The EU noise policy and its research needs

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Abstract

The new EU noise policy and particularly the new Directive relating to the Assessment and Management of Environmental Noise has a significant influence on the research and development in the field of noise control. An important part of this R&D is generated by the need for harmonised noise mapping and for harmonised assessment of annoyance and sleep disturbance. Other R&D needs are related to a greater attention for noise control at the source and to a greater attention for the economic aspects of noise abatement. A special area of research concerns the protection of quiet areas in the open country.

Resumen

La nueva política de la UE sobre el ruido y, en particular, la nueva Directiva acerca de la Evaluación y Tratamiento del Ruido Ambiental tiene una influencia significativa sobre la investigación y desarrollo en el campo del control del ruido. Una parte importante de esta I+D está generada por la necesidad de mapas de ruido armonizados y una evaluación armónica de la molestia y la perturbación del sueño. Otras necesidades de I+D están en relación con una mayor atención para el control del ruido en la fuente y sobre los aspectos económicos de la reducción del ruido. Un área especial de investigación se refiere a la protección de los espacios silenciosos en campo abierto.

Introduction

For noise control in Europe, 2002 is a very important year because in this year the European Union will adopt the Directive relating to the Assessment and Management of Environmental Noise (DAMEN) [1]. The DAMEN provides harmonised information for authorities and citizens, the making of national and local action plans and the extension and improvement of the EU legislation on the reduction of noise emission [2,3]. The introduction, execution and further development of the Directive requires a significant amount of research. This paper provides a concise overview of that research.

EU noise policy and directives

Figure 1 shows the principles of the DAMEN.

Particularly the following elements of the directive will generate research needs:

1. The harmonisation of noise indicators and assessment methods, including the making of noise maps and the prediction of health effects.
2. The action plans.
3. The further EU actions and particularly those to reduce noise emitted by the major noise sources.
4. The development of a policy for the protection of quiet areas in the open country.

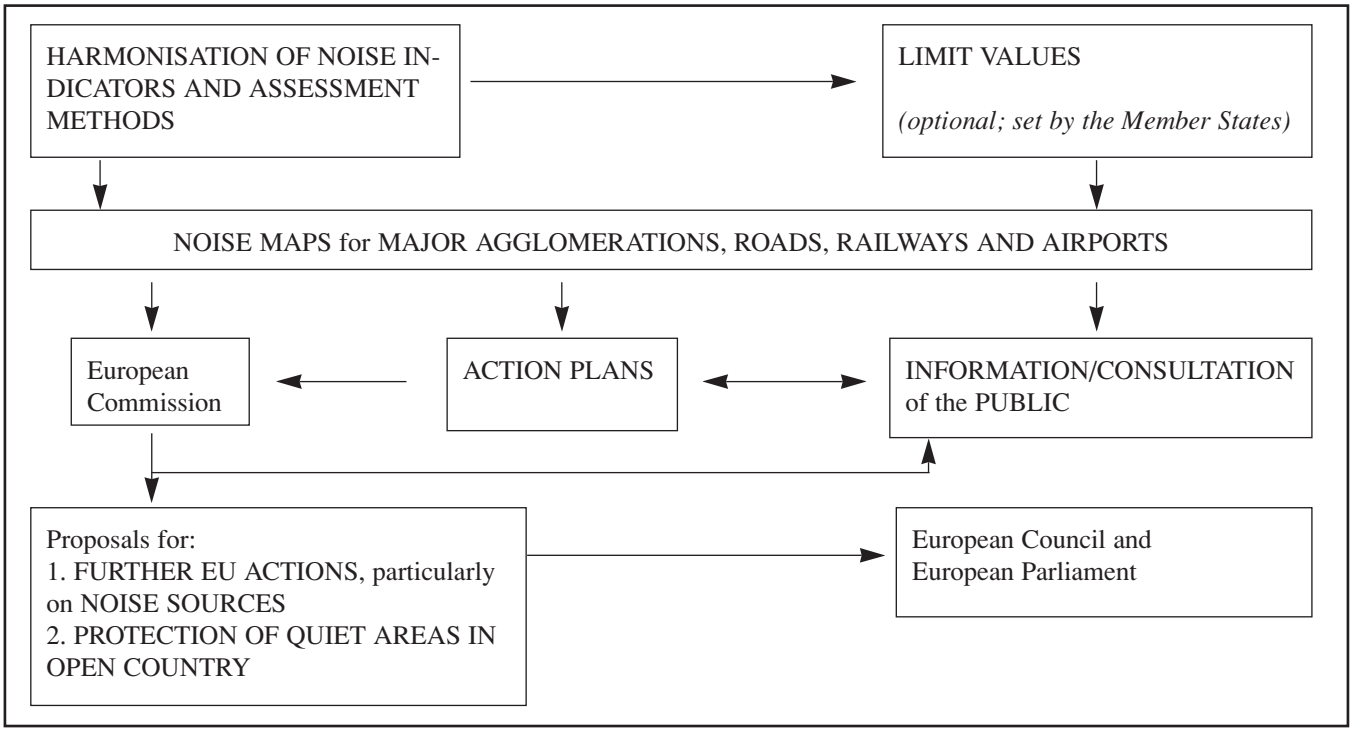

Fig. 1.- Overview of the European directive on environmental noise (DAMEN).

There are already EU directives on the control of noise emission by civil aircraft, road vehicles, tyres for road vehicles and for outdoor equipment. Directives for trains and pleasure boats are underway. The directives have rather different set-ups, as well legally as technically. Some are very effective for the reduction of environmental noise, others do contribute little - see for example [4]. The DAMEN provides the opportunity to bring these directives gradually more in line with each other and to make them more effective for the improvement of the environment.

Research needs

Measurement Of The Value Of The Noise Indicators

In the DAMEN, two quantities to characterise noise have been defined: L_{den} and L_{night}. Both are based on the determination of A-weighted long-term average sound levels. For L_{night} it concerns the L_{Aeq} over all night periods of a year, for L_{den} it also includes the L_{Aeq} values over all the day and evening periods of a year. The determination of the LAeq values can be done by measurement, by computation or by a mixture of measurement and computation. The fact that the directive allows the different approaches implies that the results shall agree within reasonable margins, which means in practice that the methods shall be as accurate as technically and financially feasible.

In principle the measurement of L_{Aeq} is straightforward and shall be carried out in accordance with ISO 1996-2: 1987 [5] or ISO 3891: 1978, or in the future, in accordance with newer versions of these standards. In reality there are some problems, however. In order to avoid these the European Commission should consider the development of guidelines.

Computation Methods And The Related Emission Measurement Methods

It is certain that in most cases the value of the noise indicators will be determined by computation because it is cheaper, quicker and not necessarily less accurate than determination by measurement. Furthermore computations can also be used for the design of certain measures, like the introduction of a noise barrier. In order to play their role properly, the computation methods should be able to determine the value of the noise indicator with an uncertainty not greater than 1 dB. Unfortunately, the present methods are not able to provide this accuracy [6,7,8]. All methods that are presently used in practice (for rail, road and aircraft noise and for industrial noise) are empirical or semi-empirical methods which contain many simplifying assumptions and have a very simple description of the source. Such methods can only be accurate for sources and geometries which are similar to the sources and situations of the original data set. Another weakness is that the description of the source and the description of the transmission are interdependent. The basis for most of these methods was laid some 30 or 40 years ago and they are scientifically and technically outdated. Differences of 5dB between the outcome of the methods are no exception. In spite of the obvious shortcomings, the methods form the backbone of the present noise policies in most EU Member States. It is obvious that the differences in computation methods seriously undermine the possibilities for comparison of results.

Table 1. - Research items related to the measurement of the noise indicators.

Number	Subject	Aspects
1	Accurate unmanned long-term measurements ("noise monitoring"), particularly near airports and industry.	Improvement of the signal-to-noise ratio, ("noise" including all unwanted signals), for example with the aid of microphone arrays.
2	Guidelines for manned or unmanned short-term measurements, particularly near industry, roads and railways.	Guidelines for the selection of short-term "samples", for the measurement of these samples, and for the computation of the long-term L_{Aeq} , L_{den} and/or L_{night} .

In the last 20 years there has been considerable progress in the modelling of the transmission of outdoor sound, using modern computer technology [8,9,10,11,12,13,20]. The technical possibilities to characterise the source and to introduce the system geometry have also been improved. Several problems have not been completely solved however, and sufficiently accurate, validated, modern models are not yet available. Thus, completely satisfying methods are presently not available and the European Commission had no other option than to start the DAMEN with existing computation methods. The development of better methods has started. These methods shall be introduced in a later stage.

Apart from the aspects that are directly related to the modelling of the source and the transmission, guidance shall also be given on some other aspects like the modelling of the geometry, the gathering of traffic data and the application of dose-effect relations.

Exposure-Response Relations (Dose-Effect Relations)

According to annex VI of the DAMEN, final results of noise mapping are presented in terms of the number of affected people. It is believed that such data form a much bet-

Table 2.- Research items related to computation.

Number	Subject	Aspects
3	Making the recommended interim computation methods operational for use throughout the EU	Adaptation to the definitions of the EU noise indicators; emission measurement method for some sources; data base for sources; small improvements; software.
4	Guidelines for noise mapping	Organising the input (traffic data etc.); modelling of the geometry; application of dose-effect relations; presentation of results.
5	Modern, more accurate methods for road traffic noise and railway noise	Independent source and transmission characterisation; better source descriptions and emission measurement methods; better transmission models, particularly for cases with screening, reflections, different ground conditions, larger distances.
6	More accurate methods for aircraft noise and industrial noise	Better modelling of the transmission and the source, independent source and transmission characterisation.
7	Operational more accurate methods, applicable throughout the EU	Emission data bases, including data for different road surfaces, rail tracks, meteorological influences and other aspects; software; guidelines.

Table 3.- Research subjects related to the definition of effects and to dose-effects relations

Number	Subject	Aspects
8	Annoyance - L_{den} for traffic noises	Road, rail and air traffic noise
9	Selection of one effect (response) descriptor for sleep disturbance.	Shall correlate with L_{night}.
10	Further dose-effect relations for annoyance.	Northern and Southern Member Sates; houses that are especially insulated against road, rail or air traffic noise; industrial noise.
11	Dose-effect relations for sleep disturbance	The dose quantity is L_{night} ; all EU climates; road, rail and air traffic noises; specially insulated houses.
12	Dose-effect relations for children	Learning capability.

ter basis for communication with the public and for well balanced action plans than the value of the (physical) noise indicators. For that purpose it is necessary to have suitable exposure-response relations.

The two effects that are distinguished in the DAMEN are "annoyance" and "sleep disturbance". Both must be defined more precisely. For annoyance that is not too difficult because a reasonably well established procedure for noise surveys has been developed from which three quantities can be derived: the percentage Highly Annoyed people (%HA), the percentage Annoyed people (%A) and the percentage Lowly Annoyed people (%LA) [15]. The latter quantity is seldom used, but a choice should be made between %A and %HA on the basis of an EU working group position paper on that topic. On the basis of existing literature , a study project has been launched by the European Commission in order to choose a descriptor for sleep-disturbance, to be used for dose-effect relations in which the dose quantity will be L_{night}.

The %HA as a function of the value of L_{den} (or related quantities) has been determined in many field surveys on road, rail and aircraft noise. Most of these surveys were carried out in the USA and Northern Europe. There are no comparable results for industrial noise. Furthermore it should be doubted whether the results on the traffic noises are also applicable in polar and sub-tropical climates as occurring in Northern and Southern EU Member States. Another situation with different dose-effect relations occurs when dwellings are especially insulated against road, rail or air traffic noise.

A special research item is the determination of exposure-response relations for children at school and at home. There are strong indications that noise reduces their learning possibilities.

Emission Measurements Methods For Type Testing And Marking

The European directives on noise emission require good testing methods for the determination of a quantity which characterises the noise emission in an appropriate way i.e. in such a way that a reduction of the value of that quantity directly results in a reduction of environmental noise in practice. In this area there are many weaknesses, which shall be reduced. See for example [16].

Table 4: Research related to the quality of type testing methods.

Number	Subject	Aspects
13	Quality check of (all) type testing methods	Relevancy for practice; uncertainty
14	Improvement of type testing methods	Greater relevancy; smaller uncertainty

Table 5.- Research related to the reduction of noise emission

Number	Subject	Aspects
15	Quieter motor vehicles and roads	Engine, tyres, exhaust, porous road surface, other silent road surfaces
16	Quieter aircraft	Airframe noise, engine noise
17	Quieter rail vehicles	Rolling noise from vehicles and track, aerodynamic noise, engine noise
18	Quieter recreational craft	Exhaust, engine
19	Quieter lawn mowers and other outdoor equipment	Engine, (exhaust), process

Noise Control At The Source

The DAMEN and the other European Directives stimulate the development of quieter transport systems, machines and equipment. Table 5 gives a survey.

Costs And Benefits Of Noise Control

For a well balanced noise policy it is very important that costs and benefits of certain measures are determined in a relevant and accepted way. Very much work has still to be done in this area. The approaches that are presently available neglect major aspects, consider the issue only from the point of view of one player (like the national road authority), or use unreliable data. For the European Union, the costs and benefits at macro (European) scale are of primary importance. However, costs and benefits considerations for the parties that shall develop the action plans must also be developed. A start in this area has been made in a special session and in a Workshop at Inter-noise 2001 [17,18].

Protection Of Quiet Areas In The Open Country

According to Article 11.2 of the DAMEN the European Commission shall assess the needs for implementing a strategy for the protection of quiet areas in the open country, which provides a subject for research – see table 7.

Table 6: Research on costs and benefits

Number	Subject	Aspects
20	Valuation of changes in annoyance and sleep disturbance	Effect of noise on housing prices, medical costs, lost labour days and other aspects, to be related with the number of affected people. *Note: the author is sceptical about the "willingness-to-pay" approach, which is sometimes used in this context.*
21	Cost-benefit models for decision making at the EU level	Cost-benefit analysis of sharper emission limits, limitations for the use of noisy machinery and other EU measures (as for example the stimulation of the use of porous road surfaces).
22	Cost-benefit models for use at the level of agglomerations, major roads, major railways and major airports	Cost benefit analysis of measures that could be considered as part of the action plans (noise barriers, traffic control, insulation of dwellings, land use, etc.).

Table 7.- Research related to the protection of quiet areas in the open country

Number	Subject	Aspects
23	Criteria for the quality of a quiet area in the open country	Role and characterisation of the noise from different sources.

Final remarks

Projects are already underway for various of the research subjects 1–23: see for example [17, 21,22].

An important role in the planning of a European research program supporting the development of the DAMEN, is played by the European thematic network CALM [19]. Regarding noise emission from civil aircraft, such planning is done by a working group of the Advisory Council for Aeronautics Research in Europe (ACARE) in co-operation with the thematic European network X-NOISE. These networks particularly consider the long-term strategic parts of the research.

Independent of the EU developments, a group of German research institutes, universities and consultants recently started a large research program on road, rail and air traffic noise [23]. Links with the EU research have been established.

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