

# Development of Automated Subsystem of USATU Civil Engineering Services Using GIS-Technologies

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## Abstract<sup>1</sup>

The article is devoted to automated subsystem of USATU civil engineering services development which allows to work with spatial objects of civil engineering networks. The main goal is to provide the University leadership with a sufficient, reliable, relevant information and information support for the University property management.

## 1. Introduction

Rapid progress of information technologies allows more and more people to use computers for solving their professional tasks. Design and maintenance of civil engineering services are modern and important tasks of information system usage.

Creation of a system that provide an user with graphical information on resources being used (communication lines, water pipes, electricity, etc.) and propose effective

methods for their better usage and support could make easier the management of civil engineering service.

Service network (pipelines, heating, road, phone and computer networks, etc.) management systems are the systems for management of spatially distributed objects having some essential and informal information related to every object.

Geoinformation system (GIS) software makes it possible to integrate certain datasets on a territory into a complex interconnection software tool for solving the specific problem. Therefore the main condition of the efficiency for using GIS-technology and its tools is their system integration into users' information and technological environment, i.e. into the environment of object-oriented databases and problem tasks of a control system.

## 2. Goals and Tasks

The main goal of implementation of civil engineering service management system (as a part of GIS of Ufa State Aviation Technical University) is to provide the University leadership with a sufficient, reliable, relevant information and information support for the University property management.

The system should perform the following tasks:

- Systematization, integration and verification of all information about civil engineering service objects;
- Inventory of civil engineering service objects;

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- Fast providing with quality information on engineering networks objects as paper and electronic documents;
- Engineering networks designing, documentation making and reporting;
- Interaction with other subsystems of engineering networks and University property;
- Interaction with regional and governmental services (land registry, preservation of the environment);
- Map, scheme, draft and attribute edition.

### 3. Choice of Software Tools

Civil engineering networks are characterized by high volume data with high requirement for position accuracy. Sometimes it needs an usage of split-hair accuracy numbers and special software to work with detailed databases.

The general requirements for information systems working with civil engineering services are:

- Availability of schematic presentation of engineering networks with modeling the statuses of elements and network parts;
- Availability of geometric presentation of engineering networks on map with dimension and coordinate data;
- Availability of attribute description of engineering data network elements;
- Description of the network and elements life cycle;
- Availability of documentation tools and reporting.

However some specific requirements for the Project development tools must be satisfied:

- Availability to work with unlimited distributed databases;
- Multi-user remote access including multi-user distributed edition;
- Plurality of engineering network presentations with their co-ordination;
- Topological correctness of all spatial data;
- Object-oriented approach to a problem with layer presentation data;
- Software tools for dynamic interaction among different layers;
- Availability to work with adequate data model that include objects in linear coordinate systems, nodes like special system objects, route graphs, ability to work with raster.

ESRI software satisfies all these requirements. Also they have a special software module ArcSchematic for dealing with civil engineering networks.

The package ArcGIS 9.1 also have a software module to analyze and process Schematic Network Analyst diagrams that permit to perform analytical tasks like:

- connection search;
- cycle search;
- route search;
- overlapping search.

An example of a route search for the hot-water circuit scheme is shown on the figure 1.

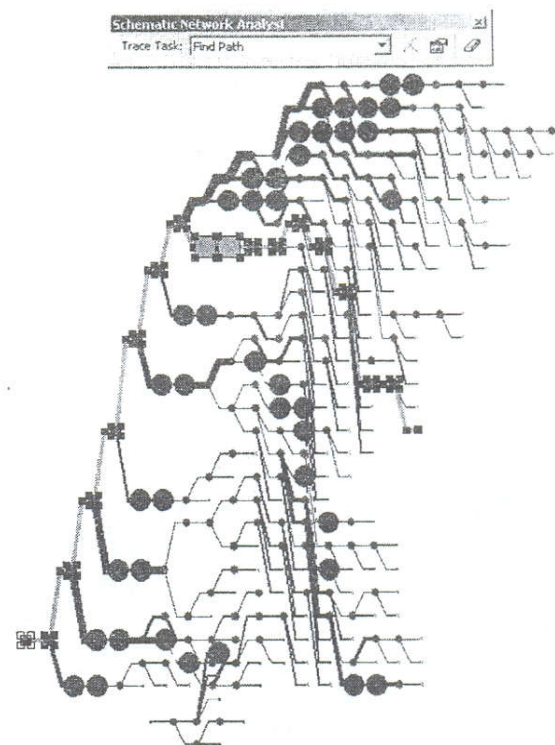


Figure 1. An Example of a Route Search for the Hot-Water Circuit Scheme

### 4. The Development Results

The following tasks have been performed in the framework of this Project:

- analyze of the subject domain;
- development of functional and information models, hardware specification necessary for the realization of automated subsystem of USATU civil engineering services;
- development of the software module for help-desk subsystem of USATU civil engineering services.



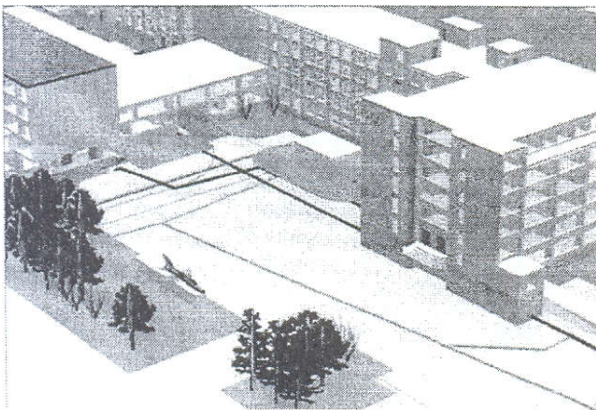
User interface design of help-desk subsystem was developed using Visual Basic for Applications (VBA) built in package ArcInfo 9.1.

The Project execution have had several stages:

- a revision of the information model of subsystem of USATU civil engineering services in accordance with capabilities of the Project subsystem and received attribute data;
- development of the database of civil engineering services and data filling in;
- development of the interface prototype for help-desk software module;
- realization of module functionality, testing and debugging.

This module give a possibility to provide the University leadership with a sufficient and relevant information on objects of USATU civil engineering services and information support for the University property management.

Also a 3d-model of civil engineering networks has been created based on the general layouts of the campus and the 6th building of USATU. The results are shown on figure 2.



**Figure 2. 3d-Model of Civil Engineering Networks Based on the General Layouts of the Campus**

The model development had several phases:

- analyze of the subject domain;
- development of functional and information models, hardware specification necessary for the GIS realization;

- development and realization of the algorithm of interaction with the subsystem of 3d-modeling of civil engineering network, buildings and constructions.

## 5. Conclusion

In the framework of this Project we have performed the detailed analyze of the subject domain, the information and functional models have been developed and the required functionality of the subsystem has been realized successfully. During the further development of GIS USATU and civil engineering services subsystem the existing functionalities will be improved and new functionalities will be added for effective and comfortable work.

The advantages of the subsystem implementation are: an ability to find quickly an information on USATU civil engineering networks, data presentation is more useful, obvious and comfortable, providing with relations between spatial data and attribute data.

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