Mikołaj Milczarek, Marcin Niewalda
University of Silesia,
Faculty of Computer Science and Material Science
milczar@gmail.com, marcinniewalda@gmail.com

Introduction to Intelligent Transportation System

Introduction

GIS technologies are increasingly used by the administrative units of states. Cities of the European Union must prepare for the introduction of the INSPIRE directive, which imposes the public geographic data collected by these entities. However, the initiative of some cities as far exceeds the legal regulation so that it is realized more and more projects based on geographic information. This refers to the Intelligent Transportation System, which aim to improve the transport network, for example, city or agglomeration. Such systems are largely based on data that are collected in the form of geographic objects such as points, polygons and lines. While the management of such facilities, usually takes place on the background of the map, which is a typical task of GIS tools. This article introduces the problem of ITS, presents the division, examples of application and technology used in implementation. Much of the information presented in this article are based on individual experience and knowledge gained during a career in one of the leading IT companies in Poland. Working in department of geographic information systems, allowed us to get to know many different realizations of the ITS and problems in their implementation. This knowledge led to present topic of Intelligent Transportation Systems.

About ITS

ITS is acronym from Intelligent Transportation Systems. Under this name hides a collection of different technologies and management techniques which are used in public transport to improve efficiency of its. In addition, these systems helps to protect natural environment and improve the safety of road users. The name ITS was accepted on first world congress of this subject in 1994, Paris.

The system was created in response to the growing environmental awareness, protesting against the negative effects of the automotive industry and also in response to the lack of expected effects of the constantly innovating investments that did not solve the problem of traffic systems bandwidth. As it turned, ITS is system without which is hard to imagine a smooth and safe movement

of vehicles in urban areas. Years of research conducted in the American and Canadian agglomerations shows that the use of these systems reduce costs of transport infrastructure 20% to 30%.

Systems division

Choice of type of ITS system and its services largely depends on local conditions and organizational structures in the areas where the system is working. But above all, from that to which the needs of such a system will be used and for what group of people use. Practice has shown that the most frequently used services are those of the groups: traveler information, traffic management, public transport and need help. Division of Intelligent Transport Systems sets the ISO TC 204 standard, according to which the systems are divided into categories of services, and these into individual, numbered services, which in total is 32 (Table 1).

ITS Users

ITS is of particular interest of many organizations and institutions from public and private sectors, academics and NGOs. In the event creating the implementation strategy of ITS at national, regional or local level, must define the institutions and organizations that should be associated with the work, which benefits will affect most by transport users.

The persons using the ITS systems are defined as institutional users who are due to perform different social roles should be join the process of promoting of this system. This is important because, as implemented applications are often bound together through e.g. the sharing of data and cooperation is necessary with many different organizations and institutions.

The needs of users are the starting point for building every system. That mean the user has set goals that he wants to achieve through a ITS. It makes a number of requirements for this system. Implementation of these requirements is associated with user engagement in the construction of the ITS system, its operation or use of the services they provide this system. When you create a project, the division was created by users, which distinguishes them is divided into seven categories:

- private consumers travelers, using private motor vehicles
- commercial consumers - freight and transport industry, using vehicle for business purposes
- providing companies / using ITS
- local authorities
- high level ministries
- exploitation level – operators applying ITS
- industry level – companies developing and producing ITS.

Table 1. Division of ITS by ISO TC 204

Service category	Service No.	Service name
Travelers information	1	Pre-trip information
	2	On-trip driver information
	3	On-trip public transport information
	4	Personal information services
	5	Route Guidance and Navigation
Traffic management	6	Transportation planning support
	7	Traffic control
	8	Incident management
	9	Demand management
	10	Policing/Enforcing traffic regulations
	11	Infrastructure maintenance Management
Vehicle	12	Vision enhancement
	13	Automated vehicle operation
	14	Longitudinal collision avoidance
	15	Lateral collision avoidance
	16	Safety readiness
	17	Pre-crash restrain deployment
Commercial Vehicle	18	Commercial vehicle pre-clearance
	19	Commercial vehicle administrative process
	20	Automated roadside safety inspection
	21	Commercial vehicle on-board safety monitoring
	22	Commercial vehicle fleet management
Public transport	23	Public transportation management
	24	Demand responsive transport management
	25	Shared transport management
Emergency	26	Emergency notification and personal security
	27	Emergency vehicle management
	28	Hazardous Materials and incident notification
Electronic Payment	29	Electronic financial transaction
Safety	30	Public travel safety
	31	Safety enhancement for vulnerable road users
	32	Intelligent junctions

Source: McQueen B., McQueen J., Intelligent Transportation System Architectures, s. 91

Interest in each category is different, because they have different roles to play in the dissemination and development of these systems in transport, which results from the different targets set before them. Typically, when project we deal with three major partners who are bound in the above mentioned users.

The first is the state sector, also called public, who directs the optimal allocation of their funds within a social cost-benefit analysis of projects. They are organizations and institutions operating at national, regional and local levels, which have a major influence in shaping transport policy, but also are responsible for the performance of such systems.

The second sectors the one which connects private users who directs the financial analysis of return on funds spent on projects. So you can include transport operators who use ITS systems to achieve its objectives, but also a specialized telecommunications service providers, hardware and software manufacturers for these systems.

The third sector partners includes the recipients of the services, which among other are drivers, passengers and travelers, who assess the services in terms of benefits and costs.

Implementation of any project is an attempt to connect the interests of each of the three above-mentioned partners. All should combine the concept of common interest, the appropriate administrative level, and which can be performed by systems and services of ITS.

ITS Benefits

Using of Intelligent Transport Systems carries many benefits, both for city and users of the infrastructure of these cities. The preparation and implementation of the system is a serious expense for the administrative cell, but the savings in first year of system activity can exceed the cost. Other benefits for cities and their users, which are the result of the implementation of the ITS are:

- increasing the street network bandwidth to 20% - 25%
- improving road safety, including the reduction accidents 40% to even 80% reducing travel time and power consumption (45% - 75%)
- reducing emissions, up to 50%, which significantly affects the quality of the environment in the area
- improving traffic conditions and driver comfort
- reducing fleet management costs of road
- reducing the cost of maintenance and restoration of road surface
- increasing the economic attractiveness of the region

Design phases

ITS projects belong to the standard of IT projects and how each of them must be accomplished by any general scheme. While working on one of the first such project, was created a typical list of activities to be carried out in order to project a success. The model project consists of five phases shown in Figure 1.

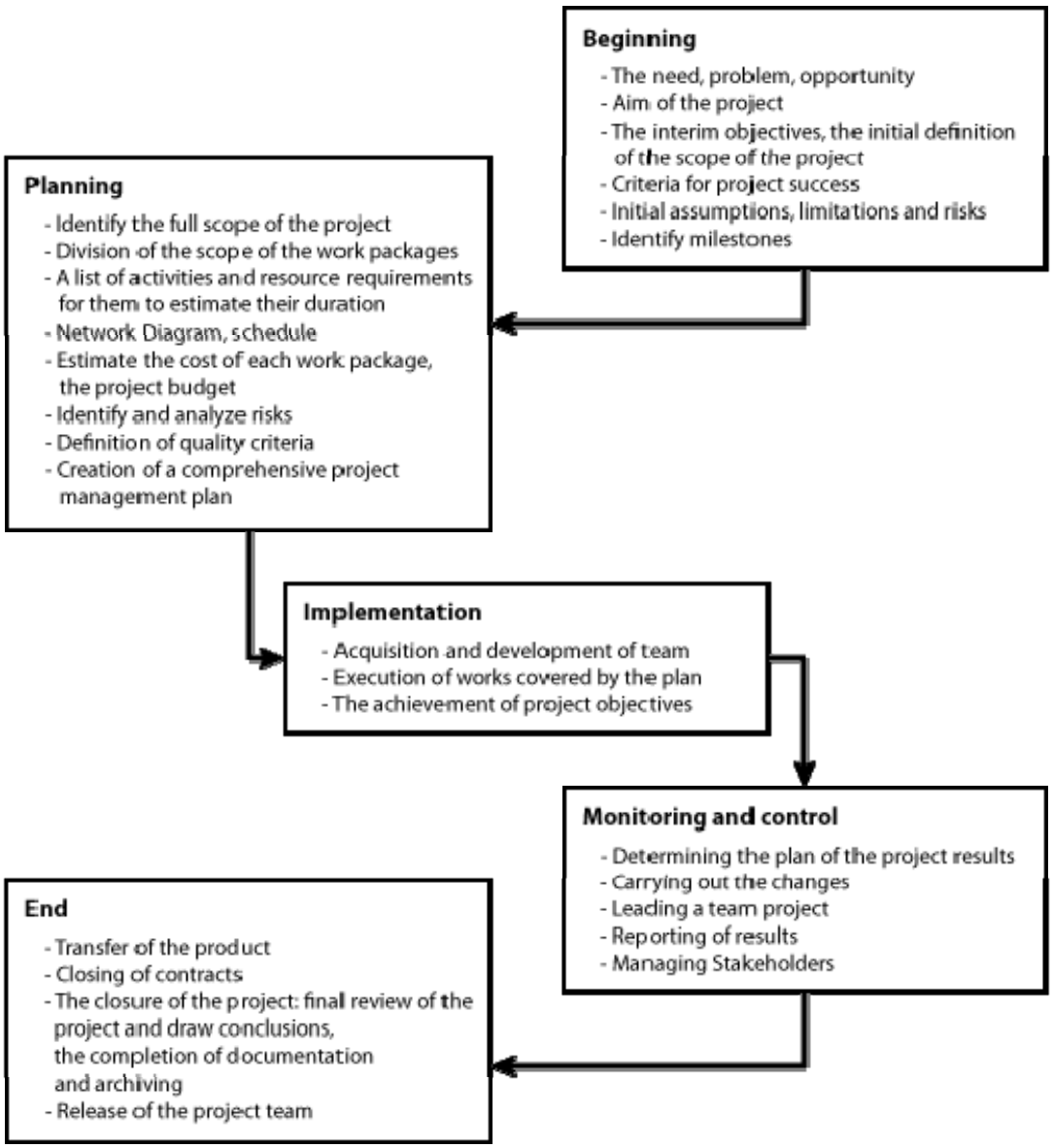

Figure 1. Phases of typical ITS project.

Source: Own, based on: Doliński J., W jakim celu podejmowane są projekty, Przegląd ITS, nr 10

Examples of implementation in Poland

Recently the Polish towns and agglomerations, are beginning to use ITS technology to improve the quality of public transport. The first example is project called "The development of the detection system in the city of Gliwice and modernization of selected traffic lights". The project involves upgrading traffic lights at 15 intersections through the design and installation of detectors, replacement of signaling equipment, upgrade signaling and works of programs for the installation of surveillance cameras the city.

Construction of the "Integrated Road Traffic Management System in Kalisz", will be one of the most modern systems of its kind in Poland and will cost over 23 million polish zloty, but over 19 million city receives from the European Union. The project envisages construction of an integrated traffic management and public transport through the purchase and installation of 10 modules covering a system for monitoring and managing the traffic lights, the video system at 23 intersections and vehicle registration system events. The target of the system will be based on the collection of up to date information on the situation on the road, and then adapt the traffic in sensitive areas of the city.

Another project, the value of which far exceeds the budgets of the previous two examples is the "Intelligent transport systems - ITS Wrocław". The total cost of the project is nearly 73 million polish zloty, with support from the European Regional Development Fund in the amount of more than 58 million zł. It is a system that gradually improves the functioning of the city through the optimization of traffic light controllers, electronic road signs at bus stops and public transport and events management by assisting in traffic and public transport. Data for the system are derived from the traffic controls and measurement devices, and public transport vehicles in Wrocław.

Supporting technologies used in ITS

The basis of any system of ITS are devices that collect data in the field, and software, through which you can manage that data and present them, but also, very important repositories of these data.

Like any large system, so somewhere ITS systems must collect the data. Used for this purpose are known database technologies. It should be mentioned here paid products such as Microsoft SQL Server or Oracle. But increasingly, in large projects, is used successfully PostgreSQL database. These solutions are selected not only because of the usual store text data in standard database tables, but also as repositories that can be used to store geographic data. All of those applications are developed for database storage and retrieval of such data. In addition, these data can be stored using tools from ESRI ArcSDE or PostGIS tools. These solutions are not the type of database, and an extension that can be installed based on one of these databases and the use of its structures, but storing data in a completely different way.

The system is also a software by which it is created, in this field are leading two programming languages: C # and Java, which, together with their extensions are used in both a desktop and mobile (ASP.NET, JSP). Software language itself is not enough to create a system where the primary source of information is the map. In this case, you should use libraries that allow you to view these maps. The best-known mapping library for C # and Java is ArcEngine ESRI, which allows full operation of the map data and work on them. Another drop library for Java (and recently also for C#) is a set of tools called GeoTools. For web solutions, among the most commonly used libraries should be mentioned the ArcGIS JavaScript APIs from ESRI, OpenLayers and Google Maps API.

Access to the data mapping is also possible using various technologies that provide this data and are consistent with the provisions of the Open Geospatial Consortium. This refers to the mapping servers, among which must be replaced ArcGIS Server, GeoServer and MapServer and their services such as WMS, WFS, REST, KML.

Each system is also equipment that addresses the issues closely computing (clusters of computers, RAID systems, machine server, a data link), as well as solutions responsible for the detection and data collection, and therefore loops, receivers and transmitters GPRS, GPS, all types of mechanical sensors, cameras and weather stations. An important element is the device indicating which include all kinds of lights, light boards, and systems for collecting data from users based on RFID technology (Radio-frequency identification).

Summary

The information presented in this article indicate accelerating the development of ITS systems in Poland and the world. A growing group of skilled professionals in the field of electronics, informatics and telematics, more and more new technologies and specialized controlling software, allows to realize many of these projects. It can be concluded that in the near future it will be difficult to find a big city, that will not use the benefits of Intelligent Transportation Systems.

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Abstract

The idea of ITS was founded in Paris in 1994 and was a response to growing demand for transport network management and communications areas. The history of an investment has shown that it is a system without which it is difficult to imagine the functioning of large cities. Also in Poland, more cities are under preparation or implementation of ITS projects. Like any system, so he has his standards. The most important of these is the ISO TC 204 standard describes a set of services provided by ITS. Among the most popular are: information for travelers, traffic management, public transport and need help. Such systems are built based on various types of electronic devices (detectors, bulletin boards), but also IT equipment and tools (database servers, GPS transmitters, programming languages and libraries), among which the leaders are the applications of GIS.

Abstrakt

Koncepcja ITS powstała w Paryżu w 1994 roku i była odpowiedzią na rosnący popyt na zarządzanie siecią transportu i obszarami komunikacyjnymi. Historia inwestycji wykazała, że jest to system, bez którego trudno wyobrazić sobie dziś funkcjonowanie dużych miast. Również w Polsce, coraz więcej miast przygotowuje bądź realizuje tego typu projekty. Jak każdy system, tak i ten opiera się o pewne standardy. Najważniejszym z nich jest ISO TC 204, norma opisująca zestaw usług świadczonych przez systemy ITS. Do najbardziej popularnych usług należą: informacja dla turystów, zarządzanie ruchem, transport publiczny i potrzeba pomocy. Systemy takie budowane są w oparciu o różnego rodzaju urządzenia elektroniczne (czujniki, tablice ogłoszeń), ale także sprzęt i narzędzia IT (serwery bazodanowe, nadajniki GPS, języki i biblioteki programowania), wśród których prym wiodą aplikacje GIS.