

On the Development of Software and Information Support for Traffic Monitoring in the Cities of Ukraine

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Abstract

The article discusses the main provisions regarding opportunities and necessity for developing information software for transportation surveys in the cities of Ukraine. A review is presented of the scientific papers and solutions which can be used to develop and implement an expert system of software and information support for transportation surveys in the cities.

Keywords: Transportation survey; Expert system

Subject Relevance

The reliability and safety of the functioning of a municipal transportation complex is a major challenge in the designing of a developmental strategy for a populated area. The lack of potentialities for changing the characteristics of the urban road network or the conditions for managing the growing traffic has a restraining effect, in the first place, on the economic growth of the city. In this context, importance is gained by the processes of identifying the problem areas of the road network and of searching for possible reserves to ensure adequate operation of the transport infrastructure.

Transportation surveys in the cities of Ukraine must be conducted for the purpose of gathering information for addressing a complex of problems of vehicular and pedestrian traffic management.

Problem Resolution

Traffic diagnostics involve:

Analysis of the intensity of traffic and pedestrians

Analysis of passenger flow rates on urban transportation routes (UTR) as well as at interchange hubs, subway stations, or railway terminals

Analysis of the speed of communication on UTR as well as of the average speeds of different types of vehicles at road network (RN) sections

Analysis of transportation delays at regulated and unregulated crossings

Analysis of the distribution of intervals in the traffic stream

Analysis of transit traffic at city entrance points and while passing through the city

Other types of analysis.

Such surveys are conducted, for a variety of purposes, by engineering companies, traffic police, universities and other institutes

of higher education, as well as by individual researchers (graduate students, experts, special bureaus and firms).

For engineering companies, data from these surveys are necessary for developing master plans of cities, integrated transport schemes (ITS), integrated traffic management schemes (ITMS), projects for redevelopment of highways and intersections, etc.

There is a variety of methods for conducting such surveys. For example, the designing of automated traffic management systems (ATMS) in Ukraine and the USSR involved a traffic intensity analysis method which was developed at the KCEI (Kyiv Civil Engineering Institute) and applied in the development of an ATMS feasibility study (FS) in 20 cities of Ukraine as well as in Riga, Sverdlovsk, Novosibirsk, Frunze, and Alma-Ata in 1985-86.

In connection with the sharply rising level of motorization (in Kyiv, it exceeded 400 vehicles per 1,000 residents), traffic in city centers has emerged as an acute problem, especially in cities with a radial-circular layout.

Transportation surveys involving the central parts of cities have their own specifics, as these areas are noted for certain peculiarities of traffic management, restrictions on entry of vehicles on certain hours of the day and days of the week, parking management, etc.

Historically, the central parts of cities were formed at a time of predominance of pedestrian and equestrian traffic. The nature of functional use of urban territories remained unchanged for many centuries - there was always a need for housing areas, places of employment, centers of cultural and community services, recreation and entertainment, and for the transportation of goods and people. But technological and social progress led to changes in the scope and methods of functional use of urban territories. Different eras saw changes in the size and location, within the city plan, of urban area elements as well as in the intensity of their functional use.

Many cities around the world still have old streets whose width fails to match the intensity of modern traffic.

Of great importance is the density of permanent and temporary population depending on the functional use of the territory, as these parameters determine the intensity of traffic and pedestrians.

High density of temporary population in the central areas of large cities has led to a considerable saturation of the central city streets with traffic and to high traffic flows. These traffic flows are usually directed to points of concentration of the working population (as well as visitors, consignors and consignees).

Professor Rothacher M of the Swiss Federal Institute of Technology (Zurich) noted that in cities with a population of 0.75-2.5 million 20% of all the working people have downtown employment. And in many cities of different sizes, this value ranges between 10 and 50%. If we also count visits to business centers with a business-related or social purpose, the aggregate passenger flow there may amount to 30-40% of the total city traffic. This means that visits by a majority of the travellers to the downtown areas in their own car form very powerful traffic streams [1]. At present, this situation is typical of all cities of Ukraine.

The cities, however, still have no clearly defined center limits; these primarily depend on the city plan, its road network density, availability of transport interchanges, etc. Based on the results of our research, Figure 1 and Table 1 show the shares of the city center in the total city area for 27 Ukrainian cities. The boundaries of the center or central part of a city were determined on the basis of its existing master development plan or of expert opinions.

For example, the level of air pollution in the city of Kyiv (including pollution from vehicles) is monitored by 21 stationary posts of the Central Geophysical Observatory (CGO), five of which happen to be inoperative. These posts are divided into groups depending on their locations: (1) in a street; (2) on a square; (3) at an intersection; and (4) far from the streets. In the central part of the city, there are only three posts.

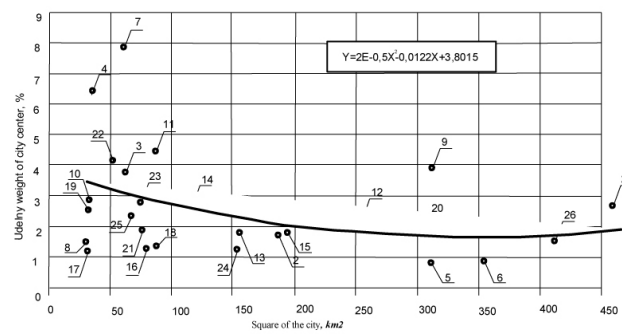


Figure 1: Dependence of relative density of city center on its area.

No n/n	The city name	Square of the city, km2	Udelny weight of city center, %	№ n/n	The city name	Square of the city, km2	Udelny weight of city center, %
1	Kiev	824,7	3,14	15	Odessa	194,0	1,82
2	Sevastopol	186	1,85	16	Poltava	83,4	1,28
3	Vinnitsa	63,4	3,82	17	Rovno	35,6	1,09
4	Lutsk	39,9	6,49	18	Sumy	93,4	1,44
5	Dnepropetrovsk	309,7	0,89	19	Ternopol	37,6	2,53
6	Donetsk	358,3	0,82	20	Kharkov	304,7	1,83
7	Zhitomir	60,8	7,89	21	Kherson	76,7	1,8
8	Uzhgorod	34,4	1,45	22	Khmelnitskiy	52,4	4,1
9	Zaporozhye	312,5	3,9	23	Cherkassy	75,0	2,72
10	Ivano-Frankovsk	38,9	2,9	24	Chernovtsy	153,4	1,11
11	Kirovograd	91,2	4,8	25	Chernigov	71,3	2,37
12	Lugansk	255,3	2,15	26	Krivoi Rog	411,8	1,42
13	Lvov	152,0	1,8	27	Mariupol	466,0	2,68
14	Nikolaev	116,8	2,7				

Table 1: Relative density of city center from its area.

Therefore, when considering the idea of creating software and information support for transportation surveys in the cities, the following questions may be asked:

1. Can this system be referred to as a cybernetic one?
2. In what mode should the separate components of the system operate?

3. What tools (instruments, equipment, techniques, etc.) should provide for the functioning of the system?

4. What criteria can be used to determine the reliability of the system?

5. Is it possible to construct it on the model of the expert systems?

To answer these questions, one must first identify the place of the expert system as a subsystem of a more general system of software and information support for transportation surveys in the cities of Ukraine.

Getting rid of labour-intensive transportation surveys, the cities have been adopting methods involving simulation modelling and use of state-of-the-art geoinformation systems.

However, their implementation requires a basis of knowledge (of laws, regulations, instructions, etc.); databases (for previously conducted surveys, current methods for conducting them, etc.); and software.

These three positions are determined by the term “expert system” - in which a special place belongs to the subsystem of software and information support for transportation surveys.

In Ukraine, the development of such a system has been under way for many years at the Kyiv National University of Construction and Architecture (KNUCA) with the participation of the National Aviation University (NAU) [2].

The functioning efficiency of the systems under development will largely depend on the choice of tools for creating the information systems, the identification of the necessary data model, the justification for a rational scheme of database construction and organization of requests for data, as well as on a number of other points. All of this needs a thoughtful application of the theoretical concepts and tools for developing databases and information systems.

The primary goal is to create the foundations of information technologies, to gain an insight into the modern methods for developing information systems needed to resolve the practical tasks of management and organization of the operation of transportation systems in the cities.

The contributors to the development of this subsystem are Reitsen Y, who in 2009 was awarded the International A. Poliakov Medal in the category “Academic of the Year” [2-5].

However, the scheme presented in ref. [2] needs to be constantly updated and improved and this is actually what KNUCA and NAU graduate students and faculty are engaged in.

Research Novelty

A version of the required system of software and information support for transportation surveys in the cities has been developed, addressing a set of problems of vehicular and pedestrian traffic management; it includes the following:

Analysis and assessment of the road traffic situation in a city, as well as prediction of its development, along with measures to improve traffic conditions in the city road network.

Obtaining data for identifying the patterns of formation of traffic streams and the characteristics of traffic in the city.

Obtaining data for making decisions in the area of traffic management and organization.

Conclusion

Research conducted within the framework of this project has shown the necessity for further research towards creating a subsystem of software and information support for traffic surveys in the cities of Ukraine.

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