

# THEORETICAL FRAMEWORK FOR DETERMINING LIMITING VALUES

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**Introduction** Aircraft noise as an environmental challenge of airport development is the most troublesome of one to control. In this paper I will examine some actual trends of discussing noise-limiting values with the aim to highlight some characteristic implications for noise-abatement. As a antecedent for a better understanding of these implications we have to bear in mind that the actual noise problem in the vicinity of international civil airports got its actual shape as a result from several interacting factors, including the subsequent ones [1]:

- Increase in air traffic.
- Increased urbanization of airport neighborhoods.
- Increased public awareness of environmental problems generally and airport noise problems particularly.

Noise impact may lower the amenities of a nice living site and may cause decreasing land values. It can be a source of annoyance, interrupting sleep, interfering conversation, depriving people from full enjoyment of many recreational activities. Experts recognize that people repeatedly exposed to high noise level may exhibit increased irritability, severe nervous tension, loss of ability to concentrate, and so on. But these hypotheses in all, and many more, have no value as long as they are not tested empirically at different places and time points at the one side and as long as they are not formulated with respect to the amount and causal direction of correlations to noise impact on the other side. Up from this background, noise impact is defined as an excessive and unwanted sound.

Within this context of antecedents six core principles of noise abatement had been developed to precede noise abatement in order to lessen the undesirable effects of noise in the vicinity of airports nowadays [1, 2]:

1. Aircraft design
2. Aircraft operating procedures
3. Airport planning and design
4. Noise preferential use of runways
5. Noise preferential shaping of routes
6. Land use planning in the vicinity of airports

Combining all these core principles as a countermeasure against aircraft noise in living areas a guidance of land use has been developed containing the following five dimensions:

1. Land use guidance zones.
2. Noise exposure class, like minimal, moderate, significant, severe exposure.
3. Noise rating technique, like Ldn, NNI, LAeq, etc.
4. Noise assessing guidelines, like clearly acceptable, normally acceptable, normally unacceptable, clearly unacceptable.
5. Suggested noise control.

All five dimensions within the frame of their interactions constitute a single corpus, an indivisible syndrome of techniques and procedures implementing the core principles mentioned above. This powerful paradigm of noise abatement got its support because it is relying on survey research that had been conducted in the vicinity of airports. One of the central goals of survey research was the investigation on annoyance, which means excessiveness or the unwanted noise impact of people's residence areas.

**Problem** Parallel to this process of institutionalizing, the noise abatement paradigm mentioned here, another process took place within the border of highly developed countries, in particular we observed a process of decreasing marginal utility of economic institutions that enforced the growing relevance of new societal values complementary to individual owned goods. These emerging collective values and goals seemed to partake of the "quality of life" value. This stands for the existence of a set of attributes assigned to societal contexts and its representation of collective goals as for example clean air, clean water, absence of delinquency, pleasant living environments etc.

Within this framework of changing societal values and personal attitudes another onset can be observed in a great variety of societal channels like public discussions, pressure groups, political parties, and institutions like public administration, parliaments, and national court of justice. One tendency seems to dominate this entire endeavor, however, to change only one of the five dimensions of the noise abatement paradigm, namely the noise assessing guidelines, in the direction of a more tough assessment. The notation "tough" in this context relies on several aspects like the following:

- A continuous shift away from the fundamental definition of noise as an excessive and unwanted sound impact by adding new agenda points, which disprove a direct or a high correlation with aircraft noise impact and consequently the effects of physical stress rest partially unexplained and as a result they rather show a more or less direct correlation with lifestyle and social class position.
- A continuous reinterpretation of the key concepts "excessive" and "unwanted" by drifting away from the proceedings, which count for the aircraft noise impact measures, brought out a more qualitative interpretation of the socio-psychological processes (e.g. interactions between neighbors) under varying the amount of noise impact.
- A continuous fractionalization and fragmentation of these core concepts of noise assessing by splitting the target objects in different assessment questions with separately defined limiting values are not in relation with the well known separation of sensitivity stages.

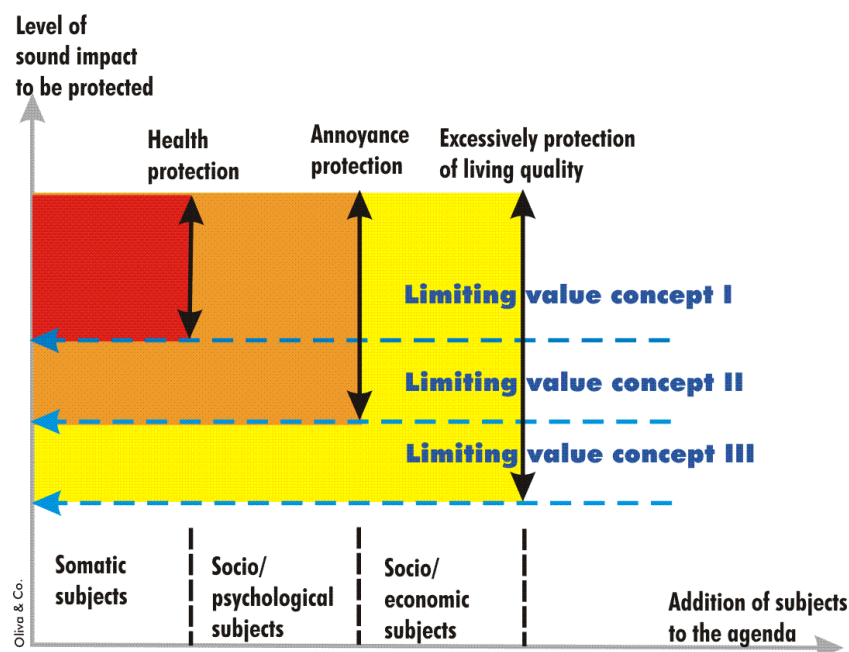
All these tendencies lead to mitigate the principal meaning of the noise abatement paradigm in the sense of a fruitful technique and procedure to lessen noise exposure in living areas relying on the aim to ensure that the terrain surrounding the airport is used in a compatible manner with the airside use, e.g. runways, arrival, and departure routes. The most impressive contradiction to the well-established paradigm is the observed shift of meaning by manipulating only one dimension and therefore not recognizing that the implication of this shift of meaning consequently leads to a new meaning, another content, which has to be complemented with a supplementary scientific approach.

**Methods** As a result of leaving the famous concept of lessening aircraft noise impact behind, and controlling only one dimension, we expect so long a deformed and crooked noise abatement understanding, until the new meaning is not completed by the following dimensions. The additional dimensions have to reflect the change of meaning in the sense of reformulating the

assessment criteria's in a more tough way. This includes a very new and adequate problem area reflecting the people's annoyance with more importance on a lower sound impact level too. Among various factors contributing to the entire impact of aircraft operations on a neighboring community, the most important are:

1. Fear of aircraft crashing within the range of a community.
2. Perceived importance of the airport system to the local economy.
3. Income, occupational status, educational status, and other social factors.

Under the condition to achieve a noise abatement concept with an intact, not deformed, and un-crooked meaning as a powerful tool, now a crossway with two alternative possibilities is shown. One way is not to modify the well-established concept relying on five dimensions and the other way leads to a modification of the core principles of countermeasure against aircraft noise in living areas still including rather lower level sites. If the last way is chosen, then a supplementary scientific approach must be designated containing necessarily the three additional dimensions mentioned above. Formulating assessment criteria's in a more tough way leads immediately to the incorporation of the principle of weighing the values of different goods including criteria like fear, perceived economic importance, and societal factors.



**Figure 1: Scheme of the theoretical framework**

The definition of a certain limiting value concept is the result of an institutionalization process. The product constitutes a framework inside of which actions take place. The crucial point is that a specific limiting value concept is a “negotiated order”. These three concepts diverge with respect to some features of the negotiation process. Thus, we introduce the following three propositions:

(1) Concerning concept I: The underlying pattern of bargaining or negotiation tends to be characterized by its “toughness”, correspondingly to the “nature” of the subject of health protection: i.e. the amount of information each of the bargainer possesses is relevant to form an agreement; the strategy of negotiation is well structured and legally based prior to bargaining; the bargainers prepare for negotiation within a institutionalized group from relatively small size. The outcome tends to be highly legitimated from the viewpoint of a broad range of inter-

est groups, because, within this negotiation process no interest group will really wants to loose its status-position.

(2) Concerning concept II: The underlying pattern of bargaining tends to be characterized by the features of a “zero-sum-game”. Within this framework, the main focus lays on an evaluative ranking of actors in order to attain a zero-sum goal-object called “limiting value”. Especially potent in the bargaining situation is the ability to convince the significant others that one has an external commitment to accept only a certain class of offers. The more scientific based this commitment the more legitimized is the process of convincing.

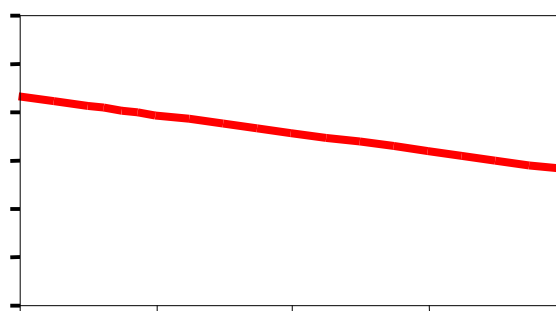
(3) Concerning concept III: The underlying pattern of bargaining tends to equalization of cumulative goal-objects. Different goal-objects are treated as they take the same bargaining-value as the annoyance protection goal. Because the state constitutes being the central actor within this bargaining process it is proposed that in order to reach an equalization of cumulative goal-objects this actor tends to reevaluate several goal-objects from a states perspective that does not include, however, socio-economic criteria.

**Results** In order to illustrate the problem of fixing limiting values within the three possible concepts, we rely on some empirical results of our Swiss Aircraft Noise Study 2000. The data for our investigation come from the sub-sample of this study examining the question of sound-impact during night-time, namely 22 – 24 hr and during 05 – 06 hr. Data were collected within 9 “micro-neighborhoods” ranging between “high” and “low” impact of air traffic noise in the vicinity of Zurich airport in Switzerland. The interviews took place in the summer 2000.

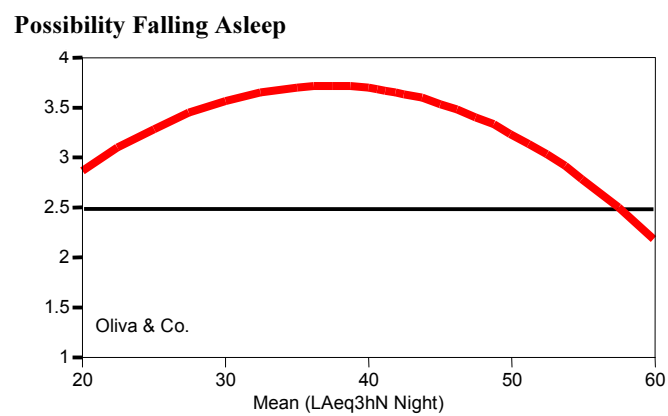
Micro-neighborhoods are territorial units, including “high”, “medium”, and “low” street traffic noise, which are more or less on the same level of air traffic sound-impact [4, 5]. The survey is a stratified sample, including persons of the age of 18 or above. This sub-sample of “night-time-exposure” consists of 360 respondents.

The level of sound impact of air traffic is calculated with the aid of the Integrated Noise Model 6: LAeq 3 hours. We counted 30 aircraft movements between 10 pm and 6 am, including 17 arrivals and 13 departures during a mean-night of the year 2000.

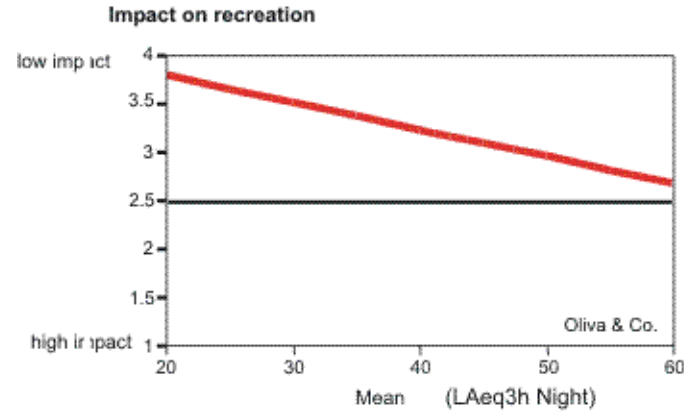
*Figure 2: Satisfaction with Silence of Micro-Neighborhood*



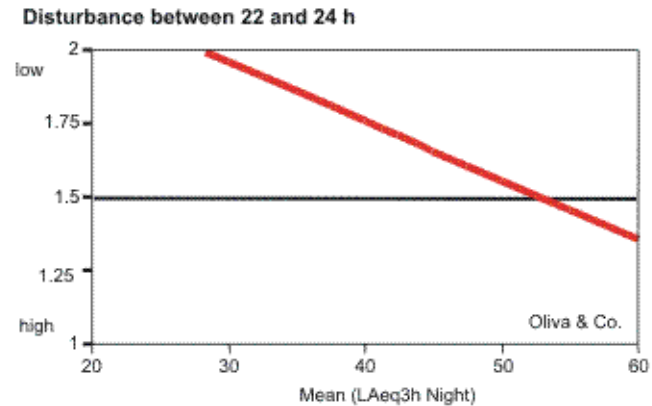
*Figure 3: Possibility to Fall Asleep*



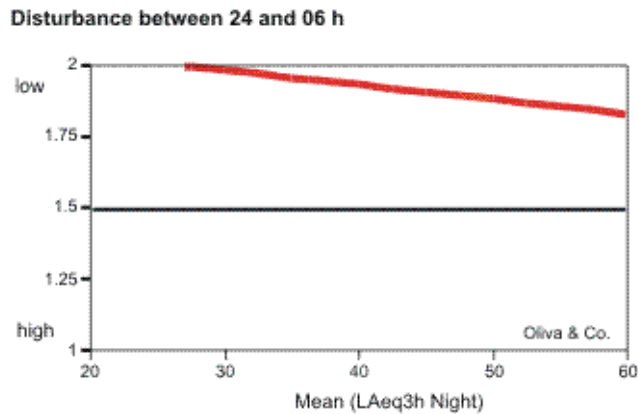
*Figure 4: Air Traffic Noise Impact on Recreation at Home*



*Figure 5: Disturbance of Sleep between 22 and 24 hrs*



**Figure 6: Disturbance of Sleep between 24 and 06 hrs**



**Discussion** As shown in the figures 2 to 6, there is no overwhelming impact of air traffic noise on micro-neighborhoods. The consequence of these results is the evidence for choosing either the here introduced concept I or concept II or a solution in between the two of them.

#### References

- [1] Ashford, N., and P.H., Wright: Airport Engineering. John Wiley & Sons, New York 1992.
- [2] ICAO: Airport Planning Manual. Second Edition 1985.
- [3] ICAO: Aircraft Operations, 1993.
- [4] Oliva, Carl: Belastungen der Bevölkerung durch Flug- und Strassenlärm. Duncker & Humblot, Berlin 1998.
- [5] Oliva, Carl: Auswirkungen der temporären Änderung von Flugrouten. Auswertung der Schweizerischen Fluglärmstudie 2000. DAGA, Tagungsband, 2002.