INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN ECONOMICS & MANAGEMENT SCIENCES

OPEN ACCESS JOURNAL

Vol 3, Issue 2, (2014) E-ISSN: 2226-3624

The Railway Infrastructure Management Using geospatial information systems

Marcel Litra
CFR Passengers SA, Bucharest
Email: marcel.litra@cfrcalatori.ro

To Link this Article: http://dx.doi.org/10.6007/IJAREMS/v3-i2/677 DOI:10.6007/IJAREMS/v3-i2/677

Published Online: 03 March, 2014

Abstract

In recent years there were two opportunities that can allow a significant advance towards the railway infrastructure management: radio frequency identification, known as RFID (Radio Frequency Identification) and geographical elements in environmental modeling GIS (Geographic Information Systems). Penetration to the top of the public agenda of the carbon pollution issue, which has the effect the increasing acceptability of a decision for introducing carbon taxation in urban communities determine the transition of road freight transport to intermodal freight transport. This article reviews the technological developments and tested solutions to date in attempts to solve the problem of traffic congestion and proposes a new approach based on a combination of technologies that have not yet been applied for this purpose in the proposed formula (Iovan, 2011). A geospatial solution is not a simple map, because a GIS map involves much more than a data "engine" for processing spatial characteristics. After overcoming the visual border, GIS map becomes a remarkable collection of alphanumeric data (attributes) and geographical (positioning elements) which usually are the result of workflows performed by personnel from various functional departments of the institution. Management and maintenance of railway infrastructure using GIS allows administrators to rapidly identify and resolve infrastructure problems caused by the disruptive factors from Romanian railway system.

Keywords: RFID, infrastructure management, multimodal transport, intermodality, GIS, GPS, geospatial, georeferential.

Introduction

New technologies developed for road vehicles and traffic management will be essential to reduce carbon emissions caused by road transport in the EU (**E**uropean **U**nion) and the rest of the world. The race for a "sustainable mobility" has global scale. Delayed action and timid introduction of new technologies could convict the EU transportation industry to irreversible decline. The EU transportation sector faces increasingly fierce competition on rapidly developing global transportation markets.

Globalization and EU enlargement to the east put the European transport in the front of new challenges. The rapid growth of freight transport contributes to the global economy, but is also a source of congestion, noise, pollution and accidents. At the same time, transportation became increasingly dependent on fossil fuels. European Commission (EC) states that, without appropriate measures, the situation will continue to become worse and will have increasingly prominent consequences on Europe's competitiveness and on our living environment[1].

Therefore, the European Commission recommends infrastructure upgrading for improving the effectiveness of individual transport modes and their combinations (intermodal transport, multimodal transport). EC recommends in particular, a better distribution of traffic to more friendly environmentally modes of transport, safer and more energy efficient. Commission presented an action plan on this issue ever since 2007.

Railway transport is sometimes considered an unattractive mode of transportation, particularly for freight. However, as demonstrated by the examples of some member states, it can provide quality service. The challenge is to make a structural change to enable railway to compete effectively and take a significantly higher proportion of freight transportation on medium and long distances (Iovan, Iovan, 2004), (Ionita, Platon, Iovan, 2011).

Railway freight transport companies became, over the last decade, more efficient in terms of transport solutions. This allowed them to improve their customer care service. One of the means to increase the attractiveness of rail freight transport is improving the quality of railway infrastructure and reduction of necessary transportation documents.

Geographical Information Systems

For those who use geospatial solutions for purposes that go beyond the mere display coordinates of managed elements, the difficulty of implementing such solutions comes from the correct identification of workflows that leads to the generation of data whose spatial information will be handled by the GIS system. Thus, in many cases, GIS systems are not simply components of an integrated IT system, but grow to become the true platform for data integration, even if they come from specialized subsystems have in common the spatiality feature.

Either as an entity, for which data about the area managed in GIS may come from workflows (or subsystems) that manages financial (contracts, user fees, rents applied to property) or technical (issuing permits on the use of certain areas) activities, whether we are talking about a utility company, for which infrastructure data location are useful in the context of business information on existing contracts in a particular part of the network, or information metering or those related to maintenance costs of a section or element of infrastructure, GIS systems have evolved from "islands" of technology addressed a small group of specialized users, to inter-departmental and inter-institutional solutions platforms, allowing existing alphanumeric data analysis from a new perspective : the geographical location.

This transformation of geospatial solutions, from platform independent to large institutional systems, interconnected with the rest of existing "business" solutions, requires a profound change in the implementation of such solutions. Thus, implementing geospatial solutions must reflect an integrated approach to information and should start with the detailed analysis workflows of the institution, the objects that will be managed within the geospatial solution, their attributes and origin information in these attributes as well as the

[1] http://www.RailConference.com/ (accesed in August 2013);

"actors" who will interact with the data and the permission that they have in relation to each object and attribute separately.

The analysis and solution definition

When the decision to start the implementation of a geospatial system (even if the triggering factor was a simple interaction with an attractive visual map) was taken, it is essential that the analysis which will be the basis of future system design to be performed in a comprehensive and professional way and be based on identifying the business needs and not the technology desire by all means. Few organizations have their own IT department with sufficient available staff for carrying out such analyzes. In the most cases, projects that have as objective the implementation of such solutions are wrongly classified as IT projects, which are therefore the responsibility of the IT department, which may put the whole project from the beginning, on the wrong path (Iovan, Ionescu, 2011) (Iovan, Ionita, 2011).

IT professionals are often attracted by the technology behind such a solution and projects turns in "for technology's sake" implementation. Another problem is given by the fact that IT professionals do not know well enough internal organization workflows and applicable "business" rules and, therefore, agrees to implement the functionality unnecessary, redundant or even if they seem initially attractive, are not supported by actual work processes to ensure further system data input (risking to become excessively complex and difficult to use, in terms of data input effort).

An efficient and recommended alternative to avoid such a situation is to contract a specialized analysis service that provides access to experienced consultants, based on the real needs of the institution (from the workflow analysis) and not from a decision already taken to identify the most effective ways of optimizing module using geospatial technology. Such specialized analysis will highlight inefficiencies or failures causes of existing work processes, will propose efficient solutions through technology and workflows redesign and will provide technical and economic project justification for a large investment approval (Iovan, Ionescu, 2011).

Design

After completing the analysis, the consultant will document all functional requirements of the system in the form of use cases, but also those of non-functional: technological standards, safety requirements, administration, performance or availability. Will be identified all data sources, workflows that will be automated, applicable validation rules, and the actors involved with their roles. The next step is to define the technical architecture (logical and physical, integration, and so on) that can support the achievement of functionalities documented in the analysis phase as well the design of the data model, business logic and user interfaces.

Of particular importance is the transformation of functional requirements related to the exchange of data, in integration specifications that must take into account not only the purpose of the transaction and the actual origin of transactional data sets, but also workflow logic that may lead to decisions that involve changing the institutional data management (eg. creating new unique lists at the level of the new implemented solution that can be accessed by any other computer subsystems for replacing similar information managed in that time separately by each subsystem) (Iovan, Ionita, 2011).

Implementation

The added value a consultant can bring in the analysis and design of geospatial solutions is equally important as the role of the one who is implementing such a solution. It is essential that the implementer should not be a simply software developer, but a company that is able to understand the client's business model, workflows and objectives (business) of the implementation.

Must be familiar with industry in that implements this solution, because in most cases it does not install a standard product, but developing or customizing by configuration a solution that must be specific to the field of work to which it is addressed and must be familiar (by functionality, but also terminology) to that institution users.

Thus, the geospatial solutions and geospatial technologies projects have a real chance to become mature projects that may become working standards in organizations and can produce real benefits.

It is true that our country GIS market, measured by criteria related to sales value and number of customer projects is undoubtedly still underdeveloped. However, market maturity is not related to the volume of sales, but the maturity of solutions and the management level to which a decision is based on a geospatial solution.

We can speak about a maturation of geospatial solutions when an activity can not be managed without it. It can be said that a software solution is mature or is deemed to be mature when it meet the needs of, either the decision or top level management or executive level or end user. Most of the times we consider that a solution is mature when no more resource is needed to investing in it, or when it becomes a routine, something that is part of our daily life and without which the business process can not function. IT solutions become mature if includes a geospatial component.

Satellite Navigation – Galileo System

GALILEO [7] is the European Programme for satellite navigation and positioning. Launched by the European Commission and developed jointly with the European Space Agency, European Union program provides independent technology that will compete with U.S. and Russian systems: GPS and GLONASS respectively. We present briefly the beginnings of Galileo and define issues and objectives of the program.

In the field of satellite navigation, the stakes are enormous and likely multiple. Currently there are two competing systems: the American GPS system, which dominates the market, and the Russian GLONASS system. The current dependence, especially on GPS, raises strategic nature issues, as the used systems are not under European control. The challenge is to protect European strategic needs, for example in the field of foreign and security policy, without risks or excessive costs.

Satellite navigation offers obvious advantages for transportation management. It allows the security consolidation, improving traffic flow, reducing congestion and environmental damages, as well as supporting of multimodal development. Available current systems, GPS and GLONASS, do not seem to guarantee the reliability and availability required for the person transportation. Implementation of the European GALILEO system will remedy these shortcomings.

Finally, the covered issues are also considerable. In practice, the use of computer-based positioning and synchronization could allow the surveillance of certain Community regulations, for example fisheries or protection of the environment.

UE Strategy

Development of a global navigation satellite system (Global Navigation Satellite System - GNSS) should be a joint effort. In March 1998, the European Council called on the European Commission to explore the possibility for developing a common system with the United States. Since the United States was not willing, for military reasons, to consider joint ownership or effective role in controlling Europe's GPS system, it was decided to develop a GNSS navigation systems based on two complementary and interoperable satellite GPS and Galileo[2].

According to the Commission, it is desirable that Galileo should be open to other partners who have already established contacts, such as:

- Russian Federation: GLONASS system could be progressively integrated into Galileo;
- Japan, which could help, especially financial, to the development of Galileo;
- Other countries (Turkey, Israel, China, etc..) in which Europe will have to promote their approach for GNSS

Galileo should exploit the potential of applying a satellite navigation system in civil use, striving to cover gaps in the system and enhance the reliability of GNSS GPS. The system should provide the top European coverage, and global reach.

Requirements and technical features

The system was designed to ensure global coverage and allow massive public applications, with a good level of security for European transport infrastructure with minimum space. On the other hand, Galileo should provide a minimum horizontal accuracy of less than 10 meters.

Concerning security, the system must ensure the physical protection of critical infrastructure and provide accurate signals in case of crisis or war. Any signal deviation or access to the system by the enemy in time of war shall be impossible. To meet these security requirements, experts recommend installing a specific access control. Current U.S. policy is to provide free basic GPS signal. This type of approach in case of Galileo will require significant public funding because private sector alone can not bear such costs for providing free services to users.

Because Galileo is considered to be a key element of the transeuropean network and the common transport policy, EU funding is justified. In addition, it is possible to set specific revenue streams through regulatory measures such as installing certain controlled access services reserved to subscribers or charging signal receivers. It is needed to encourage the development of public-private partnership.

The organizational framework and project evolution

For designing, developing and operating Galileo [7], the Commission proposed an organizational structure that includes, among others, the GNSS high level group, Commission, the European Space Agency and all investors. However, above all, political commitment was essential to give the necessary impulse to industrial investment, for negotiating the system characteristics with international partners and to strengthen European influence in this strategic area.

[2] http://europa.eu/legislation_summaries/transport/intelligent_transport_navigation_by_satellite/l24205_ro.htm (accesed in August 2013);

Following an initial approach in January 1998, in March 1998, the Council invited the Commission to submit recommendations and approach to the European on global satellite navigation. On 19 July 1999 the Council adopted a resolution on the involvement of Europe in a new generation of satellite navigation services - Galileo - definition phase in which the Commission shall present draft negotiating mandate for exploring all the possibilities of cooperation with United States of America and the Russian Federation. The Council invited the Commission to present a thorough cost-benefit analysis, studying in particular revenue options, proposed public-private partnership and funding opportunities from the private sector.

In 2002 was created the Galileo company afterwards was developed the regulation system for conducting the execution phases and commercial operation of the program. Followed by a proposal to amend the Regulation of 14 July 2004 on the implementation and deployment phases of commercial operation of the European satellite navigation program, Galileo has now reached an advanced stage of maturity and goes beyond a simple research project.

This Regulation aims the establishment of the program on a legal specific instrument, which is suitable for its industrial and commercial needs and which best meets the requirements of solid financial management. The regulation established the common program for managing the development phase (2002 - 2005) of the Galileo program. In addition to managing the development phase until 2005, the joint venture had also to prepare the implementation of subsequent phases of the program (construction and commercial operation).

SATLOC –European Railway Project

Romania participates in a project funded by the European Commission SATLOC[3], which will be implemented by a consortium of 11 partners from six European countries. The purpose of the pilot project is to improve the quality of transport services and its adaptation to new solutions and technical standards in the field.

EC with GNSS Agency responsible for satellite navigation systems, and the International Union of Railways (UIC), will fund the project SATLOC which is coordinated by UIC. The project will be implemented in Romania, a pilot application being applied on railway section Brasov - Zarnesti operated by Trans RCCF. In this project it is involved also the Romanian Railway Authority (AFER). Besides the two representatives of Romania, in this project there are also involved other companies from France, Germany, Austria, the UK and Italy.

The project is the result of over 15 years of research in the field and by releasing it, not only European countries came together but also experts from the railways and related industries, universities and railway infrastructure managers. It is a technical project that will certainly contribute to interoperability and safety railway system and ETCS compatibility.

SATLOC addresses the adaptability to the operational and economic justification for providing the opportunity to combine the optimization research (Litra, Iovan, 2012). The project may lead to promotion of railway transportation involving political class for implementing the latest solutions for signaling, train control, operations and traffic management.

The UIC role is to ensure the destination and fund spending to achieve the real objectives. SATLOC will demonstrate that the railway system is a very large market for new

[3] http://satloc.uic.org/Project-summary (accesed in October 2013)

technology solutions that not only stimulates technological innovation but also the efficiency and the return on investment. Project implementation is a proof that GNSS will heavily focus on railway needs satellite navigation solutions and applications for various railway traffic management.

SATLOC address the innovative development of GNSS related to the safety in real time railway applications for controling train movement, speed monitoring, and control - traffic management. The application contributes to technology adoption and deployment of GALILEO[4] for railway safety. The project includes the development of new operational integrated concepts, software, hardware, services and compatible information along the evolution of signaling systems and standards in the railway.

Chinese Satellite Navigation System

China launched the public and commercial services in the Asia- Pacific using the **Beidou**, a new navigation system that uses satellites. It was built to rival the American GPS (**G**lobal **P**ositioning **S**ystem). Beidou system began to be available to the civilians in the Asia-Pacific in December 2012 and will be available globally starting with 2020. China Satellite Navigation Office, said that the Chinese system performance is "comparable" with the American GPS. Beidou signals can be received in countries of the region such as Australia.

Inauguration of this positioning system is the latest technological achievement of China, a country that wants to build a space station by the end of the decade and, finally, to send people to the Moon. China considers the billion cost of space program as a symbol for reflecting China's global stature, the country's technological development and success in transforming a formerly poor country .

The Beidou system uses 16 navigation satellites and four experimental satellites. The system will provide global navigation, positioning and timing services. Chinese began to work on developing this system in 2000, wanting to avoid appealing to GPS. Having a satellite navigation system is a thing of great strategic importance. As Beidou will be developed, it will erode the dominance of the GPS system in China, which owns 95% of the market. The analysts do not believe that Beidou will be successful outside China because "GPS is available, accessed by many people, globally known and trusted by all."

It is considered that the commercial benefits of this system are minimal, because the main reason that China has developed Beidou is national security, given that the U.S. may at any time suspend access to GPS. This possibility of being disconnected from the GPS is what stimulates other countries to develop their own system outside the control of the U.S. At this point, only the American GPS and the Russian GLONASS runs globally. Beidou will become global in 2020 under the name Compass, year in which the EU intends to launch globally Galileo.

Geographical Information System

GIS is used to create, store, analyze and process spatial information distributed through a computerized process. GIS technology can be used in various scientific fields such as resource management, environmental impact studies, mapping, route planning, traffic management, road/rail [10]. The specificity of a GIS is the way in which managed information is organized. There are two types of information: a graphical one showing the spatial

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[4] http://europa.eu/legislation_summaries/transport/intelligent_transport_navigation_by_satellite/l24205_ro.htm (accesed in August 2013);

distribution of the elements and the other subjects as a database to store the attributes associated with these elements (e.g. for a length of track width, the number of lines (single or double), building material, etc.).

Graphical information can be of two types: raster and vector. Raster graphics is a way to represent images in software applications using pixel matrix while the vector graphics is a method for images representation using geometric primitives (points, segments, polygons), characterized by mathematical equations[5].

Specific to the GIS is the associations of a geographic system coordinate to the matrix of pixels (the raster case) or vectors - the process being called "georeference". Therefore, an object (represented either by image or by a vector) is associated with a unique position in the computer system corresponding to real-world geographic location.

Raster information from a GIS

Due to information associated to graphics, geographical information systems benefit from all query opportunities offered by the modern database systems and additionally can provide easily analysis focused on specific geographical areas - the so-called thematic maps.

A common example is the GIS road navigation systems. Road map is spatially referenced vector form so that the global positioning system (GPS) to be able to indicate the exact position of the vehicle. Route planning is basically a thematic map obtained from spatial query (search for the shortest between two points) combined with a database query associated for roads from the map followed by a number of conditions (speed limits, dimension, traffic systems, restrictions, etc.).

Due to the positive impact, GIS software systems have been extensively developed. There is a very large market for products of both consacrated developers (ESRI, Intergraph, Autodesk, MapInfo, etc.) and Open Source (Grass GIS, Quantum GIS, gvSIG, OpenJump, etc.).

A geographic information system captures stores, integrate, manage, analyze and visualize geographic data. Such a system uses a spatial database to refere diverse real geographical data. A GIS must integrate both geographic data and tabular data (attributes) to produce information for decision making. Data representation is made either in vector or raster format. The vector format is a set of coordinates (x, y, and optionally z) while the format for raster is represented by a grid (array) with constant dimension cells (determined by the degree of detail desired).

Geographic data can be associated with other data to model a real object (description, name, production event date, etc.). One of the many areas where using a GIS is that of representation maps, which may be the purpose of tracing the operation of devices in the network, or the analysis of possible economic development.

Geographical projections

To enable the location of points on the Earth's surface it is used a spherical surface, the Earth's center, 0(zero) meridian, equator, and a unit of measurement of angles[6]. Thus we

[5] *Georeferentiere in Global Mapper*

[6] *Georeferentiere in Global Mapper*

get a coordinate system with which we can locate any point by longitude and latitude, i.e. angles measured from the center of the earth at that point (Fig. 1.).

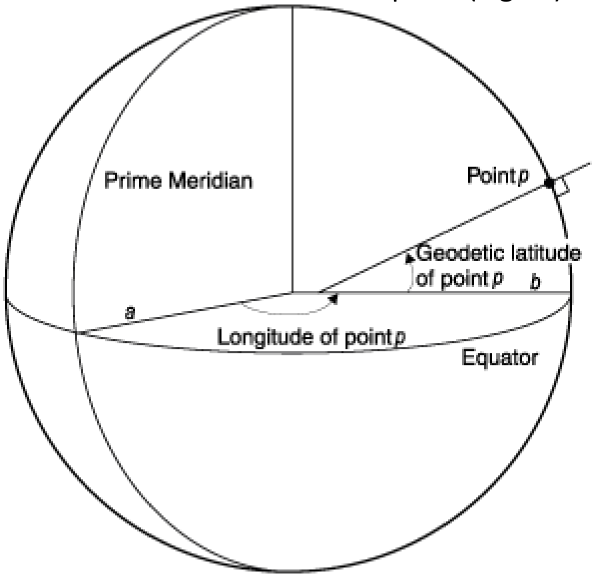


Fig.1. Elements for locating a point on the Earth's surface using the longitude and latitude of that point

In this spherical system we have horizontally and vertical lines at an equal distance between them. East-west lines are lines of latitude or parallel, north and the south are lines of longitude or meridians. This geographical grid network formed Earth. The middle line of the parallel (parallel equally spaced from both poles) is called the equator and has latitude 0 (ie any point on the surface of the equator will form an angle of 0 degrees with the center of the Earth).

Most coordinate systems consider that meridian passing through Greenwich meridian is 0 (the prime meridian). Network origin is the point where the equator crosses the meridian 0. The measurement of longitude and latitude is done in degrees, minutes and seconds. Latitudes have the reference on the equator and can take values from -90 degrees (South Pole) and up to 90 degrees (North Pole). Longitudes (measured from the prime meridian 0) can take values from -180 degrees west and 180 degrees east. Because the shape of the earth that is not a perfect sphere, model uses coordinate systems easily modified compared to the mathematical model. This is a complex subject that is not the subject of this article.

Spatial data representation in SQL Server

In Microsoft SQL Server 2008 we have available "geometry" and "geography" data types. "Geometry" is the data projected on a flat surface while the "geography" projects data on ellipsoidal surface [11]. Representation will need the following items:

- Point - object defined by **x** and **y** and optionally can be described by size (height) **z** and measure **m** coordinates;
- Multipoint - two or more independent points grouped in a collection;
- Line - set of points located on the line joining the two ends;
- Multiline - two or more independent lines grouped in a collection;
- Polygon - geometric figure composed of lines whose starting point is the point of arrival (closed polyline);
- Multipoligon - collection of polygons;
- Geometric Collection - Collection consists of objects defined above.

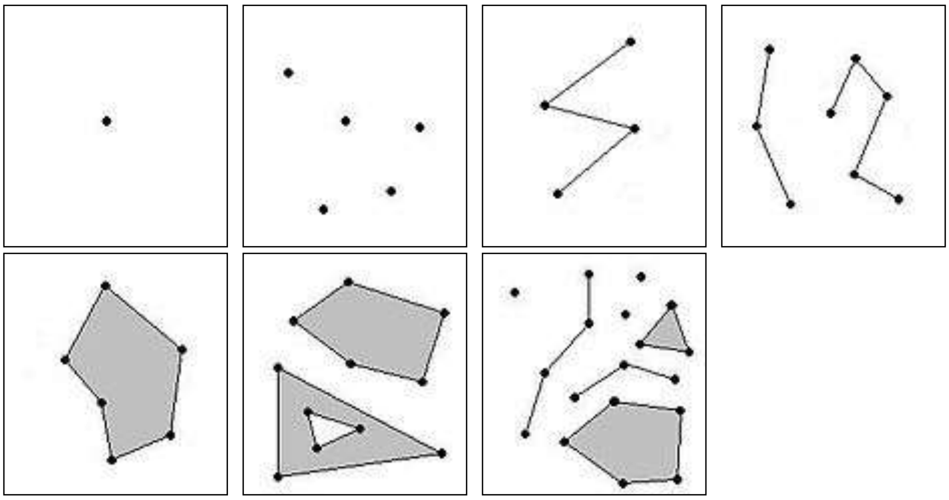


Fig. 2. Examples of objects used for geographic representation

GeoRail – APPLICATION FOR INFRASTRUCTURE MANAGEMENT

National Railway Company CFR SA, Romania manages the railway infrastructure, performs maintenance and operational maintains over 20,000 kilometers of railways all over Romania. With Integraph, Romanian Railways (CFR) was able to integrate into a single solution the management of all information related to data infrastructure, maintenance and operations (Litra, Iovan, 2012).

Geographic information management system uses a centralized database, optimized to integrate distributed applications across all CFR divisions. Developed on GeoMedia technology platform, the solution was used to integrate data coming from the main railway infrastructure maintenance activities in a single database that provides information for many applications. Quick access to updated data of all users as well as the ability to bring information in different formats as a single intuitive map, led to significant increase in overall productivity, efficiency and quality of services.

GeoRail is a GIS developed solution for Romanian Railways for the identification of rail infrastructure under plans scanned and digitized 1:1000 in the Regional Cadastre Services. GeoRail graphical representation provides a way for all elements of railway infrastructure from railway lines, taken as a reference and continuing with the related fixed assets that can be georeferenced. Also provides access and facilitated the GeoRail specific to a wide range of users from technical staff to senior managent level. The main features are:

- On scale graphical representation and geographical coordinates of the elements of the railway infrastructure, easy to identify;
- Getting graphics and alphanumeric information are subject to review and/or subject to specific maintenance and repair activities.

GeoRail application addresses the teams that need the development, maintenance, presentation and maps management for all geographic information owners and users. Data acquisition for development of a digital plan can be done by scanning (if exist) old drawings (plans) and then vectorize raster images using GeoRail program. If the existing plans does not correspond to the land, they can be updated through field data collection and putting them on the existing plan.

GeoRail can create four types of topologies (geometry) point type, type line, polygon (area), network type (multipoligon). By area (polygon) type topology creation functions, it automatically determines the area and perimeter of each plot so that by simply selecting a parcel can immediately find its area and perimeter. Depending on the information derived from the creation of network-topology (multipoligon) it is possible to run query graphs and thematic maps; (eg plots can be viewed with particular characteristics - areas between certain values - values entered by the user). For each object (railroads, buildings, signs, poles, etc.) there are attached a number of attributes (characteristics) that includes a description of terrain, object type, geographic coordinates of the object, the object's technical features, etc.

The power of a GIS, and therefore GeoRail application lies in the complexity of the database attached to the digital plan; the map is the visible part of the system, its quality being given not only by the precision of drawing but also of the atabase that map has in the back. As the database is more complex, the replies to queries increases, and the map becomes more intelligent, because the ultimate goal is to allow a user to find answers to the issues raised as complete a certain plot area, utility, etc. It can query the database and generate thematic maps based on information contained in the database. For example, you can query the database to find the owner of a parcel by its name; the same query can search for buildings, signals, switches, curves, etc. For every building it can be attached documents (surveys, building permits, status, etc). With GeoRail users have the ability to edit reports in tabular form, resulting from the running of queries. It also can be used for solving specific statements and cadastre rail (creating documentation according to HG 834/1991).

GeoRail application structure

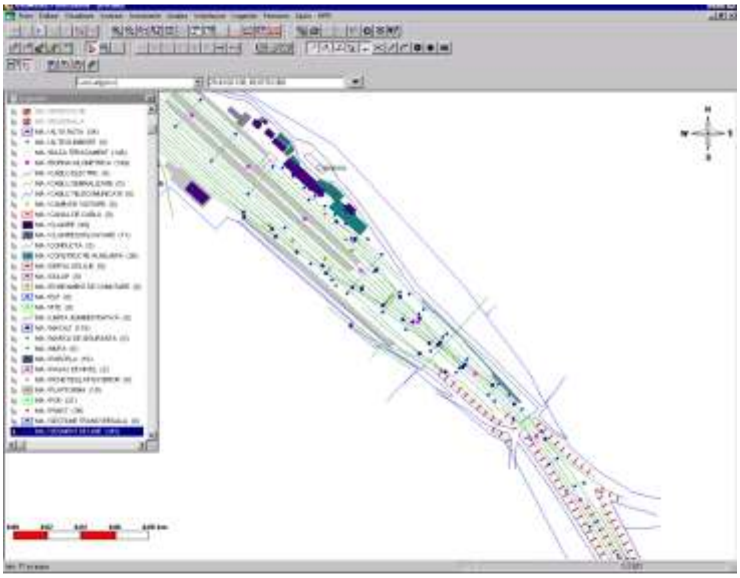
GeoRail is an enterprise-wide GIS solution specially developed for Romanian Railways. It is structured to meet the demands of users at different levels within an organization, from the technical staff to senior management. In this sense, the solution can be customized to meet the following specific requirements:

- current workflow of the organization;
- different parts of the organization;
- technical standards;
- existing data.

The solution has been designed so that it can be adapted to meet customer requirements. Regarding the workflow analysis and available data in the organization, GeoRail is a powerful tool to support business processes within the company and to combine existing data sources and new, to a higher quality of information. GeoRail solution is part from the "Infrastructure Management" application. GeoRail provides a graphical representation of railway elements - lines and other assets can be accurately represented as a map (color graphical form) on a monitor (screen) graphic station (fig.3). Map enables easy viewing of railway track construction and an easy way to identify an object or a group of objects which are seeking information, or that are related to certain activities. GeoRail application consists of the following modules:

- **GeoRail Viewer** is an application based on GeoMedia product. This module was designed for viewing and analyzing data and is particularly useful to senior management within the organization.
- **GeoRail Client** is an application based on GeoMedia Professional product. This module was designed for data visualization, analysis and maintenance and is particularly useful to technical personnel.
- **GeoRail DataCapture** is an application based on GeoMedia Professional. This module was designed to collect data and is addressed especially to cadastral personnel departments.

- **GeoRail Server** is an application based on GeoMedia Professional product. This module manages the access rights of users and the data model of the Oracle



central database and is addressed to application administrator.

Fig. 3. Graphical Interface of GeoRail Application

GeoRail users are divided into four groups; the structure of the product is configured so as to serve these groups:

- Application Administrators;
- Users responsible for data collection;
- Users responsible for maintaining and analyzing data;
- Users responsible for data analysis and decision making

Access rights to the data from the database user access rights are divided in modules presented in the previous paragraph.

Conclusions

For those who use geospatial solutions for purposes that go beyond mere display coordinates of managed elements, the difficulty of implementing such solutions comes from the correct identification of workflows with result in generating spatial data whose information will be handled GIS. Thus, in many instances, GIS systems are not simply components of an integrated IT system, but tend to become true data integration platform which, even if they come from specialized subsystems, have in common the feature of spatiality.

Either we talk about a national company (CFR), for which data managed within GIS workflows may come from (or computer subsystems) managing financial activity type (taxes , user fees, rents applied to properties) or technical type (issuance of permits on the use of certain areas , building permits), for which data location are useful and rail infrastructure in the context of business information on existing contracts in a particular part of the network or accounting information or the related maintenance costs of a section or element of infrastructure, GIS systems have evolved from "islands" of technology addressed by a small group of specialized users to solutions and inter-departmental and inter-institutional platforms, allowing existing alphanumeric data analysis from a new perspective: the geographic location (Litra, Iovan, 2012).

This transformation of geospatial solutions from independent platforms to large institutional solutions, interconnected with the rest of the existing “business” systems requires a profound change in the implementation approach of such solutions. Under these circumstances, implementing geospatial solutions must reflect an integrated approach of information and must start from the detailed analysis workflows of the institution, the objects to be managed within the geospatial solution, as well attributes and information origin within these attributes and the "actors" who will interact with the data and the rights that they have in relation to each object and attribute in part.

Transportation corridors are characterized by a concentration of freight traffic between major transport hubs and relatively long distances. Green transportation corridors will reflect an integrated transportation concept where short sea shipping, rail, inland waterways and road transport will complement each other to enable the choice of environmentally friendly transport (Litra, Iovan, 2012).

The added value that can be brought in the analysis and design of a geospatial solutions is equaly important as the role of the implementer for such a solution. It is essential that the implementer to be able to understand the business model, workflows and objectives (business) of implementation, be familiar with the industry where this solution is implemented, because in the most of the cases it is not about the installation of a standard product but developing or customizing and configuring a solution specific to the field of work to which it is addressed and must be familiar (by functionality, but also terminology) to all users of that institution (Iovan, Litra, 2013).

Thus geospatial information systems and geospatial technologies projects have a real chance to become mature projects that may become the standard work in organizations and can produce real benefits.

It can be talked about a maturation of geospatial solutions where an activity can not be managed without it. It can be said that a software solution is to be considered mature when meet the needs of decision-making level in either the executive or the end user of the organization. Most of the times, it is considered mature when they no longer invest resources in it or it becomes a habit, something that is part of our daily life and without which the process can not operate. IT solutions become mature if includes a geospatial component.

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