Experience with Transforming of Input Data into Models for Strategic Mapping of Rail Transport Noise and Its Uncertainties

INSTITUTE OF PUBLIC HEALTH OSTRAVA

NRL for GIS in Public Health

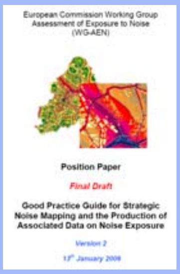
AKON

Michalik J [1,2], Snajdr K [3], Slachtova H [1,2]

1/ Institute of Public Health, Ostrava
2/ National Reference Laboratory for Using the GIS in Public Health of the Czech Ministry of Health
3/ Akon, Prague

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 L_{den} and L_{night} for the preparation and revision of strategic noise mapping. Until the use of common assessment methods for the determination of L_{den} (L_{den} - day-evening-night noise indicator - shall mean the noise indicator for overall annoyance), and L_{night} 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 rail 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 Czech Republic did not use the national methodology for calculation of railway noise annoyance, the Dutch 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).

Fig. 1 – Aerial photo and GIS localization

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 macro 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.

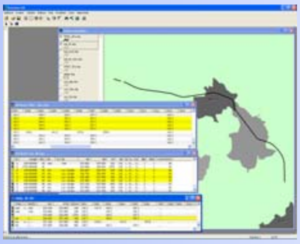


Fig. 2 – Segmentation and creating tracks

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.

Fig. 3 – Problematic area in the aerial photo

Fig. 4 – The same area in GIS with newly created embankment

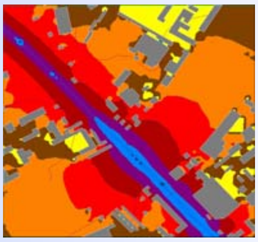


Fig. 5 – Model of the area without embankment

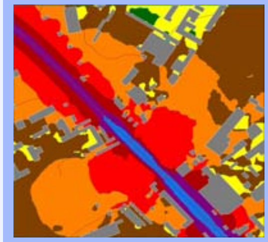
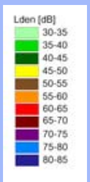


Fig. 6 – Model of the area with embankment



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 m^2.

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).

Fig. 7 – Creating of buffers around buildings

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).

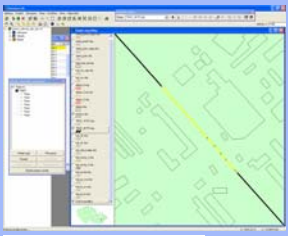


Fig. 8 – Checking geometric integrity in GIS

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 identification code of building was used as a key identificator for linkage of population and GIS address points data. The results were grouped by 5 dB (Fig. 9).

Lr	number of person		sum	
dB	(IDEN)	(IPEN)		
0-5	0	0	0	0
5-10	0	159	0	159
10-15	84	793	84	952
15-20	334	1403	418	2355
20-25	1224	2733	1642	5088
25-30	2014	6821	3656	11909
30-35	5314	15889	8970	27798
35-40	11141	22193	20111	49991
40-45	22399	9622	42510	59613
45-50	15866	1072	58376	60685
50-55	2130	441	60506	61126
55-60	521	129	61027	61255
60-65	202	109	61229	61364
65-70	106	15	61335	61379
70-75	42	0	61377	61379
75-80	2	0	61379	61379

Fig. 9 – Creating of buffers around buildings

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.

Contact: jiri.michalik@zuova.cz