



Using GIS tools to assist the management of the area of limited use around the airport and the direction of development of the system

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ABSTRACT

The study contains a description of the use of GIS tools in compensation proceedings using the example of the area of limited use set up for the Katowice International Airport in Pyrzowice. Additionally, the study describes the development history of the system so far and presents future trends allowing integration of the existing system with projects fulfilling requirements of particular airport departments. Consistently taken development steps will ultimately allow reducing the expenses incurred in relation to compensation proceedings on account of noise emissions and allow significantly better management of the infrastructure of Katowice International Airport in Pyrzowice

KEYWORDS: GIS, airport

1. Introduction

The documentation of the Area of Limited Use was prepared by INVEST-EKO of Katowice in the 2nd half of 2007 on the basis of a mathematical model, which was corrected on the basis of noise measurements taken in 20 points.

The legal basis for establishing the area was:

- Act of 27 April 2001. Environmental Protection Law.
And in particular:

Art. 135. 1. If proceedings concerning environmental impact, post-implementation analysis and ecological review show that despite the application of available technical, technological and organisational solutions, environment quality

standards cannot be met outside the area of an industrial plant or other facility, then for a sewage treatment plant, landfill, composting plant, communication route, airport, power line or substation and radiocommunication, radionavigation and radiolocation installation, a limited use area is created.

Whereas the legal basis for establishing ALU zones was:

Regulation of the Minister of Environment of 14 June 2007 on acceptable levels of noise in the environment (Journal of Laws No. 120, item 826). The Geographic Information System built within the framework of establishing the Area of Limited Use constitutes an integrated database on the terrain, containing a division on the basis of land ownership, and the facilities located in areas defined as **acoustically protected** in the surroundings of an airport and located within range of excessive effects of airline operation.

Due to the extensiveness of approx. 16 km of the designed Area of Limited Use, Invest-Eko of Katowice prepared documentation using specialised GIS tools. The specialised software for the system was supplied by WINUEL – SYGNITY.

2. Elaboration

The System introduced by the author of the study on the Area of Limited Use enabled the correct processing of data and results of acoustic analyses and appropriate preparation of an application constituting a formal basis for the regulation enacting the area of limited use for the Katowice International Airport in Pyrzowice by the Silesian Local Government Assembly.

In the case of Katowice International Airport, the Area of Limited Use was created by **the provincial local government assembly by way of resolution No. III/27/3/2008 of 27.08.2008.**

The resolution specified:

- boundaries of the area,
- restrictions concerning intended use of the area,
- technical requirements for buildings,
- methods of using the areas.

In the period of two years from the moment the resolution came into force, the GIS system functioned as a tool for managing the area of limited use by the airport service staff. It allowed systemic servicing of the Area of Limited Use within the scope of possible claims of parties acting as owners of land located within the boundaries of the Area of Limited Use. The employees of the Investment and Real Estate Department, after receiving a claim, checked whether the claimant's plot was located within the Area of Limited Use and added information about the claim to the GIS database along with the parties' contact details.

The area of limited use covered **15,89 km²** of land.

The area of limited use covers the area located in the following gminas:

OŻAROWICE, MIERZĘCICE, MIASTECZKO ŚLĄSKIE, SIEWIERZ and SWIERKLANIEC

The proposed area of limited use was populated by a total of 1612 people, including: 1104 Ożarowice, 150 Mierzęcice, 358 Miasteczko Śląskie.

The boundary of the area of limited use was designated for residential areas (one zone). The boundary is designated by the greatest range (i.e. envelope) arising from overlaying the range of identical long-term sound level curve $L_{AeqN} = 50 \text{ dB for night time}$ (forecast for 2010).

The existing system has flexibility and allows adding modules connected to, for example, automatic or periodic monitoring of acoustic impact.

The supplied system included:

- SONET application – open architecture (supports all databases compatible with the Open GIS (OGC) standard, such as ESRI ArcSDE, Oracle Spatial and many more. Presentation of data is based also on such standards as WMS and WFS and is possible in various environments, (including) ESRI (ArcGIS Server, ArcIMS), Oracle MapViewer, Google Maps, GeoServer. The system supports most standard CAD and raster formats without the need for additional components.
- system requirements – works under Windows XP Professional SP2.
- server part – the minimum configuration is: processor at least 2GHz, 1 GB RAM, 2xHDD 80GB SATA2, Windows XP Pro SP2.
- client part – processor at least 2GHz, 1 GB Ram, 1xHDD 80GB SATA2, Monitor 19", graphics card compatible with DirectX9C 256 MB RAM, Windows XP Pro SP2.
- - the system includes a server part, i.e. Oracle Standard Edition One – licence for 5 users and a client's application Sonet EE1 licence.

The database created under the project included:

- a list of plots existing in the area of limited use;
- a list of land plot owners;
- the size of each plot located within the zone;
- percentage share of a plot within the area of limited use;
- information on buildings located on plots, i.e. no., number of storeys, number of windows;
- information on submitted compensation claims;
- intended use of plot or building;
- which administrative division a plot belongs to,

Additionally, the system contained the following backgrounds:

- vector – plot areas and buildings;
- raster – orthoimage map, topographic map, master map, zone boundaries of the area of limited use and equations of the reach of equal-loudness contours, locations of the noise measurement points.

The software allows inventorying of real property, airport infrastructure and Areas of Limited Use (ALU). The data is gathered in one spatial-descriptive database, which allows easy access and preparation of spatial-descriptive reports and analyses. The data presented in the system has the form of maps which may be presented in any manner, printed and shared on the Internet (intranet).

In relation to a verdict of the Supreme Administrative Court II OSK 2032/09 of 23.03.2010, Resolution No. III/27/3/2008 of 27.08.2008 of the Silesian Local

Government Assembly establishing an area of limited use for Katowice International Airport in Pyrzowice became null and void.

In the current situation the need has arisen to analyse the legitimacy of maintaining and developing the GIS tool possessed by GTL SA. After the analysis it was found that currently we are using only a small fraction of the functionality offered by this system, the basic element being keeping the data already possessed and the graphical backgrounds for the Area of Limited Use (i.e. data on areas outside the airport) up to date and expanding the system with data on internal airport infrastructure.

Górnośląskie Towarzystwo Lotnicze SA may develop the database assets by assigning its updating to third parties or perform the updates in-house.

Both these options entail specific expenses, such as:

- in the case of the former, expenses related to hiring an external company
- and in the case of the latter, expenses related to purchasing a software license for multiple workstations, purchasing a system server, field equipment and data analysis software.

It was decided that work shall be implemented in stages, mostly using external company services and developing a technical and specialised knowledge base in the company.

In subsequent years until 2011, this resulted in data expansion in the GIS system including:

- the update of information about land plots within the Area of Limited Use in 2009;
- preparing a map overlay for the website of the Katowice International Airport allowing anyone to quickly check if their property is located within an Area of Limited Use zone;
- the database was extended to include an inventory of protected species present in the area of the Katowice International Airport, surveyed in 2009; the data collected in this respect constitutes one of the backgrounds for the existing GIS database, which allowed, after overlaying the background maps prepared under the General Plan, to determine clashes between implemented facilities and identified protected areas;
- within key investment projects, since the database appeared, detailed designs have been prepared in the form of backgrounds allowing implementation in GIS software;
- in 2010 a background containing the inventory of underground installations within the airport area was created;
- also in 2010, a project of inventorying instances of runway damage was prepared by Grzegorz Myrda (project co-financed by the European Union with TEN-T); Supplementing the terrain data for the area within the

Katowice International Airport allows:

- introduction of data concerning the course, inspection and repair of all kinds of installations and buildings,
- creation of layers by services operating within the airport infrastructure and introducing via these layers terrain data which is important for them, such as: identification of vehicles and persons present in the vicinity of the runway, recognition of areas and completion dates of implemented infrastructure elements, identification of terrain obstacles, adding building maintenance and inspection data, specifying places of priority action in emergencies.

Such actions permit more complete control over the area surrounding the airport.

Particular departments of Górnośląskie Towarzystwo Lotnicze SA have been equipped with the following sets of tools assisting the process of inputting changes into the database:

- DGPS field receiver.
- Field receiver software, controlling its operation.
- One-workstation software for terrain data processing and incorporation into the currently possessed GIS system.
- Underground installation detector with a generator.
- Laser rangefinder for entering distances and checking building heights.
- Database server.
- Employee training courses.

Next, system development was provided for through:

- Purchasing GIS field equipment for services operating in the airside zone, i.e. min 1 for the Energy Department, Airport Operation Department, SOL, and training these employees in updating the GIS database.
- Purchasing GIS network software along with servers and making this data available for the above mentioned departments and allowing them to update the system.
- Training the employees of other GIS departments.
- Updating the airport background for imaging in the visible band and with a layer in near infrared and LIDAR scanning.
- Updating the data entered into the system to encompass the data on the new area of limited use, for the creation of which GTL SA will apply to the relevant administrative organ in the 4th quarter of 2011.
- Introduction of a continuous noise monitoring system managed by GIS tools.

After the system data is extended, the system may play a significant role in the management of the airport area, emergency management, business, environment protection and improve air obstacle spatial data analysis.

2.1 Airside

Air corridors, navigation – possibility of planning time intervals for landing approaches and take-offs and tracking moving objects in real-time. This application improves the efficiency of airspace management, improves the level of safety and may be used to relay public information such as information of noise monitoring and may automatically transmit information on flying aircraft in real-time. Inclusion of information on critical situations which occurred in the past or may occur in the database. The ease of adding critical events and the simple process of transmitting such information to interested parties is an additional asset.

Analyses in 3D – in this respect, the system has the capability of creating a 3D model of the geographical data of the terrain surrounding the airport. The data concerns the land use type, building heights and changes in the terrain surrounding the airport. This application allows better graphical imaging of the operational zone of the airport and finding security weak spots, airspace obstacles and monitoring the land use of the surrounding areas.

2.2 Landside

Illustration of the consequences connected to the introduction of subsequent changes in the infrastructure around the airport.

Owing to the possibility of entering and illustrating in the form of a model on any backgrounds of unique data.

Planning and designing – using the backgrounds from design and conceptual documentation prepared by design offices and industry experts for analyses. Placing background maps concerning local infrastructure and community, such as land usage types, neighbourhood-related restrictions and environmental sensitivity (for example protests and disputes initiated by local residents) in the system. It allows setting and minimising the timeframe for performing field analyses and land development and specifying the best locations for planned facilities even in very densely populated and urbanised areas, where public sensitivity is very high. This material formed the knowledge base used by GTL SA and external companies implementing works for benefit of the Company.

Operations – the projected increase in air traffic may cause many opportunities associated with better usage of the airport operational zone to slip away. We must carefully balance between security issues and the necessity to increase the operations generated in the airport area. The analyses which can be performed in the system allow specifying the barriers limiting traffic capacity of a facility such as an airport. The system will soon be a principal tool for performing analyses of noise propagation

around the airport. Ultimately, in the near future it will work with data from continuous aircraft noise monitoring devices and analyse their results in conjunction with data from aircraft.

Efficiency – the target system will integrate real property data and managerial tools so that it can be used to specify fully the needs associated with profit-yielding and loss-making elements for the company, thus allowing reducing losses to the necessary minimum by precisely defining the boundary needs.

Maintenance – the system is able to modernise the management of airport maintenance, within the scope of controlling, for example, the condition of the pavement (inventory of repairs, damage, checks), runway lighting system, terminal infrastructure, airport drainage system and accounting handling. It also allows managing the most vital elements of airport infrastructure with a graphic interface. Ultimately, it may be included in the system connected to automatic on-line relaying of data from measuring instruments.

Security – it allows integration of separate security data into one management and decision-making environment (crisis centre). Owing to the standardisation of data flowing into the GIS system, there is a possibility of creating an integral security system inside the airport, including airport border protection, protection of the terminal zone, code access of entry and exit, and monitoring.

3. Conclusion

Summing up the above-mentioned considerations, the GIS system built in Katowice International Airport could become a turning point for the strategy of managing the airport infrastructure and neighbouring areas. Abandoning further development of the system will result in the loss of value of the already developed material, which will not undergo further updates and development. Developing the system at the time of the planned extension of airport infrastructure, which is planned within the next few years, will allow reducing costs associated with subsequent updates of the system. Purchasing equipment and training GTL SA employees in supplementing the database will reduce the costs of maintaining and expanding the system. Otherwise, each update will require the services of third parties. It is also important that all data introduced to the system be coordinated by one department, so that the system maintains appropriate quality. All new works implemented in the airport area should take into account the possibility of updating under an agreement concerning the project and implementation, and the possibility of entering new infrastructure into the GIS system. This concerns such issues as preparing design documentation

in an electronic form, which may be easily introduced in GIS in the form of a background map, applying an appropriate system which remotely transmits the information on utilities usage and, for example, sewage disposal to GIS. This allows continuous monitoring of the airport infrastructure.

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