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The efficiency of environmental impact assessments relating to noise issues

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The study aims to investigate the efficiency of environmental impact assessments (EIA) relating to noise issues. The goal is attained through evaluation of the efficiency of anti-noise measures which were detected in EIA and practically implemented, and their resulting effects on the society.
The research includes the analysis of an EIA report for a motorway project in Latvia, noise level measurement data, alongside interview results about residents' attitudes towards the noise environment in their dwellings.
The efficiency of anti-noise measures is evaluated through comparison of the forecasted and actual noise levels, and the effectiveness through the analysis of residents' interview data.
The results of this study are a critical examination of the EIA process relating to noise issues, the identification of shortcomings and the proposal of improvements.
Key words: efficiency, effectiveness, environmental impact assessment, noise

1 Introduction

Environmental impact assessment (EIA) is a preventative and integrative environmental problem solving tool. It aims to provide decision makers with appropriate information regarding a project's potential negative impacts on environment quality, and holistic health, as well as proposing methods to prevent or reduce possible harmful effects.

One of the factors which are considered in EIA is noise emissions. The necessity to evaluate noise induced effects is determined by the impacts on peoples' health, sleep regime, psychological comfort and social behaviour, as well as on wildlife.

EIA as an environmental management tool in Latvia has been used since the 1980's when the national legislation required environmental assessments for new technology and material applications, technical designs for construction works and environmental quality evaluations for construction sites. The current EIA in Latvia is conducted in accordance with EU directives and is applied to various construction projects, of which 23% are related to infrastructure development [1]. These infrastructure projects, and especially new motorways, might cause significant changes in environmental noise levels, and therefore stress the importance of noise impact evaluation in EIA process. The suitable assessment of noise impacts and necessary mitigation methods in the earliest project stages helps to ensure acoustically acceptable living environment during object's operation period.

As mentioned above this study aims to do the ex-post evaluation of EIA's carried out for significant road projects relating to environmental noise issues. This includes the examination of the EIA's efficiency through actual noise level measurement data, and the analysis of its effectiveness through the results of sociological survey, along with proposed suggestions for improvements.

2 EIA for noise emitting objects

EIA is applied for possible ecological problem anaylisis of various noise emmiting objects such as factories, motorways, rail roads, harbours, airports, etc. It includes the identification of those environmental aspects which could be affected by the initiated action, calculation of the pollution loads and ecological impacts, determination of alternatives and developement of mittigation plan for negative impact prevention or compensation. Therefore EIA has to be considered as one of the most important management tools for ex –ante evaluation of integrative environmental and social issues, and its quality has to be a matter of significance in every country.

According to J.Petts [2], the quality of every project's EIA can be accessed through an evaluation of its efficiency and effectiveness. However, the quality of an EIA system should be examined through the clarity of legislation, comprehensiveness of actions and their impacts, openness and transparency of the EIA process as well as the robustness of the assessment quality and evaluative approaches [2]. Such assessment of the EIA system can be performed after the outcome of the EIA is concluded, but each project's EIA can be appraised only when the project is put into operation.

It means that the ex-post evaluation of a project's EIA shows the EIA's contribution to the provision of sustainable and positive environment and allows assessment of whether the EIA has practically prevented the negative effects on the environment and society. In this aspect the efficiency of a project's EIA can be described as the factual benefits resulting from the EIA, but effectiveness as effects of EIA benefits. As the efficiency and effectiveness are interrelated, they should be assessed together and be used to examine every aspect of EIA.

One such issue which should be scrutinized both in the EIA process, and in its quality assessment, is noise. Due to the possible negative impacts on people and wildlife noise issue evaluation, as a mandatory duty, is regulated through the directives of EU, national legislations and EIA procedural guidelines. The latter and the fixed program of the EIA determines which of the noise indicators should be described and analyzed in a particular case. Usually EIA reports are required to contain information about:

- existing noise levels in the project surroundings and its structure, the sound propagation in particular setting and territory zoning,
- expected noise levels during construction and operation through noise pollution modelling methods,
- expected noise level compliance with the law and standards,
- possible noise impacts and their significance,
- necessary actions for noise pollution prevention or reduction [3].

Assessing probable noise impacts and residents' reactions, the practical experience of experts, information from society participation processes, data of surveys about residents' attitudes toward the noise source, its level and frequency, noise impact changes due to seasonal factors and time of the day, available information about current cases and other factors which influence subjective or objective

responses, should all be appropriately examined and observed in the EIA processes [3].

3 EIA for noise emitting objects in Latvia

EIA's have been used since the end of the 20th century for ex-ante evaluation and solving of environmental problems in Latvia. Despite the fact that maximum noise levels were established in legislation only in the year 2001, EIA had been used prior to that for assessment of noise matters. In the present day the obligations of environmental noise management and EIA use for noise issues are fixed in national laws and regulations through the transposing of the requirements from EU directives. National legislation determines the need for noise pollution limits and possible impact estimation not only in the EIA process, but already in the application for planned action and preliminary impact assessment report.

In these reports noise issues are mostly described as day, night and evening noise levels. Every of these three indicators have a significant role in impact assessment process, and their importance is acknowledged both by experts and by the state (legislation and requirements in EIA program) [4]. Meanwhile factual examination of EIA for 14 motorway projects shows that appropriate noise analysis which includes detailed numerical and descriptive comments on the existing and prospective situation and its alternatives has only been included in several EIA reports [4]. 8 of these reports contain accurate information of day and night noise levels, but just 3 of them included comprise evening noise [4].

This indicates the need to improve the quality of EIA, though without an assessment of efficiency and effectiveness it is impossible to conclude whether the information provided was indeed sufficient to achieve the EIA's goal of preventing harmful effects.

4 Methods

The study comprises ex-post examination of EIA relating to noise issues by the analysis of noise mitigation action efficiency and their resultant effectiveness. This approach is chosen because of the close interrelation of efficiency and effectiveness concepts, which mutually complement each other and allows the systemic ex-post appraisal of EIA and determining whether, and how well, the purpose of the process is accomplished.

The object of the research is a 20km long span of the road of international significance *VIA Baltica*. The EIA for it was conducted during 2000 to 2001, the road was constructed from 2005 to 2007. This project as the object of the study was chosen because of following reasons: the subject of this project is noise source, the project provides public benefits, the EIA for project is concluded, anti-noise measures were required, and the road is already operating.

Research includes analysis of the literature, EIA documentation, legislation and Riga Technical University data on noise level measurements, onsite observation of the project area, as well as structured interviews with nearby residents.

Interviews were held with local residents who live within 200m of the motorway in places where the noise abatement walls are installed or green fences are planted. Interview questions dealt with the respondents' viewpoint regarding acoustic discomfort and other effects on their health or behaviour produced by road noise as well as any involvement in the EIA process that they had and actions for noise impact reduction.

The selection of interviews includes 28% of local residents. The study excludes surveys with owners of allotments and summer cottages because maximum noise levels in these areas are unregulated by national legislation directly, people remain there for a relatively short period and most of the dwellings are not in line with Latvian standards of building acoustics.

The data and information gathered in the investigation are described and analyzed in several sections. First of all, the information about the element of the study relating to the noise issues is given. Next, the efficiency of noise mitigation activities provided in the EIA report is determined through the comparison of predicted and actual noise levels. Then, the effectiveness of the EIA is evaluated by analyzing the results of the resident interviews about the effects of noise abatement actions on them and the quality of their living environment in acoustic terms. Finally the conclusions about EIA ex-post examination in relation to noise issues, in aspects of their efficiency and effectiveness, are given.

5 Characteristics of the research object

5.1 Territorial characteristic

Accordingly to EIA report [5] the research project under consideration is a span of the road *VIA Baltica,* which links Helsinki and Warsaw through Baltic States and is a part of one of the nine priority European multimodal transport corridors. The span is located in Latvia between the settlements of Lilaste and Skulte. It relieves other surrounding roads from goods transportation vehicles and serves as a bypass around the seashore resort Saulkrasti. The location of the existent and new-build roads can be seen in Figure 1.

Figure 1: The location of the existent and new-build roads

At the same time project barely can be considered as a true bypass, because it is partly incorporated into the infrastructure of Saulkrasti town [5]. Accordingly to the local territorial plan, within 200 m from road there are located 85 private houses as well as areas of allotments and summer cottages. It is possible that with future development of Saulkrasti town and an increase in traffic flow debates about the bypass could be renewed.

The intensity of twenty-four hours traffic flow in Saulkrasti in year 2001 was 8750 vehicles [5]. It is forecasted that by 2025 traffic flows could increase by 50% reaching 13,900 cars per twenty-four hours, with the freight vehicle proportion in total traffic flows in the daytime of 20% and in a nighttime 30% [5].

5.2 Description of object's noise issues in the EIA

The EIA report contains information about the project's surroundings in aspects of noise issues – the existing noise levels in daytime and night time, territory zoning, forecasted noise levels, probable noise impacts, and their significance and a noise pollution mitigation plan. Meanwhile in contradiction to best practice it lacks information on monitoring activities, noise levels in the time of object's construction and in the evenings, and noise level comparison to those that are set in national legislation.

In the EIA report it is predicted that during the object's operation noise levels will be less than 45 dB(A) during the night time and 55 dB(A) in a daytime 430m from the road [5]. Forecasted noise levels and their impact zones can be seen in Table 1.

Table 1: Forecasted noise levels and their impact zone. [5]

Noise level	Impact zone (m from the road)
Daytime	
65 dB(A)	60 m
59 dB(A)	185 m
55 dB(A)	430 m
Night time	
55 dB(A)	80 m
49 dB(A)	235 m
45 dB(A)	430 m

Taking into account the structure of the settlements near the road, EIA report detects that high noise impact on the inhabitants is expected to be in 10 ha, moderate to high in 26 ha and moderate only in 219 ha (from total 354 ha) [5].

In order to reduce the noise levels near the dwellings and ensure an acoustically acceptable living environment, the EIA report determines the necessity to use noise mitigation measures. It advises to replace windows for 11 private houses, the use of a 4m high noise barrier wall, 2,5m high compact fence and the planting of fir-trees [5].

6 The efficiency and effectiveness of the EIA's regarding to noise issues

6.1 Comparison of factual and planned noise levels

Accordingly to the modeling data of traffic flow and proportion of the freight vehicles in it, in the EIA report it is forecasted that noise levels near the dwellings will be less than 55 dB(A) daytime and 45 dB(A) in a night time or surpluses will be corrected using reduction measures [5].
The data for actual traffic flow in years 2007. – 2008. [6] and measurements of traffic intensity [7], shows that real intensity on a new road is close to but less than the predicted one. This can be seen in Figure 2.

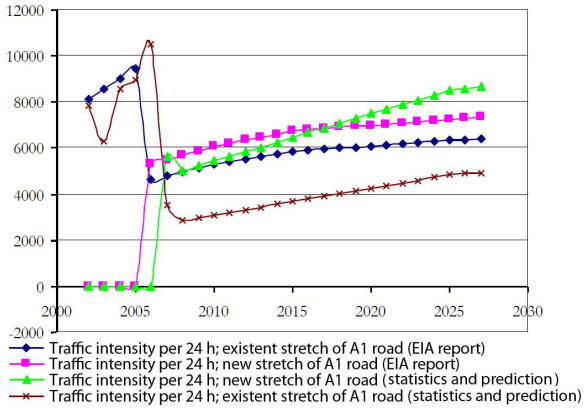

Figure 2: Actual traffic flow and prognosis. [6]

In a meantime the actual freight vehicle proportion in daytime exceeds the predicted by 10% [7]. As these changes in traffic flow and proportion together can be considered as insignificant in relation to noise levels, forecasting of basic traffic data in EIA can be considered as sufficiently accurate.

In order to determine the actual noise levels near the road and draw conclusions about the EIA efficiency, daytime noise level measurements in four places near the dwellings and institutions have been performed by Riga Technical University [7]. Two of measurement points were chosen behind the noise walls. The results of measurements after data processing demonstrates that in all measurement places - without noise barriers and behind mitigation walls - noise levels exceed the forecasted ones [7].

It should be mentioned that these noise levels not only exceed predicted ones, but also since 2001 in legislation established maximum permitted level for a daytime noise in the areas of private houses and recreation (50 dB(A)) [8], which as a settlement type predominates along the road.

Noise level measurement data indicates that noise level modeling in the EIA process has been conduced barely accurately and installed noise barriers are insufficiently effective. This might be explained with an assumption that the modeling method was not applied perfectly, also the report lacks clear technical specification of noise walls or road surface characteristics which was taken into account when modeling, or calculating noise levels and taking the decision on mitigation measures.

The discrepancy between actual noise levels and the maximum allowable levels is due to time when the modeling was undertaken (3 years before acceptance of the

EIA report and 9 years before the project was finished) – after the modeling were completed the maximum permitted noise levels were altered in legislation.

Taking into account the above mentioned, it can be concluded that in order to improve the efficiency of EIA, noise level modeling should be conducted more accurately, and the report should contain more detail technical specifications for those materials or objects which can influence the noise levels and efficiency of noise mitigation measures. This can also be passed on to responsible state institutions to require a noise section update in an EIA report in the case that noise modeling and noise mitigation plans were developed a long time prior to the EIA acceptance, or permission for the construction is demanded after the deadline of EIA validity.

6.2 Residents' opinions of noise effects on them

In the EIA report it is forecasted that noise impact on the inhabitants will be mostly moderate, moderate to high or high [5]. The noise impact will be reduced, and acceptable living environment in relation to noise issues ensured, with noise mitigation measures during a project's operation period.

Also in the experts' assessments of the EIA report it was stated that half-a-dozen meters from the prospective road noise levels would only marginally exceed maximum permitted noise levels for the areas of private houses. Obtained values are realistic and do not cause any threats to inhabitants. Conclusion – noise pollution is a non-critical factor in the total reduction of environmental quality" [5].

In the EIA public participation process petitions from the inhabitants were received. They included comments about projects, concernments about possible noise impacts and requests to take anti-noise measures. The summary of received petitions from residents and owners of the summer cottages and allotments is given in Table 3.

Table 3: Summary of the received petitions.

Number of the people	Substance of the petitions
23	Request noise walls
1	Request change of windows
3	Request fir-tree green fence
531	Supports existing trajectory of the road, because the other alternative would cause higher noise emissions
1	Believe, that project should be rejected from the ecological point of view, because the noise level will significantly increase
168	Consider that traffic flow and corridor of noise abatement walls will split the town in two parts.

In order to assess changes in the acoustic environment after the construction of the motorway and noise protection walls, a survey of residents' opinion has been conducted. The results obtained from the interviews indicate that respondents perceive disruptive effects, especially outside the dwellings during the daytime and inside during the night time. Meanwhile the severity of the noise impacts in the evenings and night time is closely related to the season and need for ventilation. A short summary of interviews results is given in Table 4.

Table 4: Results of the interviews with residents regarding to noise issues.

Question	Response
Consider to be subjected to excessive noise levels	42% (of them: 7% only outside the building, 4% - only interior)
Are dissatisfied with acoustical quality of the environment	33%
Feels impacts on their health or social behavior	25% of total
	25% feels annoyance
	21% feels sleep disturbance
	17% feels psychological discomfort
	8% feels reduction in intellectual work capacity
	4% feel headaches
Experience noise disturbance internal	29% daytime
	38% night time
Experience noise disturbance external	50% daytime
	20% night time
Consider that the main noise sources in their neighborhood are:	100% motorway
	83% railway
	4% neighbours
	4% entertainment
	4% other sources

Significant changes in the attitudes toward noise issues can be found in the answers of those people who have bought their properties near the road before the project's EIA, between EIA and construction works, and during the time of construction works or its operation.

Those residents, who have obtained the properties after construction of the project, are mostly unconcerned about noise issues. This is because they had known about the noise level before the settlement and has assessed the possibility of noise pollution before the purchase. Meanwhile those people, who has started living there in the time between the EIA and actual construction, are apprehensive of noise levels and impacts. This is related to the lack of the information or details about the project.

Attitude differences can be seen also in responses of those residents, who live behind different noise barriers. 35% of the respondents who live near the compact fence believe that the noise level at their dwellings is higher than in the properties behind noise walls. They consider that to be a sign of inequality in relation to living quality. These inhabitants evaluate noise levels inside and outside the buildings as high or very high and feel the noise caused disturbance on their health or social behavior. Meanwhile those respondents who live behind the fir-tree green fence are moderately concerned about noise level and consider that they are already used to the noise levels. At the same time they hope that by the time the traffic flow will increase more the green fence will finally reach the necessary height and density to give a practical benefit in noise reduction.

In brief summary the results of interviews show that the anti – noise measures proposed in the EIA and actually constructed ones hardly ensure the needs of noise protection and acoustically acceptable living environments. Existing noise levels for a significant part of the residents cause acoustical discomfort, annoyance and other impacts on holistic health. Thus it can be concluded that EIA has been scarcely effective in reaching the main goal of EIA – to avoid or reduce negative impacts.

In order to improve the effectiveness of EIA, the efficiency of noise mitigation measures have to be improved, and people should be adequately informed about the project, choice of anti-noise barriers and their efficiency. This could help to reduce inhabitants' assumptions of inequality in relation to acoustic quality of living environment, and lessen the factors that influence subjective perception of noise impacts.

7 Conclusions

1. The efficiency of EIA regarding to noise issues has to be determined and examined along with the effectiveness of EIA, because they mutually compliment each other, allowing systemic ex-post appraisal of EIA. In a meantime this helps to determine whether and how well the goal of EIA's are accomplished through evaluation of actual noise mitigation measure implementation and their social effects.

2. The comparison of forecasted and actual noise measurement data of noise levels proves that actual noise levels during the object's operation time, both in places without and behind noise barriers, exceed predicted ones in the EIA report and also the legal maximum permitted level. This might be explained by technical shortcomings in modelling, lack of detailed technical specification of road surface and noise barriers in the EIA report, forecasting time in comparison with EIA conduction and construction time and changes in legislation.

3. Comparison of data in EIA report and results of the interviews with inhabitants shows that residents are subjected to higher noise levels than permitted in the legislation, and a significant part of them feel acoustical discomfort, annoyance and other impacts on holistic health. This indicates that EIA has been insufficiently effective in ensuring good acoustic quality in the living environment.

4. In order to improve the efficiency of noise mitigation measures, the quality of noise modelling has to be upgraded and technical information about noise barrier and road surface characteristics should be provided already in the EIA report. It also should be required of a project's developer to prove the details of the data used in the modelling and update noise models if necessary before the decision of EIA in taken and before the permission for the construction is issued.

5. In order to improve the effectiveness of EIA, the efficiency of noise mitigation measures should be raised, and people should be adequately informed about the project and choice of noise mitigation measures. The dissemination of this information and project itself should be prior to the start of the operation of the object in order to lessen the factors that influence subjective perception of noise impacts.

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