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GIS in the management and maintenance of distribution networks

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Abstract: Water systems are limited and the management of distribution networks using GIS technology brings a significant contribution in protecting these resources. GIS is a very effective tool in analysis and database management. Although its importance is known and implemented in many countries in the world, in Romania this technology is not yet implemented for water systems at national or regional level. The purpose of this paper is to highlight the importance of GIS in the management of distribution networks, where a number of variables (area, cost, pressures, water losses and consumers) are difficult to break. GIS application interacts with other systems to plan, manage, operate and maintain distribution networks, identifying problems and recommending solutions.

Keywords: water system, GIS technology, water resources management, distribution networks

1. INTRODUCTION

GIS plays an essential role in water resources management because this technology is one of the most important for data integration, analysis and manipulation. Although its importance is well known and implemented in many countries in the world, in Romania this technology is not used in infrastructure at the national or regional level. GIS is important because it helps users to create, edit and modify a lot of data to eventually provide a graphic.

Rapid urbanization has created pressure upon infrastructure (distribution network, sewage, storm water, gas, fiber optics) and the need for a Geographic Information System (GIS) as an active information depository in permanent connection with other utilities systems is essential. GIS technology is evolving due to the Internet progress, thus GIS is being applied in more and more areas (fig.1).

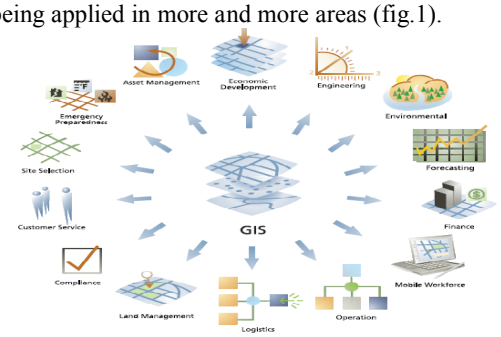

Fig. 1 Areas in which GIS are used [3]

2. GIS FOR WATER DISTRIBUTION NETWORKS

The aim of this paper is to highlight the importance of GIS technology in water resource management by combining geographical and informatics system. To maximize the GIS benefits, data form layers must be reliable to the distribution needs. They are stored in geodatabases (fig.2), identifiable by coordinates and can be accessed and shared within a department and / or at the level of the whole institution. You can decide which layers are relevant but their combination may provide a complete graphical interface of the situation on the ground.

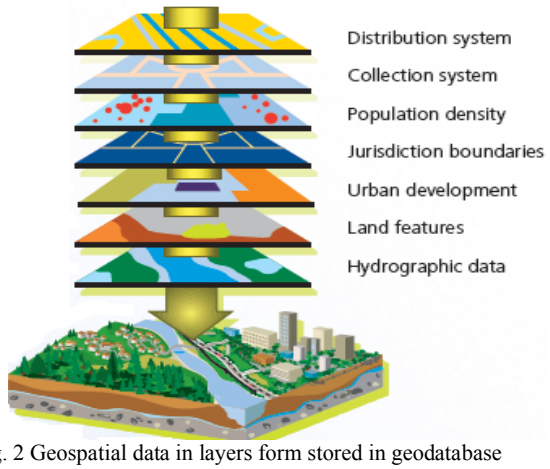

Fig. 2 Geospatial data in layers form stored in geodatabase [4]

The Water Distribution Company (gas, sewer) has a primary responsibility to properly manage a distribution network. GIS provides a framework for managing these types of data by bringing many benefits to the company, as listed below. GIS application is saving time and money while providing very brief information about the planning, management, operation, and maintenance of distribution networks, identifying problems and recommending solutions. Studies show that the implementation of this technology can save 30% of

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operating expenses (personnel expenses and utilities) and improve customer service. (faster reactions to solving problems)

GIS, due to the used language (by integrating the information in an easy manageable system) ensures effective communication and cooperation between institutions, departments, disciplines, industries, organizations, and the public.

GIS and GPS significantly increase location decisions, the correct identification being essential to a successful system. The disadvantages would be the high costs to purchase the software and the lack of trained personnel.

GIS application requires six essential steps:

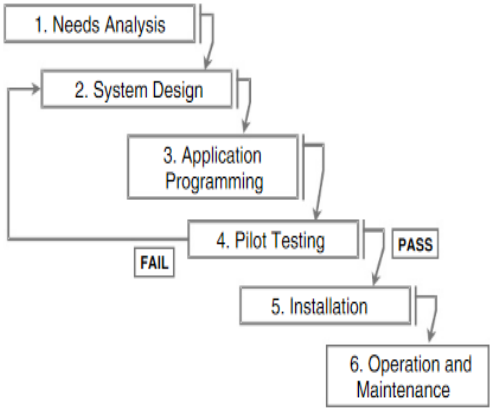

Fig. 3 Steps used in GIS technology and relations between them [1]

The first step in using GIS application is to develop a strategic plan. A correct analysis is the key to success in the GIS implementation and operation. This analysis must take into account the existing resources (data, preparation) and the results are intended to be obtained, as GIS requires a new approach in the water resources management, which is to use graphical interface in order to understand what is happening and what will happen in a network. A specification (system design) refers to the following components: data conversion, database, software, hardware and user interfaces. [1]

Application programming is the third step when using a GIS application. GIS (mapping) is a basic package (functions) which is limited and, to be used in a certain field, it must be filled with certain software. Maps are the basic component of the GIS, the fact that they contain topographical features makes them more explicit than CAD maps. Testing (pilot project) is an essential step because it allows testing and modification (where it is necessary) of the strategy before it is widely put in practice. Installation (hardware, software, and data) and operation and maintenance (includes training) are the final steps to be taken into account in a GIS application.

3. GIS APPLICATION FOR WATER SUPPLY NETWORKS

To show how to apply GIS to a distribution network we have chosen an example available on the Internet, developed by ESRI, for distribution network of Austin, Florida, USA.

Data accuracy is important; when they are insufficient, GIS has the ability to create these data through different techniques. The first variant is presented in fig.4 - aerial photograph obtained using Desktop ArcGIS Explorer (free download).

Fig. 4 Aerial photograph for study area with Desktop ArcGIS Explorer

Fig. 5 Water system with ArcGIS [5]

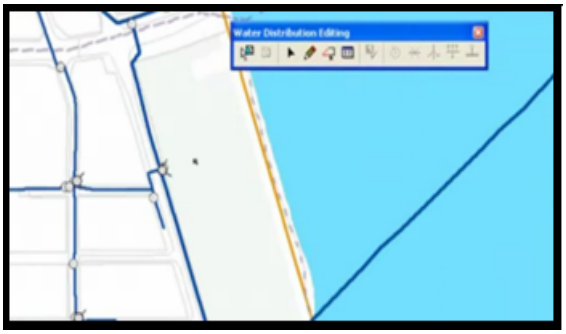

Fig. 6 Details for water system with ArcGIS [5]

Fig.7 Characteristics for water system with ArcGIS [5]

Fig. 5, 6 and 7 showing a screenshot of ArcGIS User Guide For Water Distribution Network Editing Template (ESRI) and give details about the distribution, describing the pipeline in terms of material, diameter, depth and the year it was fitted. GIS provides information about variations pressure, quality issues, relations between the distribution systems and consumption for an area.

4. DISCUSSION AND FUTURE DIRECTION

The purpose of this paper is to highlight the importance of GIS in distribution networks management, where a number of variables (area, cost, pressures, water losses, and consumers) are difficult to break.

As it was presented in the introductory, GIS technology is applied in many areas.

In the management of distribution water GIS provides information about the water distributed, to optimize the pumping rate, preventing detonation quality through continuous monitoring and evaluation.

GIS application interacts with other systems to plan, manage, operate and maintain distribution networks, identifying problems and recommending solutions. The Internet is a way of life and for GIS it is the fastest and most efficient way to transfer data and communicate with users.

If in 1990's the internet was offering only static images, now Web browsers are offering interactive images full of information. [1]

An example is fig 8 showing a screenshot of a Web GIS Internet site for the city Salt Lake City, Uthai, which uses the software created by ESRI, ArcGIS Viewer to provide us information concerning utilities.

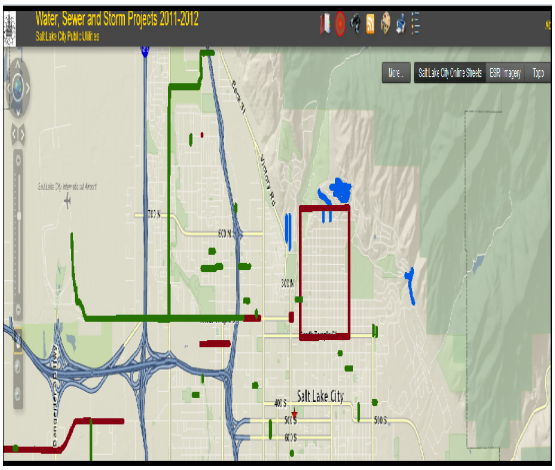

Fig. 8 Interactive GIS map for Salt Lake City, Utha, USA [6]

Fig 8 highlights areas where utilities projects are being carried in 2011-2012 and before using the interactive map the user is presented a legend. (fig.9)

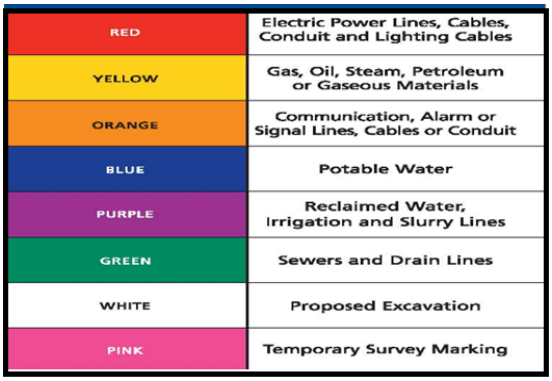

Fig. 9 Information for public utilities [7]

The top of the screen can be used to navigate (pan, zoom, etc) and to query.(fig.8) Users can apply for a specific address, can use tools to measure, can print or get a different picture for the same area (satellite, topographic, street based).

The connections between GIS, Internet (wireless) and mobile systems (phone, notebook, and laptop) have created a new technology where GPS plays the decisive role.

GPS has been created to determine the exact location on Earth or the atmosphere, information supplied in latitude, longitude, altitude and time.

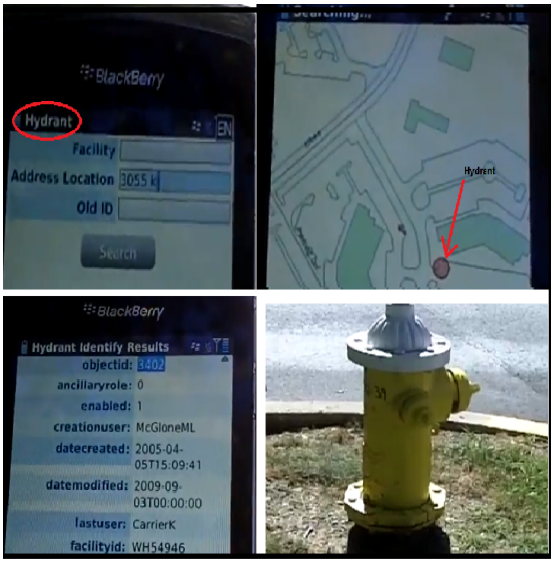

Fig. 10 Mobile GIS for water utilities [8]

In fig.10 it is an example of a mobile computer (BlackBerry), indicating the address of a point (a hydrant); this is spotted and we are provided with all the data (draft assembly, installation depth, the year when there have been made recent changes).

This technology based on data collection and on-site modifications is an important step, with the purpose of obtaining efficient results, at present being situations when people within a company (water system) can coordinate teams and perform checks from the mobile phone.

In this paper we want to expose, with as many examples, the potential application of GIS technology, a challenge in an area where the amount of data is very high, water utilities.

The examples are current and highlight what made the huge leap GIS with Internet and mobile systems (phone, notebook, and laptop) for collection and management data.

GIS overlay avoids data between departments and application interacts with other systems to plan, manage, operate and maintain distribution networks, identifying problems and recommending solutions.

Examples shown in paper prove to be as much as advanced GIS technology, but ultimate test for us is when we answer the question: We are ready to accept the challenge GIS in our life?

REFERENCES

[1] *Uzair M. Shamsi* - GIS Applications For Water, Wastewater, And Stormwater Systems, 2005

[2] *Howard Crothers, Mike Miller, Scott Oppmann,* ArcGIS for water utilities, An Introduction, 2011

[3] www.esri.com/water

[4] ESRI - GIS Technology for Water, Wastewater, and Storm Water Utilities

[5]http://wn.com/ArcGIS_User_Guide_for_Water_Distribution_Network_Editing_Template

[6] http://maps.slcgov.com/puprojects/index.html

[7] http://www.slcclassic.com/utilities/locators.htm

[8] http://www.youtube.com/watch?v=hkISNBVUfes