

BASIC ASSUMPTION FOR THE DEVELOPMENT OF A SYSTEM FOR ACOUSTICAL MAPPING OF URBAN AREAS

PACS REFERENCE: 43.50.Rq

Kazmierczak Jan; Komoniewski Marek; Lipowczan Adam
Silesian Technical University
Faculty of Organization and Management
ul. Roosevelta 26-28
Zabrze 41-800
Poland
Tel.: (+4832) 277 73 63;
Fax: (+4832) 277 73 62
komon@zeus.polsl.gliwice.pl

ABSTRACT

The paper presents both a general idea and basic assumptions of the research project, which was started a year ago at Technical University of Silesia, Poland.

In particular, the research area of this project contains the problems of preparing and utilising the acoustical maps of towns that ought to be prepared in accordance with the EC directive COM 486 (2000). The main two assumptions of the project are as follows: 1) the maps will be prepared by means of advanced computer-based tools of the GIS and GPS classes, 2) both the procedures of developing and utilising the acoustical maps will be executed in the form of group-work using the Internet and intranet tools.

The paper discusses briefly the current state of research in the mentioned field in Poland. The second part of the paper presents the timetable of further activities with a specification of expected result. Apart from the "technical" problems of acoustic mapping of urban areas, the paper also deals with some "non-technical" aspects of this field of activity.

The final part of the paper introduced some perspectives of dissemination of results of the reported research in the process of European enlargement.

INTRODUCTION

In accordance with WHO's information from 1999 [1] year in the European Union about 40% of the population is exposed to road traffic noise with an equivalent sound pressure level exceeding 55 dB(A) daytime, and 20% are exposed to levels exceeding 65 dB(A).

According to the investigation of Building Research Institute [2] from 90th years, more than 8 millions inhabitants in Poland is estimated to live in areas of "over normative" road traffic noise (below 65 dB(A)) and 15 millions peoples in zones, where acoustical conditions are considered as troublesome (between 55 dB(A) and 65 dB(A)). The number of exposed citizen in medium and large towns is constantly increased in Poland. The investigation carried out in selected Polish cities had proved, that main source of exposure and more often source of hazard is first of all noise caused by road and railway and in several cities also aircraft communication.

In spite of modest funds intended by state and local autonomies on activities restrictive noise with trying Polish Acoustical Society had undertaken several various research works aiming to recognition and limiting unfavorable influences vibroacoustic factors. To 1998 had worked out five reports characterizing the state of acoustic climate of Poland [2],[3],[4],[5],[6].The reports include detailed analysis of situation and main conclusions relating to necessary activities to restrict the growing noise and also the methods of preparing of complex acoustic plans of cities.

Worked out in last years acoustic plans delivered the information about state of acoustic climate in investigated cities, but about different degree of particularity and range gained data. Fault these indubitable of precious elaborations was lack or poor understanding presented contents of problems by personnel of local administration, which only sporadically used elaborations in spatial planning and to creating ecological policies on one's own ground.

Therefore in the Chair of Fundamental of Technical Systems of Silesian Technical University in Poland came into being the idea of realization of research project focussed on problems of preparing and utilising the acoustical maps of towns that ought to prepared in accordance with the EC directive COM 486 (2000) and new Polish law "Law of Environmental Protection" (27.04.2001)

For projects realization had appointed consortium consisting of four independent individuals scientifically investigative centers:

- Chair of Fundamental of Technical Systems of Silesian Technical University (Zabrze)
- Institute of Telecommunication and Acoustics of Wroclaw University of Technology (Wroclaw)
- Chair of Mechanics and Vibroacoustics of the Mining and Metallurgy Academy (Krakow)
- Department of Technical Acoustics, Laser Technique and Radiometry of Central Mining Institute (Katowice)

PROJECT OBJECTIVES

Accepting as essential limitations of financial outlays, which Poland will be able to intend on realization of requirements mentioned above directive and in care for correct spending of limited funds, which will be able to be delivered on this aim had prepared present project founding:

1. Elaboration equal methodic of preparing of acoustical maps of cities with use of GIS technology as modern tool, which makes possible to join digital maps of cartographical ground with databases, containing complete data for predicting, valuing and estimating of acoustic climate on given ground. Use this techniques will assure the possibility to take into account the acoustical hazards in spatial planning, and to also current environmental management with in understanding of norms PN-ISO 14000.
2. In aim of costs reduction of undertaking and simultaneously assurances high effects of putting into practice elaborated method the choice of GIS platform will based on questionnaire recognition of software at present practical in interested city offices. Select programmatic platform ought to assure automatic transfer data to most often practical systems in country.
3. Conception of project founds to lead the works in two layers:
 - **professional – utilitarian**, preparing standardized counting, measuring and informatics procedure with destination to utilizations by managements of cities,
 - **educational**, preparing qualified personnel to put into practice, exploitation and further development (in this of actualization) of acoustic maps, and also of spreading of information in Internet.
4. Range necessary to realization works requires simultaneous and constant cooperation several of specialized investigative teams. In this aim had decided to form mentioned above consortium.
5. Because realization of project requires cooperation of many working teams situated in different parts of country, and also potentially abroad, is needed strong assurance of access to created databases both to reading and actualizing data. Such a geographical extensive undertaking makes impossible to central control of databases content. Therefore a natural solution of this problem appears to introduce mechanisms of a group work. In aim of effective realization of all

task contained in projects schedule both on stage of working out of conception and assembling data use the voice communication system, as well as video conferences is foreseen.

Experiences and achievement of participants consortium in presented research area and also their formal relations with leading agencies of UE countries make possible already from beginning of realization of project the synchronization of common works, both by gathering information and by delivering of own decisions and proposal. Used become existing agreements and contracts of institution participating in consortium, and also fact of membership each persons to specialistic international organization (Federation of Acoustical Societies of Europe - FASE, International Congress on Acoustics - ICA and others)

DESCRIPTION OF INVESTIGATIVE AND DEVELOPMENT TASKS

1. Elaboration of questionnaire for the needs of identification of implementation level of GIS technology in the cities above 100 000 inhabitants.

One from superior aims of presented project is elaboration of computer tools, permitting the creation of digital acoustic maps. The accepted basic assumption, for this purpose GIS technology to use, extracts to take into consideration wide possibilities of dissemination of GIS especially in local government units. It is therefore assumed the questionnaire investigations so far existing applications GIS in selected cities to carry out. The recognition obtained this way will be the reason for choice of GIS software, which one will become used in this project. About this choice both the level of dissemination of GIS software and possibility automatic reading with acoustical maps files will be decided. The acoustical maps ought to be considered as one of layers for environmental managements in GIS system.

2. Choice and starting of GIS software in seats of consortium participants

On this stage is foreseen individual starting of select software packages in the seats of consortium members. It is assumed, that from beginning the works real digital map of selected town will be used. Up to date will be undertaken works over assurance of convertibility and communication with most often practical GIS software in country. It is advisable to take into consideration the possibility of adaptation of so far using software in suitable institutions and the susceptibility of transfer data among GIS systems.

3. Elaboration of methods of gathering and processing of data to creating of noise maps

With accordance to Polish law and EU Directive the indicators for noise assessment will be fixed, of which distribution on city's area will be content of noise map. It is assumed that for this purpose the data both from calculations and measurement can be gained. The calculation and measurement procedures will be defined for the basic kind of environmental noise: road traffic, railways, air transport, industry.

The resolution of noise maps differing both precision level and kind of source data needed to its preparation will be defined. The resolution of maps ought to be adapted to basic maps application: spatial planning, local activity planning and for spreading and accessing information about quality or condition of the environment.

GIS database supporting the noise maps creation should make possible to collect and store information in particularly data measurement from environmental monitoring. For realization of calculation procedures the professional software for noise simulations with regard to input and output data will be used. It is foreseen for this purpose packages such: MITHRA, IMMI, CADNA, SoundPlan to take into account.

4. Programming works

Two processing data systems are foreseen:

- inside of GIS – using source data, which are included in GIS (digital maps, geocoding and mapping data)
- outside of GIS – data to GIS transferred (measurement and calculate data)

It is assumed the hybrid system to create, as connection between GIS and outside software, with two way data transfer.

5. Use of satellite global positioning system (GPS)

The large number of measuring points indispensable to preparing acoustical maps require GPS for the positioning these of points and also characteristic for acoustical climate objects to apply. For realization this aim foresees the methodic of high precision positioning or using two GPS (Differential GPS) to working out.

6. Elaboration of Noise Monitoring Stations

For flexible acquisition and transmission of noise data the realization of minimum 10 sets of noise monitoring stations is foreseen. The stations ought to be prepared according to results of the project (KBN 7 TO7B03419), in which worked out the construction of local noise traffic station. The stations will be passed on to the groups verifying the measure methods in selected cities.

7. Practical verification and corrective actions of GIS software

The task embraces the realization of example acoustical maps in selected and representative districts of cities. Both calculation procedures and physical models in mentioned above software for noise simulation and also system of data transfer to GIS software will be verified.

8. Elaboration of instruction programmes for implementation of acoustical maps

The task embraces the preparation of essential elements for implementation of projects results into local government units. The didactic programme of instruction courses concerning passive and active methods of knowledge passing will be provided.

With regard to recognition and analysis of instruction programmes relating to higher education system the standard didactic methodology of preparing acoustical maps will be prepared. Special attention will be given for preparing of programme for postgraduate studies in range of environmental noise management.

9. Execution of short-term training programme for operators of local systems

It is assumed two kinds of courses to organize:

- for personnel of local administration
- for GIS operators managing

The program contents of first course should cover the area of spreading of knowledge about possibilities of using of elaborated noise mapping system in process of spatial planning and environmental management.

Special attention will be put on training of operators and supervisors of GIS system in procedures of collecting and preparing the information about city in the second course. The requirement for operators in creating and utilizing noise mapping will be defined.

10. Placing of informatics results of project in computing centre of high calculation power

General results of research will be the database system containing an enormous amount of information both high calculation power and efficient system for data storage require.

Both of these functions need to use Advanced Computational Infrastructure providing security and authorization of access. The access to database will be possible due to wideband network, which came into being by programme PIONIER. Putting into practice such network the suitable quality for all users included local and central government's administration is guaranteed.

11. Elaboration of instruction for creation of acoustical mapping of urban areas as element of general system of environmental management

The instruction will contain compendium of knowledge on the preparing and utilizing the acoustical maps. In particular the instruction will give the persons using the system information about:

- Legal bases and regulations connected with noise environmental management;
- Requirements and methodology for preparing the acoustical maps about different classes of resolution
- Requirements and standards for preparing the input data and visualization of results
- Rules for accumulating and processing data in GIS system

Instruction must to be adapted to procedures applying in local government units (communal and district autonomy) regarding ISO 9000 and ISO 14000.

REALIZATION AND FIRST RESULTS

The first stage of realization of project consisted in the recognition of applying level of GIS software in selected local governments units, as the basic component of noise mapping system in process of spatial planning and environmental management.

For realization of this task one questionnaire has been prepared, which to city offices in 40 of the largest city in Poland delivered [7].

The questionnaire contained the major issues about:

- kind of GIS systems used by local governments units
- aims and range of implementation of GIS
- ways of collecting information used to create and develop the databases
- degree of utilization of GIS software in communication with society
- basic limitation factors for applying or enlarging the GIS software,

Obtained results of such prepared questionnaire are the starting points for execution of comparative analysis in range of utilization GIS system for solving task from area of supporting of environmental management.

The main area of implementation of GIS software in researched cities is showed on picture below (Fig.1):

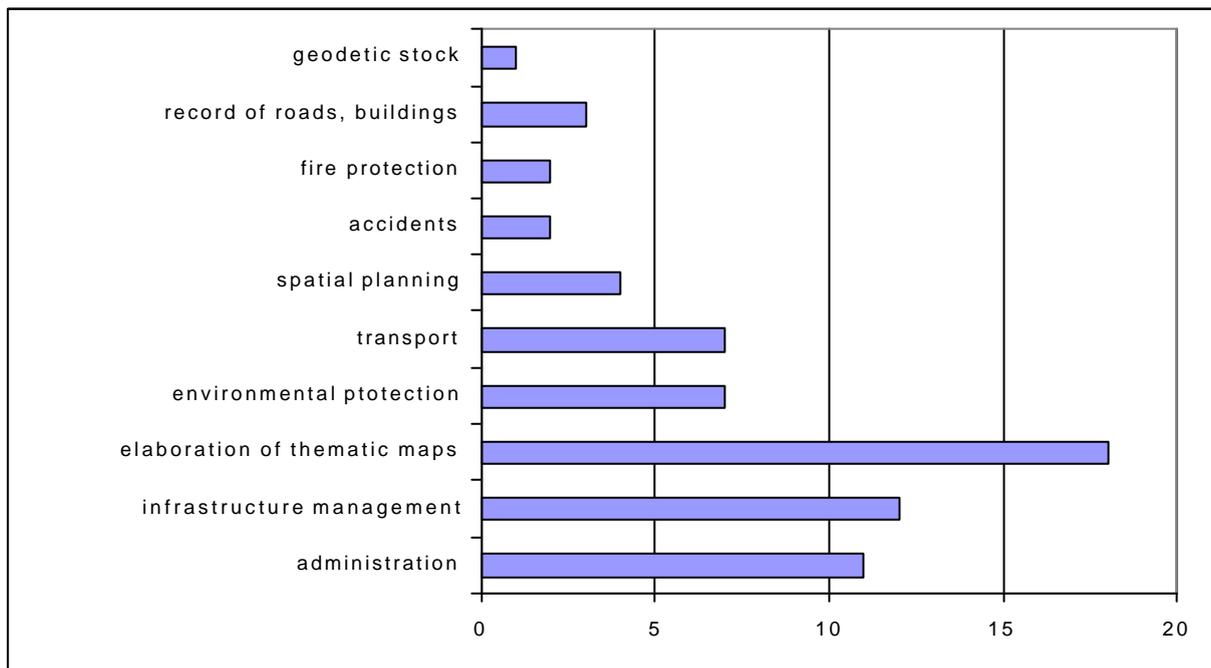


Fig. 1 Identification of implementation areas of GIS software in local government units

From questionnaire research results that degree of implementation of GIS system is high (in questionnaird city offices - 91%), but it does not find t in utilization of possibilities, that by these systems in many executable statutory tasks is offered . Reasons of such small utilization are double:

- lack of properly instructed staff and specialize units to work with GIS software
- high software cost and time-consuming of development of database and thematic maps

Recapitulating the results of preliminary researches is possible to notice, that state of utilizing of GIS technique in supporting of need of environmental management is scarce. First of all, it scants both good skilled staff and specialized departments dealing with instruction of employee. Applying of GIS technology in various domains of activities of questioned offices is continuously in sphere of plan. In particular it is strongly visible in the task relating current analysis of state of environment, environmental protection and management and also identification and localization of environmental hazards.

With sentence of projects authors the described in this article tasks are well-founded form of approach to efficient and effective system of developing and utilizing the acoustical maps. On special attention will deserve fact, that worked out system will determine integral part with superior system of environmental management and will be base for decision undertaking by local authorities, but not necessarily specialists from acoustics domain.

Bibliographical references:

- [1] Guidelines for Community Noise WHO, London, United Kingdom, April 1999
- [2] Report: Protection of environment before noise and vibrations. Current state and directions of activities. By: J. Sadowski and others. Building Research Institute Warsaw 1992
- [3] Report about state of investigations and acquired possessions in range of protection of environment against noise in Poland. By: J. Sadowski and others. Building Research Institute Warsaw 1976.
- [4] Report: Noise and vibrations threat in Poland. The Acoustics Committee of the Polish Academy of Sciences. By: Z. Engel and others. Warszawa 1984
- [5] Report: State of environment in Poland (Chapter 12. Noise and vibrations) By: J. Sadowski by the State Inspectorate for Environmental Protection and the UNEP/GRID Centre Warsaw 1997
- [6] Methods of preparing the complex acoustical plans of cities and areas. Instruction of Building Research Institute Nr 310. J Sadowski and others. Warsaw 1991
- [7] Report of own research: Comparative analysis of GIS software in range of identification of interaction of environment. BW 502/ROZ5/2001. Zabrze 2001