

GEOGRAPHIC INFORMATION SYSTEM (GIS) AS A FACTOR OF INCREASING QUALITY OF SERVICE IN DISTRIBUTION NETWORKS

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SUMMARY

In this report, I presented the rules and implementation possibilities of Geographic Information Systems (GIS). This system collects, stores, processes and analyses data related spatially to the earth surface. GIS is commonly used in telecommunication, transport, public administration, demography and statistics, trade and power energy. The report concentrates on works that have already started and the expected future developments in the power energy sector.

Keywords: telecommunication, distribution service

1. INTRODUCTION

In the Polish language, there are three concepts related to the specificity of the domestic GIS technology [1]. The first one is SIP [Spatial Information System]. Additionally, within the system there is SIG [Geographic Information System] – under this caption, there are projects covering bigger areas like province, region or country – and SIT [Terrain Information System] – projects covering smaller areas like municipality, town, where detailed data are stored. The GIS technology enables to combine typical operations on data stored in data bases (statistical analysis) with operations, which visualise spatial effects and conduct analyses, which results could be presented in the form of maps, reports or graphs. The GIS technology is used when one seeks answers to the following questions:

- Where to put up the new undertaking?
- Where are the best conditions to cultivate particular type of cereal?
- Which road shall go the public services car called in case of emergency?
- How to plan the development strategy for the particular region?

In each case in order to solve the problem, information about its spatial relations is required. GIS is used if information about location in space is necessary to take decisions. Such information is required by specialist from many fields: public administration, trade, marketing, transport, logistics, spatial management, finance, industry, telecommunication and power energy as well many others. GIS brings lots of advantages for decision making processes and creation of development scenarios by taking spatial information into account.

2. GIS – THE NEW IDENTIFICATION TOOL

Data in the Spatial Information Systems is stored as topic layers that are mutually connected by spatial relations – see Figure 1 below.

Data stored in the Spatial Information Systems contains unambiguous spatial points of reference – longitude and latitude or geodesic co-ordinates as well as other information enabling location of objects and phenomena in the space. In order to create unambiguous spatial points of reference, which contain additional data, the automated process called geocoding is used. The spatial points of reference defined in such a way enable fast and error free location of objects.

In the Spatial Information Systems two models of spatial data are used:

- vectorial model
- bitmapped model

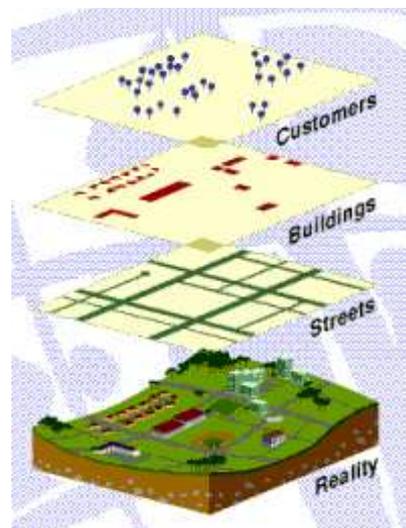


Figure 1. Information layers in the Spatial Information Systems
Source: ESRI Polska, Information Materials, Warsaw

In the vectorial model, data related to objects is stored as a set of flat co-ordinates (x,y), in case of need supplemented by a height co-ordinate. In this model, objects are split according to their character into: point, line and surface objects.

In the bitmapped model, data is stored as a set of raster eyes, where each eye has a value, which describes the corresponding object.

The possibilities of Spatial Information Systems are very extensive. There are following advantages of their implementation:

- decrease of own costs
- strengthening of the internal structure of institution
- faster access to information, which enables to take the right decisions
- more efficient creation and map availability process

As far as cost reductions are concerned, GIS decreases costs by more efficient customer service, choice of optimal solutions, making logistic activities more efficient and fast analysis of available data possible.

The very important feature of GIS is improvement of information flow and fast access to information. It enables to generate necessary data for taking decisions fast and efficiently. Such decision is required due to the following reasons 1) it is fast and thus is ahead of competitors 2) it is reliable because is based on a set of parameters describing particular issue.

3. IMPLEMENTATION IN THE POWER ENERGY SECTOR

The efficient, planned development and functioning of the energy network depends on access to data describing the possibility of building new network sections and information enabling fast location of breakdowns. GIS is an integrated tool used in management of data, which enables to combine data used by energy service into one common system and analyse it, taking spatial correlation into consideration. It is also possible to include in the process of planning of the network development data about energy receivers and create systems of tariffs on that basis, taking into account demographic data.

The basis software used is ArcView 8.1 [2]. At present, it is the most popular GIS package, which enables visualisation of data, searching, conducting spatial analyses, creating and editing of geographic data as well as data interpreting. The latter is the new feature of ArcView, which enables to combine data from different sources saved in the vectorial or bitmapped format and its presentation in the common spatial system. Among many functions of the software, the following are the most important: formatting of descriptions, possibility of defining of the level of transparency of the information layer, wizards facilitating cartography production, two and three dimensional graphs and diagrams depicting results of conducted analyses.

The Faculty of Electrical Engineering of the Technical University of Czestochowa takes steps to

buy this software. It is expected that it will be used by for the following purposes:

1. own research
2. analysis of distribution companies

As far as the first segment is concerned, the first research on logistic efficiency of the network has been conducted. Its objective is to set the reduced points of supply and receipt of the 110 kV network of the distribution company. Description can be made with usage of Cartesian or geographic coordinates. In the first case, it is the *local analysis*¹, in the latter – the *adjusted analysis*². This issue is very important from the point of view of the efficiency of energy distribution. The results of research are expected to lead to rationalisation of functioning of the network.

It is also expected that the software ArcView will be used in this segment for analysis of reliability of the network functioning. Research will focus on the impact of the density of the road network and terrain characteristics on the time necessary for energy emergency forces to get to the place of breakdown. The results of research are expected to lead to rationalisation of functioning of the network.

The software will also be used for spatial presentation of research results (with usage of the package ArcView 3D [3]).

The Faculty of Electrical Engineering co-operates intensively with practically all distribution companies in Poland. The co-operation consists in implementation of software for calculation of energy losses in distribution networks of these companies [4]. In the beginning, it was software STRATY'96 [LOSSES'96], later software STRATY'99 and presently the brand new version STRATY'2002 PLUS. The results generated by the software are in the form of tables or graphs.

It is assumed that introduction of visualisation of results with usage of software ArcView may enrich the analytical materials through additional presentations as follows:

- presentation of energy losses on the 3D map of territory serviced by the particular distribution company
- presentation of energy losses on the 3D map of territory serviced by regions of the particular distribution company
- inclusion of additional information in the presentation e.g. for distribution of trade losses – information on the number of receivers, households and farms
- forecasts of losses for different types of transformers

It should be stated that the already started research with usage of the GIS package is very promising and shall be continued. Its implementation in basic works as well as in

¹ Own phrase

² Own phrase

presentations of results of analyses of energy losses may bring additional values, which causes that analyses are shown in a new, unprecedented way.

REFERENCES

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BIOGRAPHY

Jerzy Szkutnik Works in the Faculty of Electrical Engineering, Institut of Electrical Engineering in following areas: transsmision and the distribution of the electrical energy in technical and economical aspects, expert of distributive networks for distribution companies co-author of several softwares of distribution efficiency in high, medium and low voltage. The participation in passed 150 scientific works - investigative of executed on the order of the Institute of the Energetics, the department of the energetics and on immediate orders companies of distibution electricity, currently cooperation from 28 with distribution companies of Poland. The co-author of 2 books, the author and the co-author 70 of articles in periodicals and of reports presented on conferences national , international and foreign, for example: in Berlin, Bangkok, Kosice, Budapest, Florence. Performed functions: Deputy Director of the Institute of Electrical Engineering. The initiator of many international contacts with Technical University of Częstochowa. Since 1999 the Vice- President of the Association of Graduates of Technical University of Częstochowa.