Experience with Transforming of Input Data into Models for Strategic Mapping of Rail Transport Noise and Its Uncertainties
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Introduction: The EU member states are obliged to elaborate Strategic noise maps till June 2007. This duty was given them by the Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. Member States should apply the noise indicators den and denight for the preparation and revision of strategic noise mapping. Until the use of common assessment methods for the determination of den and denight - day-evening-night noise indicator - shall mean the noise indicator for overall annoyance, and denight is made obligatory, existing national noise indicators and related data should be converted into the indicators mentioned above. The presentation is focused on experience with elaboration of the Strategic Mapping of Railway Noise.

Data and methods: The National Reference Laboratory for using GIS in Public Health was delegated by the Czech Ministry of Health with the task to elaborate strategic mapping of railway transport noise. According to criteria of the Directive 2002/49/EC in the Czech Republic the maps of 300 km of tracks were elaborated. Whereas the criterion about the depth of penetration of noise is not applicable in the Czech Republic, where the tracks are generally located in the outskirts of towns, the methodology was used. Geographical data (geographic, topographic and geodetic data) was obtained from the Czech Office for Surveying, Mapping and Cadastre (ZABAGED®). It creates a digital topographic model of the Czech Republic territory in measuring scale 1:10000. Data on categories of railway vehicles, graphic timetable and track construction was obtained from the Railway Research Institute prepared according Dutch computing method standards (“Reken- en Meetvoorschrift Railverkeerslawaai 2004 Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer Versie: 7 december 2004”). Input data were prepared using GIS (desktop ArcView GIS ESRI, GIS Christine) according the recommendation of the EC Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure (WG-AEN). The calculation of the noise models followed the European Noise Directive (END) using software LimA Advanced Type 7812 C.

Solution of problems with creation and transformation of input data:
During the preparation phase more problems appeared.

Problem:
The linkage of data on track construction with the geographical data as new corridors were built and tracks have been slightly changed.

Solution:
This problem was solved using GIS for segmentation of tracks according the chainage and the final linkage was corrected with implementation of the aerial photos into GIS (Fig. 1).

Problem:
Assignment of train movements to different tracks in a multi-track rail corridors.

Solution:
In the first step the segmentation of tracks by different parameters of tracks (acceleration, breaking, speed, type of and number of trains) was prepared. In the next step the special macros was created (in MS-Excel) to enable automatization and minimalization of input data into LimA. This procedure was based on look up the trains with the same attributes - creating trains (Fig. 2). After that the newly created trains were putting on the tracks.

Problem:
The insufficient precise of digital terrain with the precision of contours 2 meters. This lack of accuracy of maps and missing of parts of contours led to ignoring of the cuttings, embankments of tracks and bridges; and consecutive alteration of the modelling results. Following example demonstrates the differences in modelling results using not-completed/completed contours across the track (Fig. 3-6; Fig. 5 - without information on bridge and embankment and Fig. 4, 6 – including this information).

Solution:
The above problem was tackled by special programme included in the software LimA, that is able to remodel the missing parts of terrain using the grade of tracks.

Problem:
Specification of ground absorption (definition of areas with reflecting or absorbing ground). WG-AEN recommends to ignore the areas when they are less than 250 m².

Solution:
The buffers were created in GIS in the distance of 100 m around the buildings and the function for creating buffers with dissolve barriers between buffers was used. This function connected buffers into larger ones, where overlapping in order to ignore small areas of land that have different characteristics to the larger surrounding areas. These buffers were specified as hard ground, while the surrounding areas soft ground. The buffers around detached houses were consequently manually deleted (Fig. 7).

Problem:
Checking geometric integrity (duplicate objects, source polygons with forward-backward digitising resulting in double emission, etc.).

Solution:
One of the tools of the sw LimA enables checking of the input data and their consistency using the control function for checking the duplicities that might altered modelling results. All the input data were checked using testing model and errors were corrected before the final model was produced (Fig. 8).

Problem:
Tackling with annoyance analysis.

Solution:
The input population data in the Czech noise mapping were obtained from the Czech Statistical Office – to each building was assigned the real number of permanently living inhabitants. The unique identifier of building was used as a key identifier for linkage of population and GIS address points data. The results were grouped by 5 dth (Fig. 9).

Discussion and Conclusions: Whereas in the Czech Republic do not exist complex digital maps of railway tracks at present, the methods used for preparation of input data for strategic noise mapping will be used for implementing existing data into GIS. The capabilities of the software LimA were verified to be able to solve the problems of lacking data on terrain along the tracks. The use of GIS helped to precise the input data what is extremely important for quality of outputs of strategic noise mapping, because the next step will be the elaboration of the Actions Plans for reduction of the noise annoyance of population.