Pollution for Air, Water and Soil," entitled "Pathway to a Healthy Planet for All." The action plan is accompanied by two staff working documents, one on zero pollution monitoring and outlook and the other on digital solutions for zero pollution. It sets out an integrated vision for 2050: a world where pollution is reduced to levels that are no longer harmful to human health and natural ecosystems, as well as the steps to get there. The action plan sets key 2030 targets to reduce pollution at source, and includes a target related to noise—to reduce the share of people chronically disturbed by transport noise by 30%.

Drones Creating Quiet Zones!

Dronelife recently reported on a really cool idea—a new USPTO patent application from Sony proposes using drones for noise cancellation. The idea is to use a networked system of drones, equipped with specialized audio equipment, to cancel out the noise of the environment and develop a virtual noise cancellation barrier. In this way the drones could create a mobile quiet zone… imagine the possibilities!

The International Year of Sound Extended through 2021

Due to the impact of the COVID-19 pandemic, the International Year of Sound has been extended beyond 2020, through the year 2021. Here is an interesting article from the International Science Council highlighting the importance of sound and related sciences and technologies for all in society.

Just for Fun…Lego and 10,000 Tiny Instruments

The Guardian (United Kingdom) reports on Lego White Noise—an album made by Lego (yes, that Lego), spanning 3 hours and 29 minutes, which provides recordings of someone building with Lego. It is a streaming-only album, which is described as a collection of soundscapes designed to promote relaxation and mindfulness. You should check it out.

The Sounds of Mars

Ever wonder how you would sound on Mars? NASA has developed a playlist outlining the subtle differences between the sounds on Earth versus how they would sound on the Red Planet. Grab your headphones, sit back, and have a listen.

Noise Is Bad for Your Health

Here is another article, this time from the BBC, outlining the now very well-established links between exposure to noise and adverse health effects. We can only hope that articles like these will elevate the issue of noise so it is no longer considered a forgotten or ignored pollutant.

EUROPEAN

NDT&CM2021

PRAGUE, CZECH REPUBLIC

OCTOBER 4-8, 2021

BETTER CM & NDT – WARRANTY OF QUALITY, RELIABILITY AND SAFETY

FOUR NDT, CM AND SHM EVENTS IN ONE WEEK IN THE MIDDLE OF THE EUROPE

Following the 1st ENDT Days in 2007 and the highly successful 11th European Conference on NDT 2014 (ECNDT 2014) in Prague, **the Czech society for NDT** in cooperation with other NDT and CM Societies is preparing another important meeting of experts and users from the **NDT, including Condition Monitoring and Structural Health Monitoring areas for the year 2021.**

The 2nd European NDT & CM Days in Prague (October 2021) will consist of – **11th workshop NDT in Progress, International conference NDE & CM for Safety, 51st annual CNDT conference Defectoscopy 2021** and **NDT&CM Expo**. During these days you can visit four different events at the Cubex centre Prague. It will be an exceptional opportunity to meet people interested in research & development, as well as in practice, standardization and the application of all NDT/NDE, CM and SHM methods with an emphasis on areas of modern Industry.

These „Days“ will be one of the most important NDT, CM, SHM and related branches **European events in 2021**. We hope that the 2nd European NDT&CM Days 2021 will not only be an opportune time for exchanging research findings but also an occasion for strengthening existing contacts and establishing new ones for all participants. Naturally, seminars, workshops, excursions and other social events will be organized.

This event represents a great opportunity for a select group of interested parties to be actively included in sponsoring and promoting the event and their business.

This will be the event of the decade; we hope to see you there!

Libor Topolář
CNDT president

Pavel Mazal
member of CNDT presidium

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What Floor Vibration Will a Machine Produce When It Is Relocated?

Eric E. Ungar, Acentech, Inc., Cambridge, Massachusetts

The Problem

In an often-encountered situation, a vibration-producing machine is to be moved from its present location to a new one without changing how the machine operates and one wants to predict the expected vibrations of the floor in the new location. If the floor structures are the same at the machine's present and new locations, then the vibrations that the machine will produce in its new location will be the same as those it produces in its present location. But what if the floor structures at the two locations differ considerably?

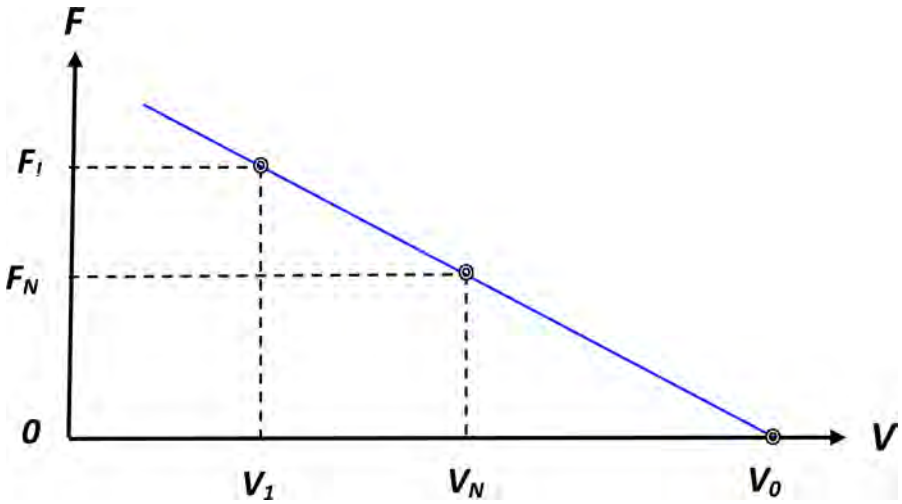
Basic Considerations

The following discussion focuses on vibrations in the vertical direction, in which direction floors are most easily set into motion. However, the approach discussed below can be applied for any direction.

The vibration velocity V of the floor under a mounting foot of the machine depends on the vertical force F that the mounting foot exerts on the floor as $V = F/Z$, where Z represents the floor's impedance at the point under consideration. (All symbols represent frequency-dependent magnitudes.) The vibration velocity of the floor at the machine's future location then is related to that of the floor at its present location by

$$\frac{V_2}{V_1} = \frac{F_2}{F_1}\frac{Z_1}{Z_2} \qquad (1)$$

Subscript 1 refers to the machine's initial location and subscript 2 to its future location.



Relation between mounting foot's force and velocity

The foregoing expression permits one to take account of changing of the mounting foot's force as the foot acts against a different floor impedance. If that force does not change when the machine is relocated, then the velocity V_2 expected in the new location may be ascertained simply from the floor impedances Z_1 and Z_2 and the velocity V_1, all of which can be measured relatively easily. (Note that the floor impedances need to be measured without the machine in place—or at least without the mounting foot under investigation in contact with the floor.)

Accounting for Change of the Vibratory Force

One may expect that in the general case the mounting foot will vibrate with a smaller amplitude and exert a greater force as it is made to act against structures that impede its motions to a greater extent. This change can be accounted for at least approximately by assuming a linear relation between the mounting foot's force and its velocity—that is, taking the force/velocity relation as corresponding to a straight line (see figure).

One readily established point on that line indicates the velocity V_1 measured at the machine's foot in the machine's initial location (with the machine in operation, of course) and the related force F_1 exerted by the foot. That force may be calculated from $F_1 = Z_1V_1$ using the floor impedance Z_1 measured at the mounting foot location (without the mounting foot making contact with the floor). One may find a second point on the line by having the mounting foot act against a structure with a new measured or known "test impedance" Z_N, measuring the corresponding new velocity V_N, and determining the force $F_N = Z_nV_N$. A test impedance may be realized, for example, by inserting a soft pad or mount with

known properties between a relatively rigid floor and the mounting foot. (In a test configuration that is particularly convenient if it can be implemented practically, the foot is kept out of contact with any structure. In this case $F_n = Z_n = 0$ and the mounting foot's velocity V_n can be measured relatively easily.)

The force/velocity line indicates that the mounting foot's force F is related to the foot's velocity V as

$$\frac{F}{F_1} = 1 + \left(\frac{V - V_1}{V_N - V_1}\right)\left(\frac{F_N}{F_1} - 1\right) \qquad (2)$$

If one applies this relation to the machine's new location, identified by subscript 2, and combines the result with equation (1), one obtains

$$\frac{V_2}{V_1} = \frac{Z_1}{Z_2}\left[1 + \left(\frac{V_2 - V_1}{V_N - V_1}\right)\left(\frac{F_N}{F_1} - 1\right)\right] \qquad (3)$$

By solving this expression for V_2/V_1 one may determine the sought-for relation of the velocity V_2 at the machine's new location to the velocity V_1 at its initial location:

$$\frac{V_2}{V_1} = \frac{\frac{Z_1}{Z_2}\left(\frac{V_N}{V_1} - \frac{F_N}{F_1}\right)}{\left(\frac{V_N}{V_1} - 1\right) - \frac{Z_1}{Z_2}\left(\frac{F_N}{F_1} - 1\right)} \qquad (4)$$

In the special case where the test impedance $Z_N = 0$ (e.g., where the mounting foot was allowed to vibrate with no significant contact with any structure), $F_N = 0$ and the foregoing equation reduces to

$$\frac{V_2}{V_1} = \frac{\frac{Z_1}{Z_2}\frac{V_N}{V_1}}{\frac{Z_1}{Z_2} + \frac{V_N}{V_1} - 1} \qquad (5)$$

For the case where $Z_1 = Z_2$, the two foregoing equations yield $V_2 = V_1$, as one would expect.

From equations (1) and (4) one may determine that

$$\frac{V_2 \text{with constant force}}{V_2 \text{with variable force}} = \frac{\left(1 - \frac{F_N}{F_1}\right)\frac{Z_1}{Z_2} + \left(\frac{V_N}{V_1} - 1\right)}{\left(1 - \frac{F_N}{F_1}\right) + \left(\frac{V_N}{V_1} - 1\right)} \qquad (6)$$

This relation indicates that assumption of a constant force results in overestimation or underestimation of the velocity the machine induces in the floor at the new location, depending on whether Z_1 is greater than or smaller than Z_2, respectively—in agreement with intuitive expectations.

Summary of Evaluation/ Prediction Steps

a. Measure the velocity V_1 of the floor and mounting foot at machine's initial location.

b. Measure the impedance Z_1 of the floor at machine's initial location, without the machine (or mounting foot) in contact with the floor.

c. If possible, measure the velocity V_0 of the mounting foot as it makes no contact with the floor. Otherwise, measure the velocity V_N that the machine produces on a support with known impedance Z_N. (If a measurement is done with an isolator or pad that is much softer than the supporting floor, take Z_N as the impedance of the isolator or pad.)

d. Calculate the force $F_N = Z_N V_N$. If the methodology of step (c) was used where the mounting foot was made to have no contact with a structure, take $F_N = Z_N = 0$.

e. Measure the impedance Z_2 of the floor at the machine's planned location.

f. Calculate the floor velocity V_2 at the new location using equation (4). If $F_N = Z_N = 0$, use equation (5).

In the most general case this procedure would need to be carried out for each of a machine's mounting feet. However, if all of a machine's mounting feet behave similarly, this procedure needs to be carried out for only one mounting foot. All velocity and impedance measurements should be made over the frequency range of concern, but in cases where the machine produces significant vibrations only at a few frequencies, the measurements and calculations discussed here need only be carried out at these frequencies.

Some Background

Vibration sources with linear force/velocity characteristics are discussed in "High-Frequency Vibration Isolation," by E. E. Ungar and C. W. Dietrich, *Journal of Sound and Vibration*, 1966, based in part on "The Evaluation of Mounts Isolating Nonrigid Machines from Nonrigid Foundations," by A. O. Sykes, *Shock and Vibration Instrumentation*, ASME, 1956, and "Isolation of Vibrations," by D. Muster and R. Plunkett, *Noise Reduction*, McGraw-Hill, 1960.

SAE International Recognizes Dr. Pranab Saha with the Organization's 2021 Medal of Honor

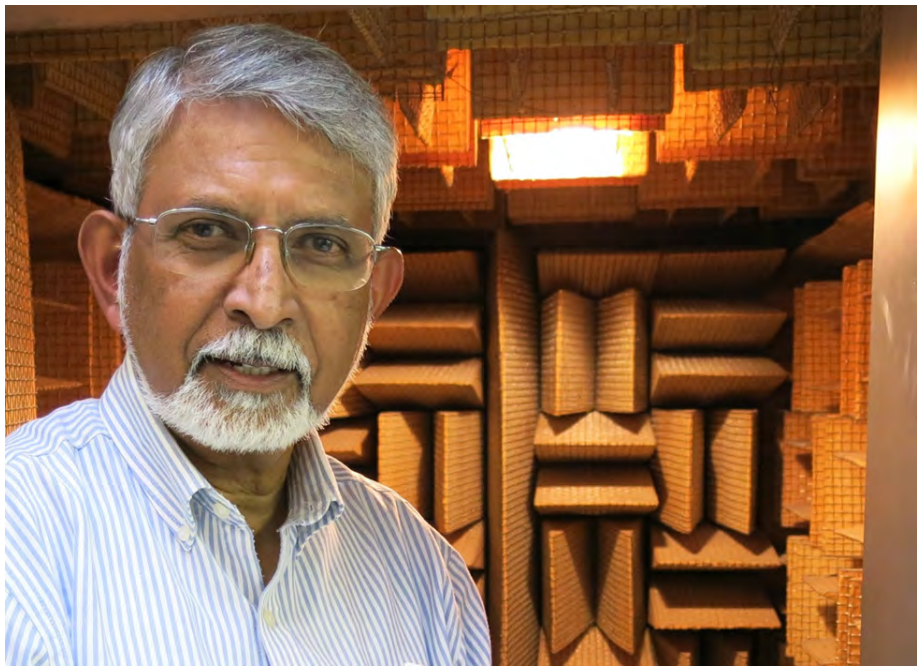
Award Honors an Active SAE Member for Unique and Significant Contributions That Strengthen SAE's Ability to Advance Mobility Knowledge and Solutions

SAE International recently announced that Dr. Pranab Saha, cofounder and principal consultant at Kolano and Saha Engineers, Inc., is the recipient of the 2021 SAE International Medal of Honor. As SAE International's most prestigious award, this honor recognizes an SAE International member for their unique and significant contributions to the industry and organization.

"Dr. Saha has demonstrated an exemplary commitment to supporting both SAE International and the entire mobility industry through his contributions and leadership. This commitment has distinguished him among his peers, and we are proud to honor his commitment with this award," said Lori Gatmaitan, director of the SAE Foundation. "Dr. Saha's efforts are reflective of SAE's entire 138,000-plus membership base, who lend their time and expertise to support our mission of advancing mobility knowledge and solutions for the benefit of humanity."

In his role as principal consultant at Kolano and Saha Engineers, Inc., Dr. Saha leads automotive, commercial vehicles, other transportation systems, appliances, and product noise-related programs in addition to serving as the direct link between the client and company's staff and resources.

Dr. Saha is a well-known authority on automotive noise, body interior systems, and sound package materials. He has



directed and participated nationally and internationally in numerous advanced noise control engineering programs and training seminars for various OEM companies and suppliers worldwide.

As a contributor to SAE International, Dr. Saha led the development of the SAE document "How to Write an SAE Technical Paper" and has helped develop several SAE standards on acoustics. He is a professional development instructor, lead faculty member of the SAE Vehicle Interior Noise Academy and is currently serving as an associate editor for the SAE *International Journal of Vehicle Dynamics, Stability and NVH*. He has presented several technical papers and has organized and chaired numerous technical sessions sponsored by SAE and other professional organizations. Dr. Saha was previously honored with SAE's Forest R. McFarland award twice and the Technical Standards Board certification of appreciation.

Dr. Saha is a member of SAE International, ASA, ASME, ASTM, ESD, INCE-USA, and NSPE/MSPE. Previously, he was the chair of the SAE Engineering Meetings Board (EMB), Technical Quality Response Team chartered within EMB, SAE Noise and Vibration Conference, and

SAE Acoustical Materials Committee and contributing editor of *Sound and Vibration* magazine. He served on SAE International's Executive Nomination Committee and on the Fellows Committee.

Dr. Saha is a fellow member of SAE International and ESD, a practicing professional engineer (PE), and an INCE Board Certified in Noise Control Engineering and has been named an SAE Master Instructor.

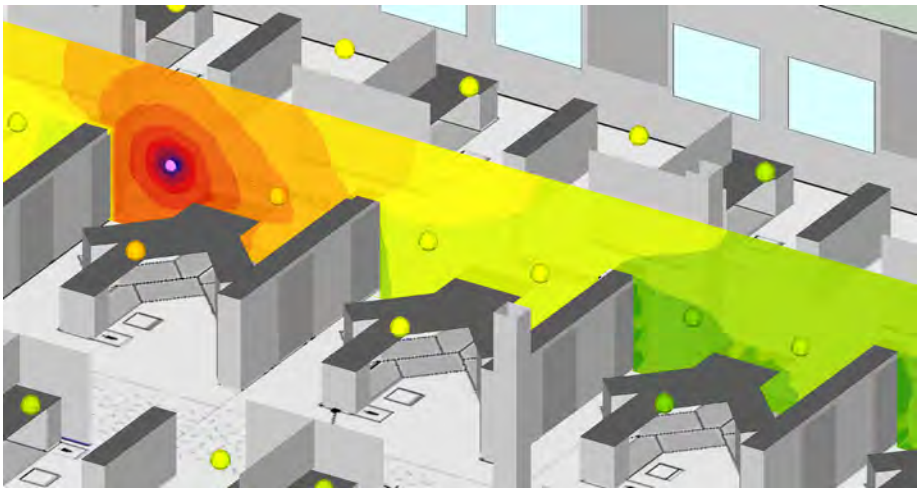
About SAE International

SAE International is a global association committed to advancing mobility knowledge and solutions for the benefit of humanity. By engaging nearly 200,000 engineers, technical experts, and volunteers, we connect and educate mobility professionals to enable safe, clean, and accessible mobility solutions. We act on two priorities: encouraging a lifetime of learning for mobility engineering professionals and setting the standards for industry engineering. We strive for a better world through the work of our philanthropic SAE Foundation, including award-winning programs like A World In Motion® and the Collegiate Design Series™. More at www.sae.org.

Noise Mapping Specialist SoundPLAN Launches Newly Developed Room Acoustics Module

Noise mapping software specialist SoundPLAN GmbH has launched a newly developed room acoustics module, available in its world-leading software SoundPLANnoise. The tool has incorporated noise calculations for indoor environments for many years, but this update takes calculating sophisticated acoustic scenarios with arbitrary geometries to another level—even in complex situations.

The module is designed for application in the fields of occupational health and safety, and room acoustics. The specialized software supports engineers, architects, and planners in the design process. Modern architecture is based upon new and innovative technologies and is characterized by exposed concrete and glass facades and open room concepts.



SoundPLANnoise room acoustics software, sound level.

This poses a great challenge to achieving pleasant acoustics that are suitable for the intended use of the room, and failure to do so often results in annoyance, stress, and poor work performance.

Possibilities and Scope of Functions

The algorithm used for this purpose is the sound particle diffraction (SPD) method, which is an extension of the well-known

Example of interior office space (Source: Pixabay).

Example of auditorium space (Source: Pixabay).

and frequently used ray-tracing method. It allows the user to analyze and evaluate the acoustic properties of a room and any room acoustic optimization measures extensively and in detail.

In addition to the frequency-dependent sound pressure level values, all commonly used room acoustic parameters according to ISO 3382, such as reverberation time, Definition—D50, and speech decay rate can be calculated. It is also possible to calculate the increasingly popular speech transmission index (STI) and listen to how recordings sound in a room (auralization). By storing the corresponding evaluation criteria according to VDI 2569 and DIN 18041, the user can quickly check whether the room acoustics meet the selected requirements.

The room acoustics module is designed for use across a range of room types, where the demands on the acoustic quality may vary greatly. This includes open plan offices, conference and lecture theaters, concert halls, restaurants, and doctors' practices.

The program also has features to help accommodate electro-acoustics. In addition to frequency-dependent directivities, all sources have a delay setting, and the Source Library within the software contains a selection of official specifications and loudspeakers.

How Does It Work?

For the interior calculation, in addition to the geometry, the user simply enters the essential acoustic properties (absorption coefficients, scattering coefficients if available, and transmission coefficients) of the boundary surfaces and furnishings. A new interface to the Sarooma acoustics database gives direct access to data from over 3,200 commercially available sound-absorbing acoustic products from many well-known manufacturers. This, together with the improved, intuitive room editor, leads to easy and fast model creation.

A detailed overview of the results, and the possibility of producing meaningful graphics such as color maps of all room acoustic parameters, simplifies the comparison and evaluation of the measures and makes it easier to communicate results with customers.

Proof of Principle

The calculation is based on state-of-the-art scientific methods. In the sound particle model, the source emits sound particles, taking into account the directivity. These sound particles carry different energies per frequency band.[1] On their way through the acoustic landscape, they are reflected specularly or diffusely (according to Lambert's distribution) at boundary surfaces or obstacles, depending on the surface. When the sound particles pass through receivers on their flight, these detect the time and energy. In this way, an energetic impulse response is formed in the course of the simulation. From this, all further room acoustic quantities can be calculated.

In the sound particle method with uncertainty-based diffraction, particles are additionally deflected to a greater or lesser extent depending on the bypass distance at diffraction edges. This approach, empirically derived from Fraunhofer diffraction, allows the extension of the sound particle high-frequency approximation to lower frequencies and has already been able to offer advantages in numerous studies/investigations.

For more information about the room acoustic module and SoundPLANnoise software, visit: www.soundplan.eu, email SoundPLAN's distributor in Canada and the USA at forschner@navcon.com, or contact the team at SoundPLAN's headquarters at marketing@soundplan.de. For press enquiries please contact Michelle

SoundPLANnoise room acoustics software, speech transmission index.

Eastty at Ceris Burns International, t: +44(0)1506 857790, e: michelle@cbipr.com, w: www.cbipr.com.

About SoundPLAN

SoundPLAN GmbH in Backnang, Germany, is an engineering company with the main focus on noise control and software development. Its interdisciplinary team consists of engineers, geographers, physicists, and computer science specialists. The team generates cutting edge engineering solutions delivered to the global market in the format of our SoundPLAN software. Its SoundPLAN noise modeling software has maintained the status of the market leader for more than 35 years.

Note

1. U. M. Stephenson, "An energetic approach for the simulation of diffraction within ray tracing based on the uncertainty relation." *ACUSTICA United with Acta Acustica 96*, no. 3 (2010): 516-535.

ecore™

New Floor Impact Sound Test Data available from Ecore

PERFORMED BY INTERTEK INDEPENDENT IAS-CERTIFIED LAB IN YORK, PA

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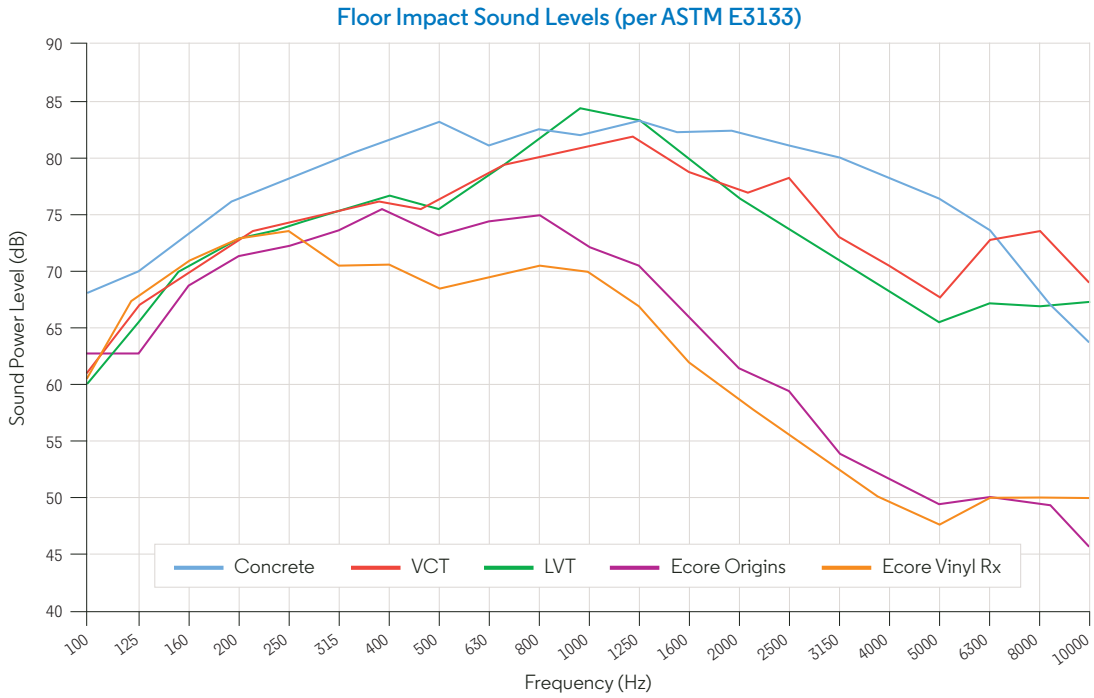

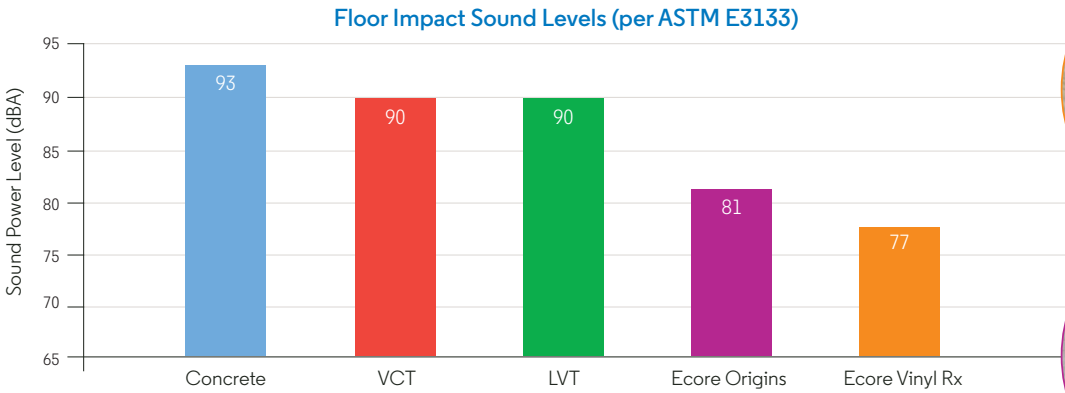

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In Memoriam: James (Jim) Chalupnik

By Ulf Sandberg, Swedish National Road and Transport Research Institute

It is with great sadness that we announce that James (aka Jim) Chalupnik passed away on January 14, 2020. Jim was one of the original Founders of INCE-USA.

James Dvorak Chalupnik was born in Bay City, Texas, in 1931 to Czechoslovakian immigrants. He is survived by his wife Janet, his children Kenneth Henry Chalupnik and Karen Ann Chalupnik, and grandson Tyler James Chalupnik.

Jim grew up to attend Texas Tech, where he received his BS in Mechanical Engineering in 1953 while also serving as a naval officer during the Korean War. He received his MS in Engineering Mechanics from the University of Texas (UT) in 1960 and his PhD from UT in 1964.

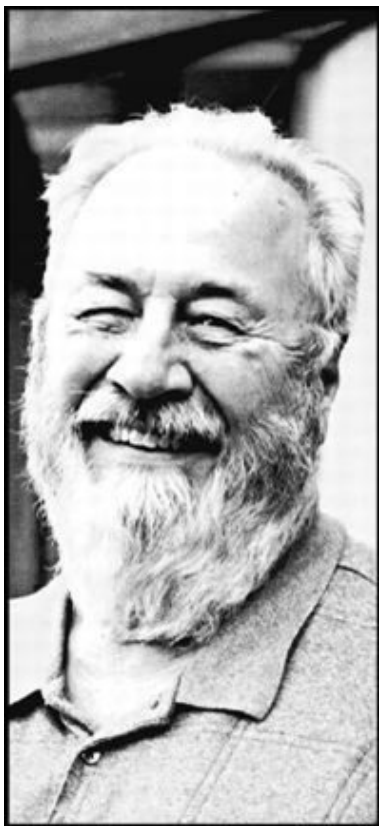

Fig. 1. Jim, as he is remembered by many: smiling and sharing his knowledge and humor. (Photo courtesy of Karen Chalupnik)

While at UT, James met Janet Connor. They soon married, and in 1963 adopted a baby boy they named Kenneth Henry. They moved their small family to Pasadena, California, where James worked for the Lockheed Missile and Space Company Research Labs in Palo Alto. It was in this job that he became interested in what would be his primary professional focus: acoustics and noise control.

In 1964, James got a job at the University of Washington (UW) as assistant professor of mechanical engineering and the family moved to Seattle. He was promoted to associate professor in 1968 and professor in 1977. He and Janet adopted their second child during this time, a girl they named Karen Ann. The family spent many years in Seattle, and James served a rewarding and distinguished 31 years at UW. He was a favorite among professors and was appointed professor emeritus in the Department of Mechanical Engineering on his retirement in 1995.

Jim wrote at least three books about tire noise and the acoustic characteristics of roadway surfaces. Two are out of print and one is still available on Amazon (and in my bookshelf): *Transportation Noises: Symposium on Acceptability Criteria*.

In regard to Jim's expertise in the acoustic characteristics of roadway surfaces, Dr. Fabienne Anfosso-Lédée recently shared that in 1987 she was doing a two-month internship with Jim's team at UW. The work consisted of participating in a Close ProXimity (CPX) tire/road measurement campaign for the monitoring of acoustic properties of several road sections amid the beautiful scenery of Washington State, a pioneering study for a still relevant issue. As of January 1, 2021, Dr Anfosso-Lédée is the convener of the ISO WG that develops the CPX and a few other ISO standards, so it is fair to say that she got an excellent start in this career thanks to Jim.

I got to know Jim in the late 1980s when he was appointed US member in an ISO standardization group (ISO/TC 43/SC1/WG 33) that I convened. He had valuable experience in measuring noise emission from the tire-pavement interaction, partly based on using what we now call a CPX trailer that he had developed, and his advice was appreciated in the group. He took part in developing ISO 11819-1 (the SPB method) and in designing the first unofficial but widely used version of the CPX method, later to become ISO 11819-2. After Jim's retirement we continued to stay in contact via frequent emails.

Jim was not only a skilled researcher in acoustics and vibration. Humor was also a substantial part of his life. Whenever we had some relaxing times in conjunction with our ISO meetings, Jim liked to joke and made us laugh really hard many times. After his retirement in 1995, and until one month before his passing, Jim and I continued to have fun conversing about various aspects of life. Jim was also a generous person, which I enjoyed when some of the ISO group members and I had the opportunity to visit him and Janet in their home in Seattle in 1994. I cherish many fond memories of our time together.

It was during his time at UW that Jim co-founded INCE-USA in 1971. He was later appointed fellow of the institute, based on his service as founder and former director of INCE-USA, as well as for his contributions to education in acoustics and noise control

engineering and research in roadway noise, modal analysis, shock and vibration, and stress analysis. Jim was also recognized for leadership in community noise control and abatement and volunteer service in noise control at all levels of government in the United States and internationally.

In retirement, Jim and Janet moved to Edmonds, Washington. They traveled often, and, while home, were very active in their community and in Edmonds Unitarian Universalist Church.

Finally, I want to add condolences from some present or previous ISO WG 33 members, Fabienne Anfosso-Lédée, Truls Berge, Jørgen Kragh, and Heinz Steven, who have asked me to mention that they loved working with Jim and sharing a beer here and there while having fun, mostly in Europe. We all knew and forever will remember Jim, not only as a professor who made an impact on the US and international noise engineering scene but also as a truly gentle and joyful person. Jim is deeply missed and our sincere thoughts go to Janet, Jim's wife for so many years, and to their children.

Fig. 2. The last time the author met with Jim, at NOISE-CON 2011 in Portland. Jim was 80 then. (Photo taken with Ulf's camera by an unknown colleague)

Note: Part of this remembrance is copied from the obituary written by Jim's daughter Karen Chalupnik, who reviewed and approved this article.

The Association of Acoustic Consultants of Ireland

Damian Brosnan

I'm an acoustic consultant in the Republic of Ireland (ROI). I've been a sole trader since 2015. Prior to that, I was a partner in a multidisciplinary environmental consultancy for 15 years. I was the sole noise guy in the consultancy. Although being a sole trader and being a sole noise expert in a larger team are very different, they share one common feature: Where does a sole noise operator go to for support? In a team with several experienced acoustic consultants, junior members can approach others for advice. A casual discussion around the coffee machine can resolve any noise issue. The knowledge that an experienced practitioner picks up over the years is not taught in university, or at seminars, or in online continuing professional development (CPD) sessions.

The poor acoustic consultant who operates solo does not have access to such an incredible resource as the wily old expert who has encountered every possible noise issue under the sun. For instance, a difficult project lands on your desk that can be approached in a number of ways. Which way is best? How do you know that your interpretation of a standard is the right one? What averaging window should you use? And who was Maekawa anyway?

There are other drawbacks too. It is difficult to keep tabs on the standards that are being revised and updated all the time. It can be even more difficult to contribute to the development of standards. You might be an expert on the relationship between vehicle speed, asphalt type, and noise level, but what standard review committee is going to listen to you? Why should that department official or environmental regulatory body pay any heed to your little opinion?

Enter the Association of Acoustic Consultants of Ireland (AACI). The question that sticks in my mind is, Why didn't we think of it sooner? You see, I was not alone. There were other acoustic consultants across the country, beavering away on noise impact assessments, calibrating sound level meters in a field at night, and checking their notes before presenting evidence in the case of Mr. & Mrs. Longsuffering -v- Noisy Factory Ltd. Sure, I'd heard of these consultants. I had met many of them over the years at various conferences and talks. I'd reviewed reports written by some of them and looked at them across the courtroom. I'd even collaborated with some of them on large projects. But I didn't realize that they were experiencing the same issues as I did. It turns out that we all suffer from impostor syndrome.

The AACI was formed in 2019 out of discussions among a few acquainted acoustic consultants who ultimately became founding members. The genesis of the association would most likely have been slower if not prompted by two factors. Coincidentally, both factors originated outside of the ROI.

The AACI project was particularly driven by current chairman Diarmuid Keaney. Diarmuid and the similarly experienced Ted Dalton had both encountered difficulties in winning various acoustic testing contracts in completed residential developments. They were being regularly denied the opportunity to quote by potential clients because of the clients' misinterpretation of a policy statement issued in Northern Ireland (NI)—not even the same jurisdiction. Diarmuid and Ted had been trying to get the issue resolved with the relevant government department in the ROI. They had also raised the issue with the Irish branch of the Institute of Acoustics (IOA), which had an indirect involvement in the original NI policy statement. Their frustration with progress convinced them that there was a need for

a trade body for acoustic professionals working in the ROI.

The second factor was Brexit, which we all thought was the worst thing that would affect our lives this century. Those were simpler times! Being members of the IOA, we were entirely unsure how Brexit would affect us. The only thing we were sure about was that we should not be sure about anything. We did not know how the departure of the United Kingdom from the European Union would affect the IOA's role in the ROI, or our daily use of the wide range of excellent British Standards in circulation. We still don't, in fact. We needed a voice to represent us among all this upheaval.

And so the AACI was quickly born. Since 2019, several more acoustic consultants have been invited to join. Membership now stands at 10, which is not bad for a country of only 5 million. It will continue to grow as more consultants ask or are invited to join. The 10 current members probably have a combined total of 200 years' experience, across environmental noise, occupational noise, and building acoustics. Each member excels in a certain area, such as traffic noise, building insulation, impact assessment, wind farm noise, and so on. It's like the world's greatest acoustic team!

The wide range of expertise is not just confined to acoustics. Some are great at social media. Some are great at presenting. Some are really good at writing articles such as this; unfortunately they were busy, so I stepped in. I've noticed that one member is astoundingly good at picking out minute but critically relevant details in guidance documents, the kind of details that I miss, even after I've been told where they are. These skills are essential when promoting a new professional entity. With only a small number of members at present, everyone pitches in to help grow the association. As the AACI grows, it is hoped that new members will contribute and bring their own unique skills to bear.

It is intended that our association will fulfill a role similar to that provided by the Association of Noise Consultants (ANC) in the United Kingdom. The ANC describes itself as a representative body for acoustic consultancies. We see our role as similar, meeting a need in the ROI that the IOA cannot. We see the AACI as a professional association for qualified acoustic, noise, and vibration consultants, as well as other professionals working in the field of acoustics in the ROI.

One major difference between the ANC and the AACI is that we decided, after some discussion, to award membership to individuals rather than companies. This allows tighter control on membership. The chief AACI membership criterion is full membership of the IOA. All current AACI members are also IOA members and have completed the IOA postgraduate diploma in acoustics and noise control. Several AACI members also sit on the IOA Irish branch committee and actively participate in the advancement of acoustics in the ROI.

In the short time that the AACI has been in existence, some major goals have been achieved. At the start of 2021, we registered with the European Acoustics Association (EAA) and have now formally become the EEA membership society for the ROI. We have reached out to several acoustic researchers spread across ROI colleges and universities, with a view to potential collaborative work in the future. A code of ethics has also been prepared.

The founding members of the AACI are (clockwise from top left) Diamuid Keaney, Chairperson; Damian Brosnan, Guidance Document Coordinator; James Walsh, Ethics Committee Member; and Ted Dalton, Group Secretary, Finance and Membership.

One of our biggest achievements has been the preparation of the ROI's first substantial noise guidance document issued outside of the ROI government or the EPA. The document, aimed at local authorities, provides guidance on drafting noise conditions for inclusion in planning permission and identifies key issues to look out for when reviewing impact assessment reports. It also summarizes all the noise guidance documents currently available. The document has been well received in the absence of any governmental guidance, and several local authorities make reference to the document in their noise action plans.

It is the AACI's intention to prepare further guidance documents in the future. First up will be a document relating to sound testing measurements, one of the objectives of which will be the setting out of clear guidance on competence with a view to finally resolving the issues identified by Diarmuid and Ted previously. The AACI has been in discussion with the relevant government department regarding the issue in the meantime.

Another area where the AACI has excelled has been the provision of short training courses and seminars, which go toward CPD. Members cannot get enough of these. Through the collective power of networking and purchasing, approximately 10 such seminars have been held to date, mostly online. This will continue to be a big part of the AACI's raison d'être in the future.

One AACI feature that was completely underestimated at the outset is a WhatsApp group for members, where advice can be sought on any acoustic issue. This has been a godsend on complex projects. Why spend hours trying to determine the relevance of some parameter in a formula that begins with Σ and ends with four closing brackets when a quick question on the WhatsApp group will shine a light? Members are only too happy to help.

This is fundamentally what the AACI is about: improving the standard of acoustic assessment and surveys in the ROI through collaboration. As I mentioned earlier, why didn't we think of this sooner?

Assessment of Potential Health Benefits of Noise Abatement Measures in the European Union: Phenomena—A Study for the European Commission

Michael Dittrich, Erik Salomons, Eszter Kantor, Magdalena Klebba, Nico van Oosten, Itziar Aspuru, Nuria Blanes, and Jaume Fons*

Introduction

In March 2021, a study was concluded on the **P**otential **He**alth Benefits of **No**ise Abate**men**t Me**a**sures in the European Union (Phenomena),[1] performed for the European Commission Directorate-General for Environment by a consortium consisting of VVA, TNO, Anotec Engineering, Tecnalia, and Autonomous University of Barcelona.

Noise exposure from road, rail, and aircraft is a major health burden, second only to air pollution, with around one in five people in the EU exposed to high noise levels with negative impacts on health. Road traffic has by far the largest impact. According to the World Health Organization (WHO), the impacts include cardiovascular disease, cognitive impairment in children, sleep disturbance, and annoyance.[2] With traffic and urbanization continuously growing, policies are required to reduce these impacts. In the EU policy framework, there are several instruments for this, such as the Environmental Noise Directive (END), legislation for noise limits for new road and railway vehicles, operational regulations for aircraft (Balanced Approach, and for railways (quieter routes), and the Green Deal, which includes noise as well as emissions.[3–8]

The objective of the study was to support the European Commission in defining noise abatement measures capable of delivering a 20–50 percent reduction of the health burden due to environmental noise from roads, railways, and aircraft and to assess how relevant noise-related legislation could enhance the implementation of measures, while considering the constraints and specificities of each transport mode. The project collected and analyzed data from geographic areas as set by the END, for

- roads and railways inside agglomerations of more than 100,000 inhabitants;
- major roads with more than 3 million vehicles a year;
- major railway lines with more than 30,000 trains a year; and
- major airports with more than 50,000 movements a year.

The focus was on situations with long-term noise exposure levels above 53 dB L_{den} for roads, above 54 dB L_{den} for railways, and above 45 dB Lden for airports. These are the exposure levels mentioned by WHO's 2018 Environmental Noise Guidelines for the European Region.[2]

Peak noise from occasional sources that does not affect the L_{den} levels was not within the scope, although it can be relevant for perceived noise. Health impacts are primarily associated with the year-averaged L_{den} and L_{night} levels.

The study ensured that results are representative at the EU level by analyzing a wide range of literature sources and assessing a balanced selection of member state noise abatement practices. The following was undertaken to achieve these objectives:

- A review of international and EU literature as well as EU and member state legislation
- Assessment of noise action plans (NAPs) and their implementation and enforcement
- A broad stakeholder consultation and two stakeholder workshops
- Identification and assessment of legislative drivers of noise abatement solutions
- Revision of the intervention logic
- Listing of good practices

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- Health impact assessment and cost-benefit analysis (CBA)
- Assessment of available noise abatement solutions
- Scenario analysis of noise abatement solutions
- Proposals for EU and member state policies to reduce the health burden

Overall Findings

Overall, the study found that within the given time frame up to 2030, more than 20 percent reduction in health burden would be feasible, and this is possible only by using combined noise abatement solutions, which are driven and supported by revised and strengthened EU environmental policies, including the END, noise source directives (limits for vehicle noise emission), the European Green Deal, and other legislative measures with a strong environmental impact. There is also a recognition that a revised EU policy framework is only as good as the national implementation and enforcement measures are in the member states. Consequently, in order to harmonize the fragmented approaches currently seen in member states and to drive the dissemination of good practices, increased emphasis should be put on the consultative participation of those national and local authorities that identify, select, and implement noise abatement measures.

EU and National Legislation

The consortium reviewed international, EU, and member state level legislation and research that could, directly or indirectly, impact the reduction of noise sources and consequently the reduction of the associated health burden. The review found that noise mitigation requires more efficient horizontal coordination between different policy areas and alignment with the Green Deal ambitions in pursuing sustainable development goals (leading to more electrification and less propulsion noise). In doing so, the EU would put more emphasis on the focal point of its environmental policy: the principle of integration of environmental policy in other sectors. Horizontal coordination can also bring cost savings as pointed out in the European Environment Agency's (EEA) 2020 report,[9] which states that air and noise mitigation measures jointly would give better cost-benefit results than each of these areas treated separately.

The role of national and local legislation and enforcement is of primary importance as urbanization levels, geographic aspects, and local governance mechanisms all have an essential role in determining the selection and implementation of the most adequate noise abatement solutions. Noise abatement practices applicable for various transport modes differ between member states, and relatively little attention is paid to the sharing of good practices. Increasing communication and encouraging consultation between the local authorities of EU member states in charge of selecting and implementing the noise abatement measures could facilitate an increase in the implementation of effective noise solution measures.

A schematic overview of EU legislation in relation to noise from transportation is shown in figure 1. Elements of national legislation are shown in figure 2. They both affect environmental noise in the "real world," although in different ways. Perceived noise and long-term average noise exposure, which is considered most relevant for health effects, can differ.

Noise Action Plans

Three hundred NAPs were reviewed with the aim of identifying which noise

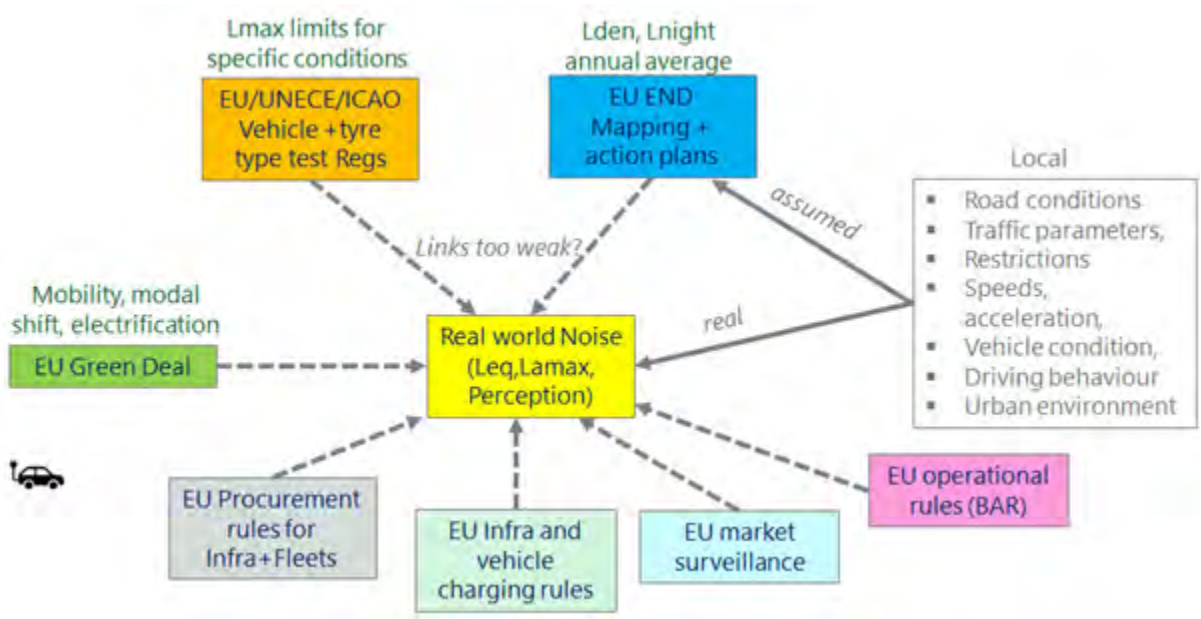

Fig. 1. EU legislation in relation to noise from road, railway, and air transportation.

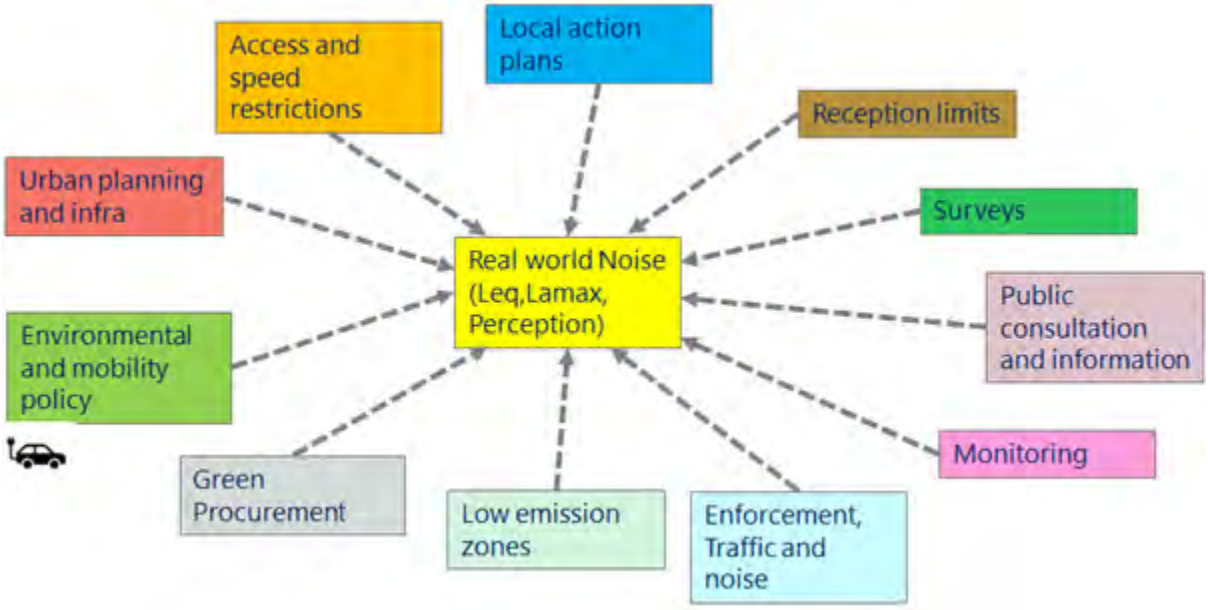

Fig. 2. Elements of national legislation in relation to noise from transportation.

abatement measures have been planned and implemented in member states. For 100 action plans, more detailed information was gathered on the implemented interventions and the extent to which national and EU legislations drive the implementation of noise abatement measures.

Road: Member states may prefer noise barriers, quiet road surfaces, and road maintenance as main solutions. These are usually combined with other source and infrastructure interventions and mobility plans depending on the availability of financial and technical resources. Public awareness and information campaigns are less common.

Rail: Common measures implemented or planned are rail grinding, noise barriers, rail dampers, and embankments. Also innovative or unique solutions such as quieter railpads or low barriers were identified, although these are not widespread and not yet approved everywhere.

Aviation: Measures are both at receiver and source level. These often combine operating restrictions such as curfews with a penalty regime, noise monitoring, and infrastructure development, including lengthening the runway to avoid low flights over residential areas.

Fig. 3. Rail traffic noise (courtesy of TNO).

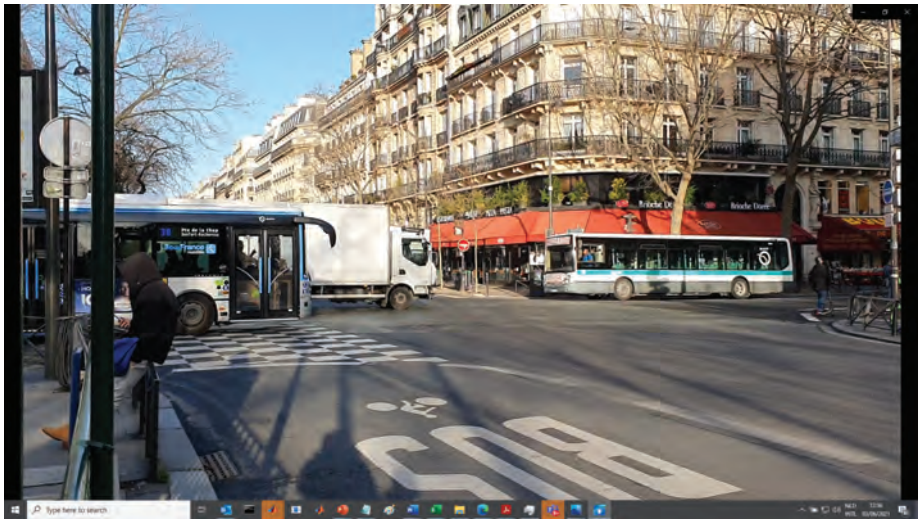

Fig. 4. Urban crossing (courtesy of TNO).

Stakeholder Consultation and Workshops

Stakeholders were widely consulted throughout the project. Bilateral interviews with member state officials, private enterprises, NGOs, associations, researchers, and EU officials were conducted. The purpose of the interviews was to gather information relating to national or EU level implementation of noise abatement solutions and to clarify stakeholders' positions on the effectiveness of noise abatement measures as well as their suggestions on potential improvements. Altogether 64 stakeholder interviews were carried out, bringing together a balanced set of opinions from the three transport modes and agglomeration representatives of various member states.

Also two online workshops were held in June and November 2020, attracting over 200 participants from across Europe.

Intervention Logic

Intervention logic is the causal relationship between the needs, objectives, and inputs that drives the action of intervention and results in a form of desired outputs, results, and impacts. A revised intervention logic was proposed, with more defined needs and objectives for reducing noise pollution and relating it to the health burden. These needs and objectives can be met by a more effective implementation of a common approach to noise reduction, which also takes socioeconomic characteristics into account, for example, population growth and increased urbanization, share of low-income households, increasing connectivity in densely populated urban areas, and transport innovation. The revised intervention logic emphasizes those supporting measures that can further increase the application of relevant regulatory frameworks, such as financial assistance or stakeholder involvement.

The revised intervention logic emphasizes a more effective implementation that relies on a combination of measures including compliance with relevant EU and national policies as well as innovation and collaboration. Coherence between EU and member state policies, including those on thresholds and noise emission limits, is essential for achieving cohesion between noise abatement measures in the member states. Moreover, increased coherence between noise policy and various other policy areas to enhance cobenefits (e.g., urban and mobility plans) should be explored to facilitate a more effective implementation of noise abatement measures.

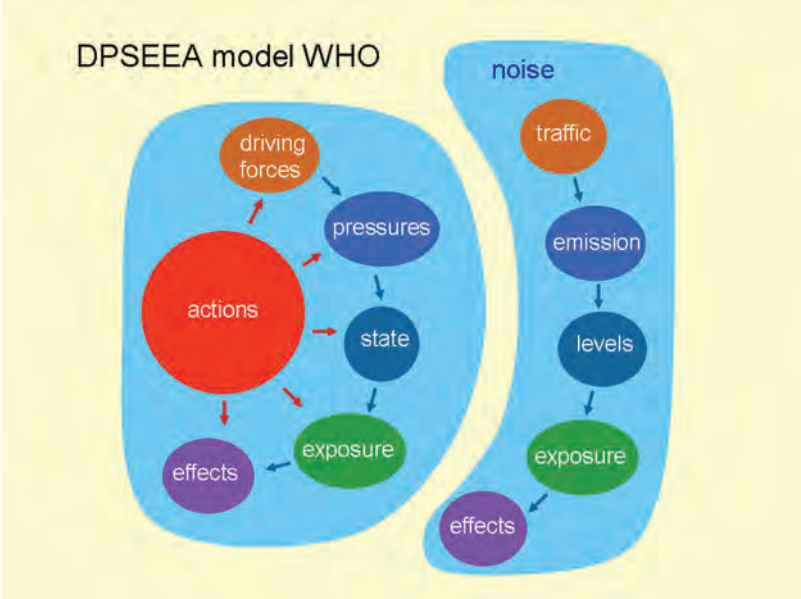

Fig. 5. The DPSEEA approach for health impact assessment, in general (left) and for traffic noise (right).

Methodology for Analysis

A methodology was set up to quantify the health burden and its reduction at EU level over time. The driving forces, pressures, state, exposures, health effects and actions (DPSEEA) framework (fig. 5) was applied, quantifying each step in the chain from source to receiver and health impact (fig. 6). The health burden is quantified not only by two monetization methods to account for potential spread but also in terms of percentage reduction of highly annoyed people, highly sleep-disturbed people, and disability-adjusted life years (DALYs), including heart disease. The present average noise distribution in the EU, from EEA data, is used for the baseline, and forecast traffic growth (around 1 percent per annum) and currently foreseen noise legislation are taken into account.

The health burden reduction is calculated from the change in the noise distribution resulting from deviations from the baseline, for example, due to further reduction of noise at source, in the propagation path, or at the receiver.

The CBA is based on the costs for increased implementation of noise abatement measures and the monetized health benefits using the two methods. It results in a benefit-to cost ratio over the period 2020–2035, net present value, and a breakeven year (see example in fig. 7).

Test Site Analysis

The methodology for calculating noise exposure in the EU was based on the exposure distributions calculated in the framework of the END. So as to indicate the uncertainty of the distributions, the END results were compared with the results of local noise mapping calculations for test sites. The following types of test sites were considered:

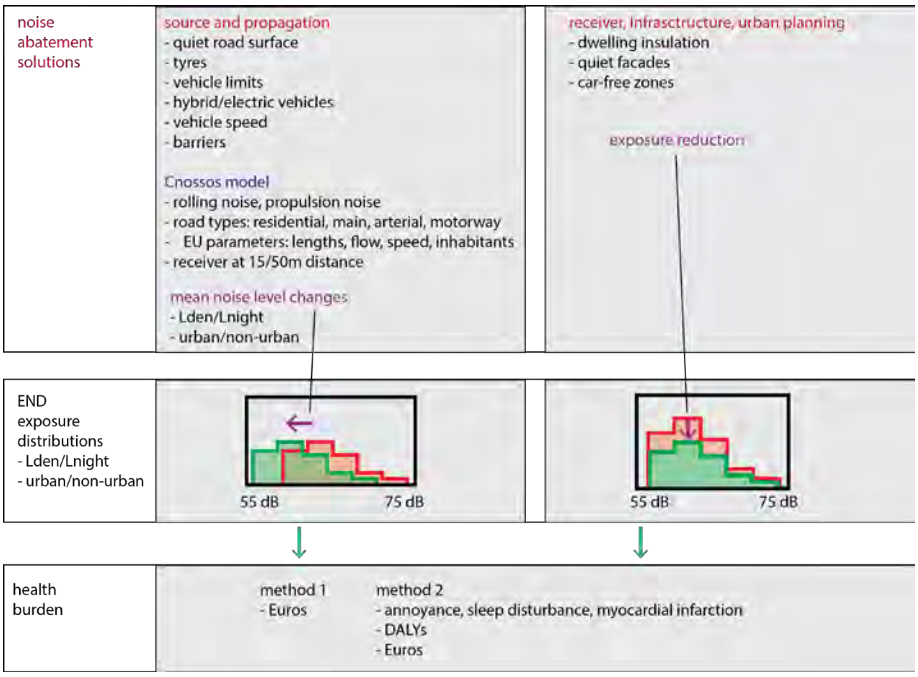

Fig. 6. Illustration of the effects of different types of noise abatement solutions on the END exposure distributions, which are used to calculate the (reduced) health burden.

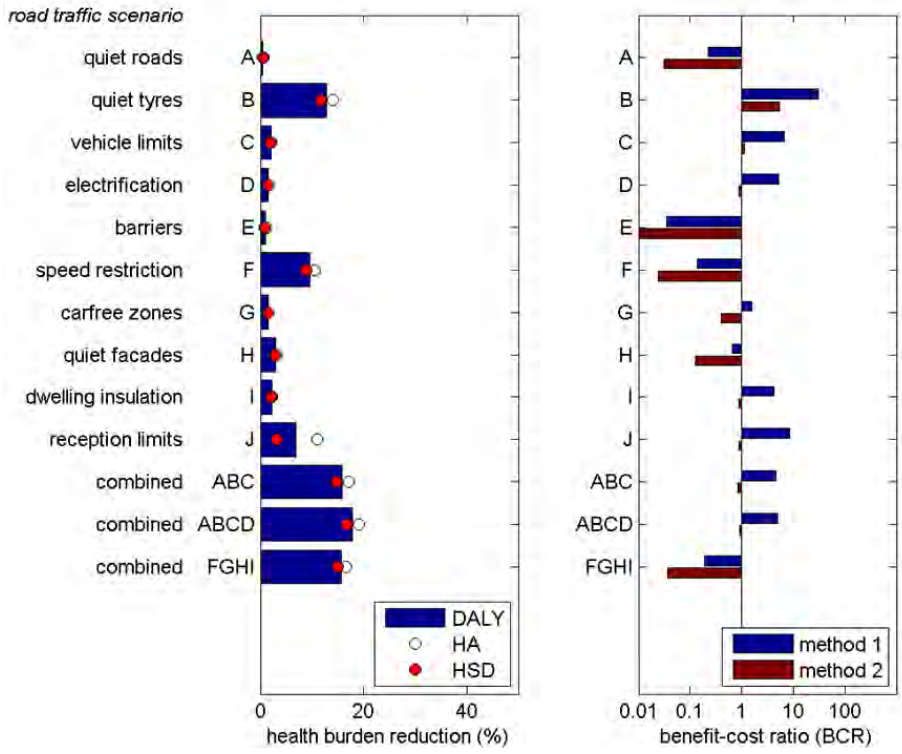

Fig. 7. Percentage health burden reduction in 2030 and benefit-to-cost ratios in 2035 for selected single and combined scenarios for road traffic noise.

- Subareas of urban agglomerations with road and rail traffic noise
- Areas near major roads and major railways
- Airports and surrounding area

The test site calculations focused on the effects of noise abatement solutions on the noise exposure distributions. This provided input for the effects of noise abatement solutions in the global health impact assessment methodology. Two examples are the following.

- *Noise barrier*. The effect of inserting a noise barrier in a specific situation has been investigated for various road and railway test sites.
- *Rerouting traffic*. A complex noise abatement solution is rerouting of urban traffic. This has been investigated by a test site calculation for the city of Karlsruhe (DE).

It appeared from the test site calculations that the effect of (local) traffic measures such as rerouting on the exposure distributions of the entire city is usually quite small, partly because the noise is shifted from one area to another. Furthermore, it was found that low-speed urban streets (50 km/h, 30 km/h) have a major effect on the exposure distributions.

Noise Abatement Solutions

For each transport mode, available noise abatement solutions were selected for this analysis in terms of their potential noise reduction and known effectiveness. Innovations and solutions still under development were not included, as they would not be widely available by 2030.

For road transport, the solutions considered include (a) quieter road surfaces, (b) quieter tires, (c) quieter vehicles, (d) more electric vehicles, (e) noise barriers, (f) speed restriction, (g) car-free zones, (h) quiet facades, (i) dwelling insulation, and (j) reception limits.

The railway noise abatement solutions include (a) smooth tracks, (b) smooth wheels, (c) quiet vehicles, (d) quiet tracks, (e) barriers, (f) traffic management, (g) urban planning, (h) dwelling insulation, and (i) reception limits.

For aircraft, the main noise abatement solutions include (a) improved flight profiles, (b) precision area navigation, (c) night curfews, (d) phaseout of noisier aircraft, (e) accelerated fleet renewal, (f) sound

Table 1. Monetized Health Burden Reductions and Benefit-to-Cost Ratios for Selected Best Scenarios

Noise Abatement Scenario	Monetized Health Burden Reduction in 2030	Benefit-to-Cost Ratio over 2020–2035
Roads		
ABCD: more quiet roads, quieter tires and specific lower vehicle noise limits	18–24%	0.9–5.1
FGHI: speed restriction, car-free zones, quiet facades, and dwelling insulation	16–20%	0.04–0.2
Railways		
ABCD: smoother and quieter vehicles and tracks	37–52%	0.9–3.1
EF: more barriers and traffic management	5–10%	0.9–4.5
GH: urban planning and reconstruction and more facade insulation	7.8%	0.2–0.4
Aircraft		
Best possible on "aircraft side" (ABEF): improved take-off procedures, dispersion or concentration of flights, phaseout of noisiest aircraft, and accelerated fleet replacement with quiet aircraft	44–46%	–0.2 to –0.1 (cost saving)

insulation, (g) buffer zones, (h) stakeholder engagement, and (i) reception limits.

Scenario Analysis

Single and combined scenarios were analyzed in terms of their reduction in health burden and benefit-to-cost ratio (BCR). The results for road scenarios are shown in figure 7. Combined scenarios are mostly required to achieve a significant effect by 2030. The selection was based on the health burden reduction, feasibility, and timescale. In some cases, the health burden reduction is high but the BCR rather low, due to relatively high cost, for example, in the case of urban planning. This should not necessarily disqualify these solutions, as the benefits may actually be much larger if more parameters than noise are factored in, for example, reduced pollution, improved access and property value, quality of life, and others. Where the reductions seem moderate, such as for vehicle noise limits, it should be considered that foreseen limit changes as in regulation 540/2014/EU are already included in the baseline. The limited effect of more electric vehicles is due to the tire noise contribution, if tires are not quieter. The quiet road surfaces scenario is counterintuitive, as it can give a large noise reduction for speeds above 50 km/h. This is because the implementation at EU level is low and urban roads with lower speeds have a much larger overall length. Further variations on these results and results for railway and aircraft noise are presented in the report.[1]

The most effective scenarios identified and their reductions in monetized health burden and BCRs are set out in table 1 for all three modes of transport.

Policy Options

Policy options were developed based on the results of the NAPs analysis, stakeholder consultations, and the CBA and noise abatement scenarios set out earlier. The analysis found that an effective and EU-wide reduction of noise emission, which would result in a decrease of at least 20 percent of associated health burden within the next 10 years, cannot be reached by individual scenarios but rather by a set of combined and complementary abatement measures. The highest benefits from noise reduction are to be expected from the implementation of the most cost-effective combined scenarios.

The proposed measures that could be implemented within the next 10 years include both mandatory (hard) and optional (soft) policies. In addition to noise- and transport-specific instruments such as the END, vehicle and tire sound limits regulations, TSI Noise limits for rail vehicles, and the Balanced Approach Regulation (BAR) for aircraft, other instruments not related to noise policy (legislative and nonlegislative across various policy areas) have also been analyzed. Altogether 23 individual policy changes are proposed. These include 6 legislative changes for generic policy measures and 17 specific for road, rail, and aviation. Most of the proposals require review and amendment of EU Directives or Regulations.

This approach follows the principle of horizontally integrating environmental issues into different policy areas. Therefore, it is suggested that the proposed policy options are developed within the context of an overarching strategy. This will require setting an overall target of the noise reduction across different policy fields. This strategy could be ideally composed of a set of a horizontal (general) and vertical (sector-specific) measures. The establishment of such an umbrella approach would streamline the efforts undertaken and ensure their timely application.

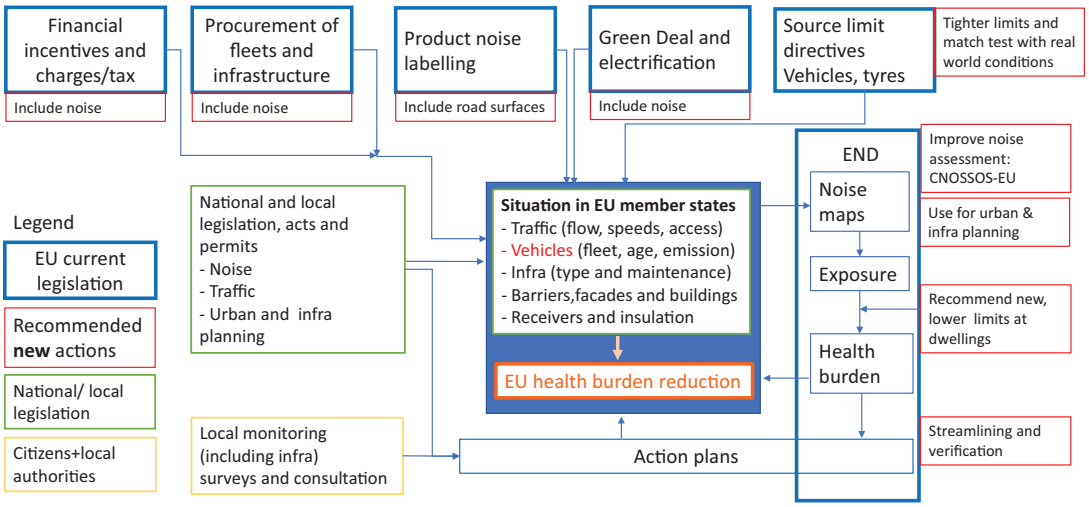

Fig. 8. Policy options for road traffic noise: EU and national, local, citizen-based, and recommended new EU actions (in red).

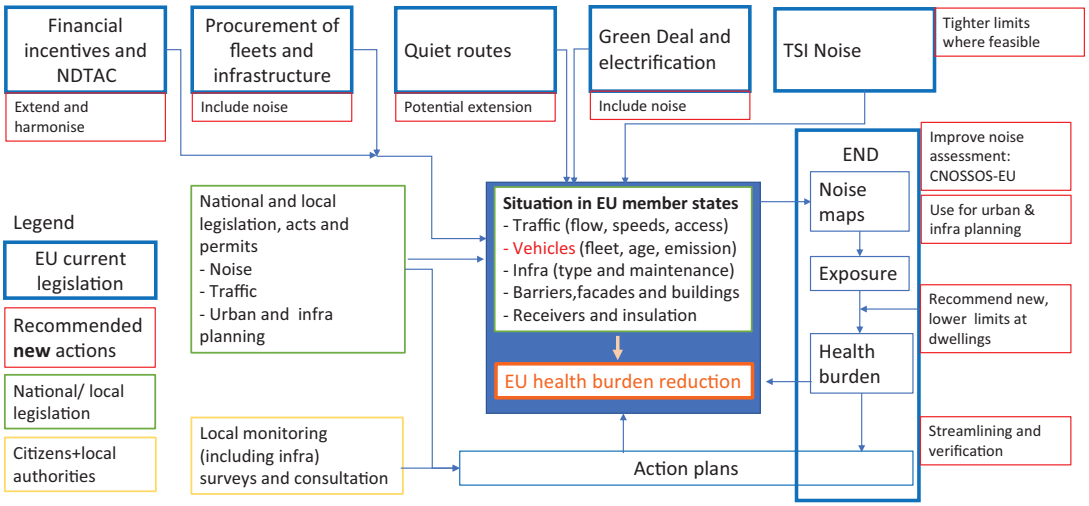

Fig. 9. Policy options for railway noise: EU and national, local, citizen-based, and recommended new EU actions (in red).

The recommended generic policy options include the following:

1. Standardization, streamlining, and mandatory evaluation of NAPs
2. Extend the scope of the END to urban planning, infrastructure planning, and land use
3. Introduction of EU noise reception limits at dwellings
4. Improve coherence between noise prediction models and vehicle type tests
5. Include noise requirements in public procurement procedures for vehicles and transport infrastructure
6. Enhance EU financial incentives and increase noise charges

The proposed policy options for road, rail, and aircraft are shown schematically in figures 8, 9, and 10, as recommended actions for existing regulations. The options that can be addressed at EU level are marked in red.

Conclusions

The Phenomena study has provided a series of policy recommendations to reduce the health burden of environmental noise from roads, railways, and aviation by 20–50 percent by 2030.

These recommendations would require updating of existing EU noise legislation and better integration for coherence and effectiveness. In particular the follow-up of action plan implementation and the application of combined noise abatement measures needs strengthening. These are administered and implemented at national and local levels, so better management, resourcing, guidelines, and information exchange are required.

Acknowledgments and Disclaimer

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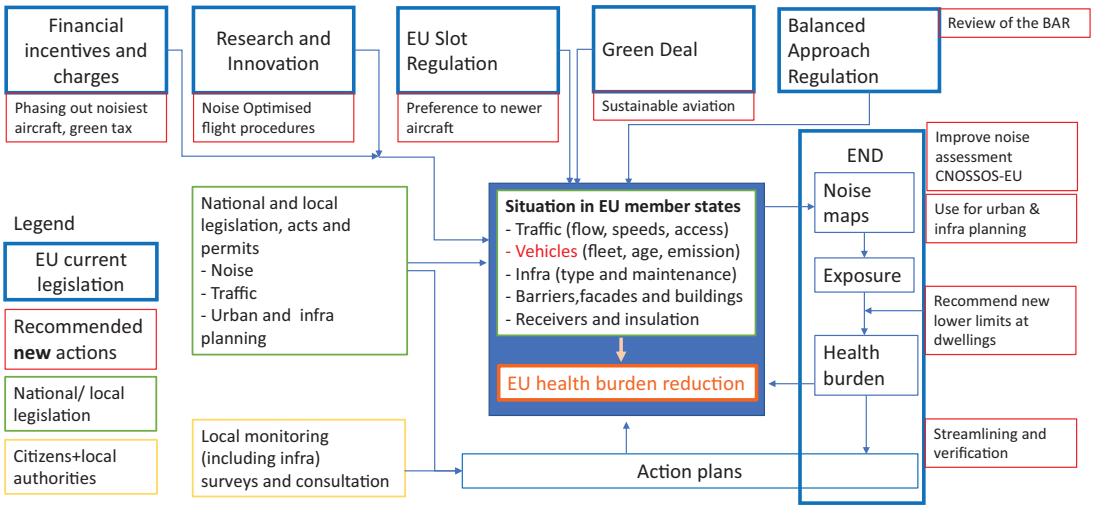

Fig. 10. Policy options for aircraft noise: EU and national, local, citizen-based, and recommended new EU actions (in red).

whose support is gratefully acknowledged. Thanks are also due to the many stakeholders who provided inputs during the study. The work was performed under EU Contract number 07.0203/2019/ETU/815591/ENV.A.3. The contents of the report and this article represent the findings and conclusions of the authors and do not represent the position of the EU.

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Lessons Learned from a Career in the Noise Control Industry, Part 2

Jim Thompson

Some of you may have read the first part of this article in the previous *NNI*. As I stated in that article, sometimes I find it helpful to look at my experiences and try to derive some lessons learned from what has happened. One of my goals is to treat life as a continuous learning process. It takes some time to absorb some of what I have experienced and see how I can use it going forward.

What follows are some more of the lessons that have been meaningful to me. These are not strictly noise control issues, and in some cases they may not apply to others. I just thought they might be helpful or entertaining.

Unconventional Solutions Can Be Important

One of the tire noise contributors discovered while I was at Goodyear was the tire cavity resonance—a longitudinal acoustic resonance in the tire air cavity. This turned out to be an important source related to tire size and vehicle speed.

As cars got quieter and tire cross-sections got shorter, this resonance noise became more apparent at normal operating speeds.

Since this noise was directly tied to basic tire geometry, we did not have many real solutions. At one point, one of our engineers tried stuffing bubble wrap in the tire cavity and found it was enough to prevent the resonance. I dismissed this as a waste of time since it could not be used in real operation.

A few months after this, I was having lunch in my office when I got a call from an original equipment manufacturer (OEM) engineer. He had a VP coming to ride his prototype that had a cavity resonance noise problem. He was concerned that the VP was going to reject the vehicle for noise. He had less than an hour and needed a miracle to save his program. He had talked to our sales representative and was assured I would have an easy solution. In this one case, it turned out to be true.

So, I told him to put bubble wrap in the tires. After a great deal of skepticism, he agreed he had no choice.

The result was that I had a friend for life. I learned that you never know when a stupid solution is suddenly going to seem brilliant. I did go back and apologize to the engineer who came up with the idea in the first place. The bad news was that the sales representative assumed I could solve every problem that easily from that point on.

It Is Critical to be Able to Speak to a Hostile Audience

Too many of us go through school and even work experience never really speaking to a hostile audience. Maybe your boss in not receptive to your idea, or your major professor does not agree with your results. This is not hostile. This is a professional disagreement. Speaking to a truly hostile audience is a whole other experience.

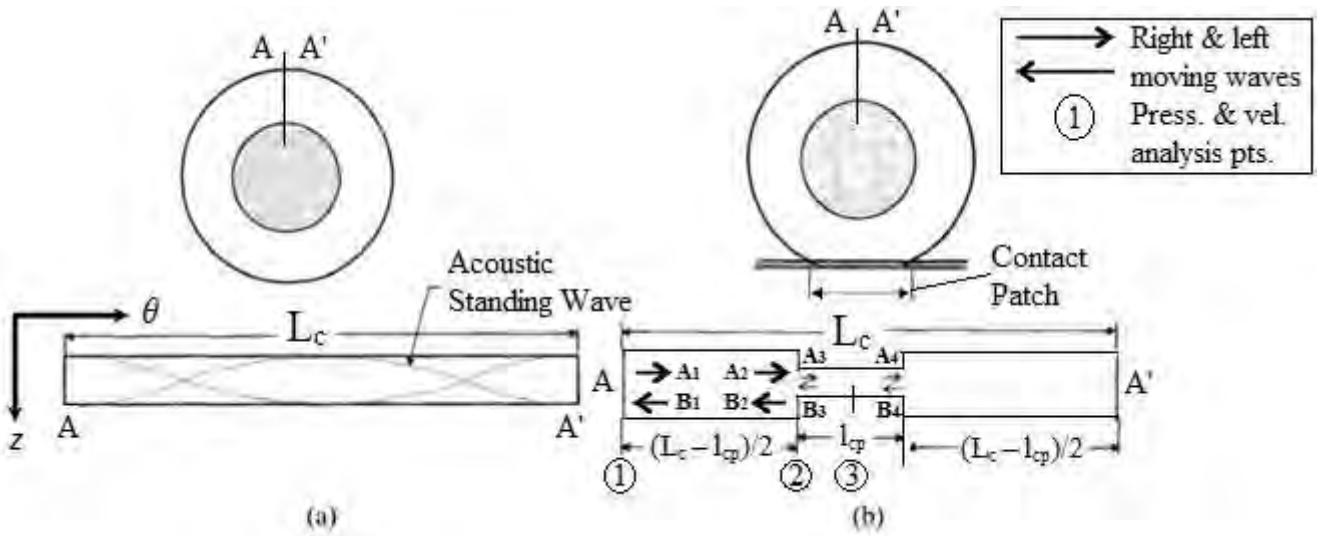

Fig. 1. Tire cavity resonance.

A few times I have had to speak to hostile audiences about environmental noise studies that did not agree with the community's opinions. In some cases, customers are not happy with the results from a consulting program or the cost and complexity of a solution. I have found handling these situations professionally and not getting caught up in the emotion can be difficult. Here is the acid case that tested my abilities and turned out to be a great success when all was done.

I was working as a consultant, and a brake friction material supplier came to us. Their material was on a new vehicle that had a unique noise problem. There was a groaning noise after a stop. The OEM and foundation brake supplier were blaming them for the noise problem. They had investigated the noise and could not understand what was causing the problem. They needed our help and hoped we could show that their friction material was not the source of the problem.

This turned out to be a difficult problem to replicate. The noise only occurred when the vehicle was pulling away from a stop. Yes, that is right, a brake noise problem that only occurs when the brakes are released. In the simplest terms, the noise occurred when the brake system was at high temperatures and the vehicle came to a slow stop. There was some stiction between the brake pad and the rotor. When the vehicle pulled away from the stop, there was a sudden release that excited a resonance in the caliper. The vehicle passengers heard a strong moaning noise that only lasted a few seconds, but it was clearly audible and could be a source of concern.

Once we were able to recreate the problem, we understood the caliper resonance and could see how the problem might be resolved. We provided a demonstration for the friction material supplier, and they were delighted with our results. They scheduled a meeting with the OEM and the foundation brake supplier for us to present our findings. At this point it all seemed straightforward to me.

A couple of days before the presentation, I learned that the brake engineer from the OEM was an individual with a bad reputation. He was infamous for chewing up and spitting out suppliers. He had a bad temper and felt his role was to abuse suppliers at every opportunity. This was the guy who would make brake purchasing recommendations and supplier decisions. As the friction supplier put it, he could make a "life or death" decision.

I had planned to have some of the junior engineers who participated in the test

to be part of the presentation. They all begged to not be asked to stand up and present to this gentleman. Their immediate supervisor advised me it would not be good to have them to be a part of the presentation. He was afraid they could not take the abuse well and would make poor presentations. So, it all fell to me.

Knowing all of this, I tried to prepare a short presentation that was to the point that showed both the problem and a potential solution. When all gathered in the conference room, the OEM engineer stated to all present that this meeting was a waste of everyone's time because the problem was clearly the friction supplier. I had gotten to the second slide when the OEM engineer interrupted me to tell me again that I was wasting his time. I took a chance and told him he was wrong and if he would let me continue that I would explain the real problem. To my surprise, he sat down and said "OK, show me." I should say this was uttered with less than a positive attitude. I got about two-thirds through the presentation, and he stopped me. He stood up and said "So, the problem is the caliper." He turned to the foundation brake supplier and asked if they had seen this problem before. To everyone's surprise, they said yes.

Leaving out the expletives used by the OEM engineer, we then began to discuss the real problem. The OEM engineer told the foundation brake supplier they had a month to solve the problem. In addition, he demanded that they pay our fees even though the friction supplier had contracted the work. He then walked out of the room. I never got to finish my presentation.

In the end, the foundation brake supplier paid for our original work and another month to come up with a solution. The friction supplier thought I was a god—until the next project when we wanted money to do the work.

If I had not handled the hostile OEM engineer well, this would have been a disaster. I did what I thought was best at the time and did not get intimidated. I also had a very well-prepared, logical, and succinct story to tell. I was happy with the result even though I never got through my whole presentation. The lesson I learned is know your audience and when they are hostile, be prepared for it. Knowing when to hold your ground and when not is essential. Above all, you must always stay professional even when the most important person in the audience is hostile to you and what you are trying to say.

Good Work May be Slow to be Acknowledged

My MS project was focused on modifying the room acoustics equation to better predict sound in factory spaces that are not regularly proportioned rectangular

shapes. Because of contract issues, I had to work as a teaching assistant for funding, and the project did not have funding for experimental work. I was doing measurements in irregularly shaped classrooms: removing and replacing a hundred desks at 3:00 a.m. in the morning to try to get the experimental data I needed without running up costs. When funding was received, all the enthusiasm was behind building a ray tracing model to predict noise in these spaces. I finished my thesis and left school with a bad taste in my mouth. I felt what I did was good work that was underappreciated.

I never really got back to building acoustics again, but I stayed interested. At a recent INTER-NOISE conference, there was a session on industrial room acoustics that looked interesting. I was running from another session and got there a little late. The presenter was talking about the different methods he had used to predict noise in several factory spaces. Then he summarized the findings noting that the best predictor was the equation from Thompson. I had missed the part where he reviewed my work.

Silly as it may seem after 40 years, I walked out of that session with a smile on my face. Sometimes there is a long delay before your good work is recognized. Probably I was too sensitive about my work not being appreciated, but it sure felt nice to find out over 40 years later that someone still found it useful.

Conclusions

I hope these lessons learned have been helpful and perhaps a little entertaining. I have enjoyed sharing them. Please remember that life is a learning process and drawing lessons learned as you go along can be helpful. I have many more of these, but I think I have shared enough for now. Maybe the most important lesson learned is to keep learning lessons and be open to life's educational process.

Report: NOISE-CON 2020

The Show Must Go On(line)!

NOISE-CON 2020, the national conference of INCE-USA, was held as an online event from November 16 to 20, 2020. The theme of the event was *Jazzin' Up Noise Control*, in a nod to its original location of New Orleans (unfortunately, due to travel restrictions related to the pandemic, the event was moved to a virtual event earlier in the year).

While organizing a conference like this involves contributions from many, many people, the chief organizers deserve special recognition for the incredible job they did switching from an in-person meeting to an online event. These include Gordon Ebbitt (conference chair), Kristin Cody (conference vice chair), Paul Donovan (technical chair), Steve Sorenson (technical cochair), and Pranab Saha and Patricia Davies (technical advisers).

Over 400 people participated in the conference, and 122 technical papers were presented on all aspects of noise control, from building acoustics to maritime noise. The conference was spread over five days, with events taking place every day.

Plenary Sessions

There were three plenary sessions during the conference First, Dr. Lily Wang (University of Nebraska–Lincoln) presented "The Acoustic Experience in Restaurants," which described the high levels of noise that diners experience in restaurants (and often complain about in Zagat surveys). Dr. Wang reviewed recent work aimed at characterizing restaurant acoustics in real-world settings and followed up with real-world tests. In situ measurements, along with geometric room characteristics, room impulse

responses, and background noise levels, were gathered from various spaces. During restaurant operating hours, sound levels using dosimeters and sound level meters and occupancy using thermal imaging were logged during lunch or dinner service. Comparisons of the logged sound levels against Rindel's predictive equation for restaurant noise levels were then made. A primary goal of this research was to understand how sound levels in operating restaurants vary with occupancy and the levels of ambient noise sources, as well as how specific architectural and design features such as seating style and density may contribute to the acoustic experience.

The second plenary talk was probably the highlight of the conference for this attendee. It was titled "Hand Dryer Noise" and was delivered by Nora Keegan, who had her research published as an eighth grader! (It was reported by many major news outlets at the time, but also by *NNI* back in 2019.) Nora studied hand dryer noise in a variety of locations where children were likely to be exposed to noise. She surveyed the devices by performing sound level measurements of 20 different conditions for 44 hand dryers, resulting in 880 hand dryer sound level measurements to quantitatively assess this issue. Nora concluded her study by submitting her findings to the journal *Pediatrics & Child Health* in 2019. While these efforts to study the issue and be published are noteworthy by themselves, even more impressive was that Nora was only nine years old when she started this project.

The final plenary talk was delivered by Dr. Juliette W. Loup (University of New Orleans), titled "Underwater Acoustic Noise Effects on Marine mammals in the Northern Gulf of Mexico." The talk focused on the work of the Littoral Acoustic Demonstration Center (LADC), which was formed in early 2001 to utilize environmental acoustic recording systems (EARS) buoys developed by the Naval Oceanographic Office (NAVICEANO). LADC is a consortium of scientists from the US Navy at the Naval Research Laboratory-Stennis Space Center as well as a number of universities, including the University of New Orleans and the University of Southern Mississippi. The long-term goal of LADC is to use advanced technology to study the anthropogenic soundscapes of the Gulf of Mexico and their impact on marine mammals. In 2007, LADC conducted two-week visual and acoustic surveys of marine mammal activities just 9 miles and 23 miles from the Deepwater Horizon spill site, giving LADC a unique prespill

baseline data set of marine mammal activity and anthropogenic soundscapes near the oil spill site. These results, including associated noise analyses, were presented during this talk.

Special Sessions

As with any NOISE-CON, there was a wide array of special sessions throughout the conference. Highlights included the INCE-USA General Meeting, a Classic Paper Session, Student and Professional Awards ceremonies, Career Development Workshop, a Product Noise Rating Workshop, Women in Noise Control Engineering Session, Sonic Sea Panel Discussion, and a variety of Technical Committee Meetings. There was also a tutorial on sound level meters, which was recorded and will be made available on the INCE-USA website.

Open to the Public

NOISE-CON conferences have a long history of having events related to outreach to the community. Typically, these have involved seminars and workshops focused on a number of topics related to noise. The year 2020 was no different, and there were a number of open sessions to mark the occasion of 2020 being the International Year of Sound. These events included a career development forum, a Women in Noise Control Engineering Meeting, the INCE-USA General Meeting, the awards ceremonies, and a variety of Technical Activity Committee Meetings.

Conference Chair Gordon Ebbitt, on behalf of INCE-USA, presenting the donation to Andrea Williams, executive director of the Foundation for Science and Mathematics Education

Giving Back

Following NOISE-CON 2020, INCE-USA donated $1,000 from proceeds generated at this annual conference to the Foundation for Science and Mathematics Education in New Orleans to help finance the New Orleans Center for Science and Math (Sci High). Sci High is an open enrollment high school dedicated to a full curriculum with an emphasis on science and math. Contributions for this donation came from NC20 exhibitors, Head Acoustics, Rion, VI Acoustics, the efforts of INCE-USA president Mike Bahtiarian, and a portion of the NC20 registration fees. This donation is part of a larger effort by INCE-USA to promote a more diverse and inclusive environment in the field of noise control engineering.

Announcement: INTER-NOISE 2021

Welcome to a Premier Noise Control Event

As you may already know, the 50th International Congress and Exposition on Noise Control Engineering (INTER-NOISE 2021) will be held in the virtual (online) mode from August 1 to 5, 2021. This will be the premier noise control conference in the United States in 2021. There will be outstanding papers, first-rate plenary speakers, and networking opportunities. So, please consider attending. As with last year's NOISE-CON, you don't even need to pack a bag or get a plane ticket!

The regular registration fees are US $420 for authors or attendees and $200 for students. The registration and payment system can be accessed (after creating an account) via this link: https://internoise2021.org/shop/.

The Congress's theme is "Next 50 Years of Noise Control" and it is organized by INCE-USA and Pro Acustica (Brazil) on behalf of I-INCE. INTER-NOISE 2021 will have an outstanding technical program with seven keynote/plenary lectures at the cutting edge of technology

and several special events, such as the opening and closing ceremonies; Pan-American Symposia; 50th Congress celebration; Technology for a Quieter America (and the World); workshops on "active control" and "hearing conservation"; and over 50 informal networking sessions with focused topics.

Over 850 abstracts in all aspects of noise and vibration control and acoustics have been received. View these by topics at https://internoise2021.org/session-list/.

A preliminary program should be available around June 28, and the e-platform will be open to registrants on July 15. The exposition will have at least 21 e-booths, including one featuring INCE-USA activities (board certification, NCEJ journal, *NNI*, and the like). Yet another booth will highlight the 50th INTER-NOISE Congress celebration and I-INCE.

Check out https://internoise2021.org/ for more details, and we hope to see you online in August.

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June 21–23, 2021
EURONOISE 2021
Madeira, Portugal
www.spacustica.pt/euronoise2021/

August 1–4, 2021
INTER-NOISE 2021
50th International Congress and Exposition on Noise Control Engineering
Washington, USA
http://www.i-ince.org/

December 6–10, 2021
181st Meeting of the Acoustical Society of America joint with WESPAC 2021 and the Australian Acoustical Society
Seattle, Washington
acousticalsociety.org/asa-meetings/

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Information on listings in the Directory of Noise Control Services is available from the INCE-USA Business Office, 11130 Sunrise Valley Dr., Suite 350, Reston, VA 20191-4371 Telephone: +1.703.437.4073 email: ibo@inceusa.org.

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