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SOLUTIONS FOR IMPROVING URBAN ROAD TRAFFIC

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ABSTRACT

This study presents solutions and measures to improve the quality of transport services. To ensure quality services, the transports need to meet certain conditions from a technical-economic point of view, such the economic and population transport needs to be satisfied on a high level, both quantitatively and qualitatively. For circulation capacity development, we need to implement, improve, and continue developing a management system for public transport which will ensure adequate support in the decision-making process. This implement of a management system for public transport will raise the transport services efficiency, the journey will be made in safe conditions, quickly, with comfort and economic, with good consequences for the environment.

KEYWORDS: quality, transport, management.

1. INTRODUCTION

The actual transport network contains a high level of saturation because of the demographic and economic expansion and that leads to urban mobility rising, a fact which represents the increase of urban traffic. Traffic issues require a complex approach for the particularities of travelling in the urban agglomeration and urban specify of each city. For circulation capacity development, it needs to implement, improve, and continue developing a management system for public transport, which will ensure adequate support in the decision-making process [1]. A management system for public transport considers:

- creating a database regarding urban mobility which contain network transport, local transport, data regarding socio-economic evolution
- projects regarding road infrastructure and public transport expansion
- measures and projects necessary for the efficiency of public transport, for reducing the usage of road vehicles and attracting more people to public transport
- implement a management system for transport demand for minimising the high-level volume of traffic on rush hours
- optime measures in case of incidents or events that can affect the urban transport system
- integrated strategies of major urban developments and transport [2].

The management system of public transport has a role in increasing public transport services efficiency and the capacity of satisfying user requests. These include distribution information systems, refer to schedules of public transportation, costs, ways, automatic system charge for the journey and GPS for vehicles. Through implementing these measures, the quality of public transport services will improve. Public transport will be more comfortable, more accessible, in safety conditions, the dependence of the citizens for road vehicle will drop and life quality of persons with reduced mobility will rise [1].

The most used method of traffic measurement in our country is:

- to use of road vehicle detectors where data are collected and then processed through the human operators or by using special programs;
- to use of human observers on the place (manual measuring of traffic);
- to record the traffic sequences and using automated vehicle detection algorithms based on automatic processing of captured images;

In the next chapters, we will present the advantages or disadvantages of each method.

2. METHODS OF MEASURING THE ROAD TRAFFIC TO INTRODUCE THE INTELLIGENT SEMAFORIZATION

In the last years, traffic has become more important for the state economy. Worldwide, higher interest is granted for this type of transport, attention being directed to an intelligent system transport and road infrastructure. To grant safety conditions on all categories of road, we place an accent on introducing “intelligence” at the vehicle level. Communications between vehicle and infrastructure become a necessity to increase the movement speed, knowledge about traffic conditions and expansion of safety movement wherever this will take place. We can talk about a tendency of globalisation of communications with applications in road area in special after the cellular communications appear with his services. All of these benefits of the intelligent transport system cannot be obtained without an analysis process of traffic particularities, the way how that is going on, how it will behave in case of an event appear and the measure for streamline traffic with real impact. Any system of traffic management, but especially that for urban traffic, is realised on base. Any system of traffic management, but especially that for urban traffic, is realised on the base of analysis about the area where it will be applied, the characteristic of road arteries, the intersection and road signalling systems. City Hall will make this analysis in association with experienced companies in the consulting field and in the operation of the road signalling system. The surveillance techniques used are very important because of the influence that will have about traffic determinations and also regarding road vehicle flux and about changing their direction through intersection. Each intersection has its structure, and the use of some methods for traffic measurement is essential. There are many methods and techniques which can be used and even more criteria that need to be handled to choose the best technique.

In general, is easier to use specialised equipment and the results of the measures will have the smallest coefficient of error, but in most cases, you don’t have permission to use traffic detectors intensive because of many operations which he needs, like equipment installing, surveillance of process development and further processing of traffic data. The process can become completely automatic in the management of traffic systems which are already in function and operational but is not possible in case of systems which are being implemented.

Traffic represents the close relationship between three elements: human + vehicle + road. The analysis of each element in part and the heaviness that each has in the realisation of the “road traffic” system leads to an optimal system achievement [3]. Also, for fluent road traffic is necessary to use instruments and math methods of analysis and statistics which can process traffic data

1. The method of traffic detectors is recommended for traffic flux analysis. There are no human errors that can affect the traffic measurement process because special equipment is used for vehicle detection. This equipment is generally composed of a sensor, a box for signal processing, a memory for data saving and a power source.

Using automatic traffic detection has its own advantages and disadvantages, as follows:

- the flow of information collected is error-free compared to manual measurement with human operators;
- with the help of various types of sensors, it is possible to classify vehicles by many categories;
- atmospheric conditions represent the influences of some types of sensors
- the personnel required for the acquisition of traffic data are tiny or are not required at all;
- most of the sensors allow intensive use and successive installation, so we have a relatively low cost after purchasing the equipment;
- further analysis and processing of the collected data is required, but this can also be achieved automatically;
- the use of these detection methods does not allow the determination of the directions in which the flows of vehicles converge.

2. The use of human operators to observe and count vehicles that come in intersections with directions where these are moving does not require special equipment. Sometimes, maybe, the human operator needs a special device to notate the count. It can provide the sketch of intersections to the observers beforehand, to define precisely of the positioning of observators and directions that they will follow.

This technique has some disadvantages, among which

- the costs of the determinations increase substantially with the number of intersections examined, due to the greater number of observers engaged in this activity;
- the branches or directions with multiple lanes and heavy traffic require a larger number of observers;
- human errors are inevitable and there is a certain percentage of imbalance between measurements made at different locations;
- difficult weather conditions can affect the accuracy of traffic determinations;
- vehicles that obstruct the field of vision may cause losing important of data;
- intersections, where traffic is moving at high speeds and are dense, are difficult to evaluate;
- primary traffic data necessarily require further processing (manual or computer-aided) to get vehicle flows.

3. The recordining of the traffic sequences for its evaluation requires specially trained operators or placement of video cameras in special locations, at a height, to have a field of vision large enough to cover the entire intersection. The main disadvantage of static camera methods in the intersections is that the camcorder will permanently require a wide field of view over the entire intersection and its entrances,

otherwise determining traffic is impossible. For those intersections where positioning the video camera at height is not possible, it is necessary to use other techniques to determine the traffic. This is a disadvantage because the universality of this method is not very high. The quality of the determinations is affected more than other techniques by the weather. Also, for long-term observations, it is necessary to link video cameras to permanent power supplies. To facilitate the activities of determining the traffic based on the films made in the intersections is recommended the use of the video capture on the computer, because of the possibilities of fast scrolling and stop-frame, which can facilitate the observation of vehicles. Also, the use of digital cameras for recoding can substantially improve the quality of the image on the computer screen. They equip these types of cameras with image stabilisers, which are useful for reducing or eliminating blurring caused by vibration or by holding the camera in your hand. The use of tripods or different methods of mechanical stabilization of the camera is highly recommended. In night sessions, it is also recommended to use night shooting facilities or electronically enhanced night shooting, as some camcorders are equipped with night shooting capabilities.

The major disadvantage of this technique is that it requires a second measurement phase: observation of the recorded images and the effective counting of the traffic. This method does not require the movement of large numbers of people to capture traffic data. The images are recorded on the field, while the observation process takes place in a room. Weather conditions (such as heavy fog, heavy rain or mist) can reduce the quality of the images and reduce the chances of correctly determining traffic.

However, an advantage of the video technique is the possibility of keeping the video recordings for a long time, allowing subsequent analyzes of traffic and their use as examples for other applications (presentations, particularities of intersections or analysis of traffic incidents). This technique has lower costs compared to the previous one because it is not necessary to move an entire team of observers at each intersection. Only a few video operators must move the spot. The above observations regarding human error are also valid for this method of observation.

The technique of using video cameras with specialised software for image recognition (detection and identification of vehicles, registration number, incident detection, etc) is valuable but expensive. Some camera positioning is required for image recognition, there are certain requirements for communications if the processing programs are resident in a remote computer. As a result, the costs increase according to several aspects: equipment, road infrastructure works, and communications. The personnel required for processing the traffic data after equipment installing is reduced to almost zero.

3. STATISTICAL REALIZATION AND PROCESSING OF TRAFFIC DATA FLOW

Statistical methods provide a way to manage variability [4]. A variable is a feature that can vary between subjects of a sample or population. How a variable is analysed depends on how that variable is measured. When the possible values of a variable differ in magnitude, the variable is quantitative. Each possible value of a variable quantity is higher or lower than any possible value. Such comparisons are possible for variables measured on a numerical scale, such as the number of vehicles passing an intersection within a 24-hour interval, Figure 1. It is noted that both the minimum and the maximum flow of the two intersections time interval do not differ. The primary experimental data were entered into the cells of the spreadsheet, then sorted in ascending order. To achieve a distribution of frequencies, the data were sorted in ascending order using the Sort option. It will analyse traffic flow to two consecutive intersections, the data being collected from the field, to show how to achieve a distribution of frequencies, frequency histograms and frequency polygon.

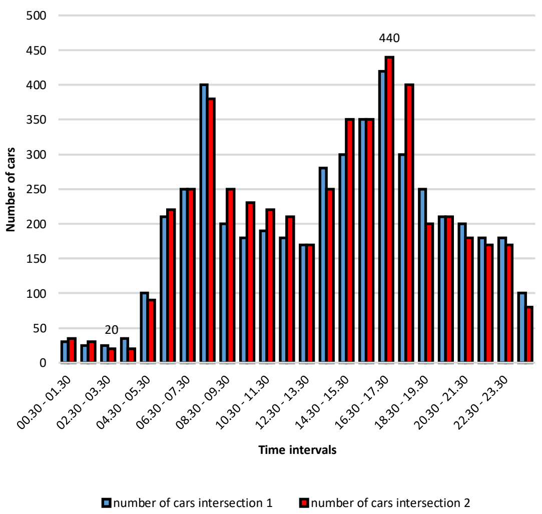


Fig. 1. *Number of cars in hourly intervals*

The grouping of statistical data into classes or grouping intervals is preceded by the appreciation of the number of groups (n_g), with the relation:

$$n_g = 1 + 3,222 \ln n \quad (1)$$

where: n is the number of data (the volume of the sample); for the example presented:

$n_g = 1 + 3,222 \times 3,17805383 = 11$ (is rounded to integer).

Determining the frequencies of the group intervals

- absolute frequency (f_{ai})

$$f_{ai} = n_i \quad (2)$$

where n_i represents the number of the value of parameter x from each group interval „i". The sum of all absolute frequencies is equal to the total number of determinations (n).

- relative frequency (f_{ri})

$$f_{ri} = n_i / n \qquad (3)$$

The sum of the relative frequencies is equal to 1.

The absolute frequency histogram and the frequency polygon for intersection 1 are shown in Figure 2:

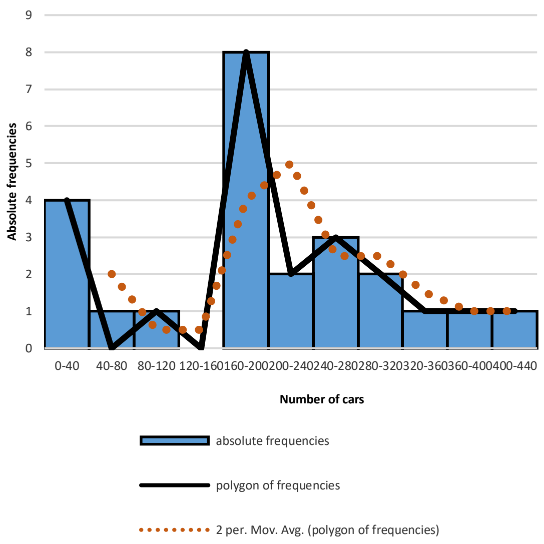


Fig. 2. *Histogram and polygon of absolute frequencies intersection 1*

The absolute frequency histogram and the frequency polygon for intersection 2 are shown in Figure 3:

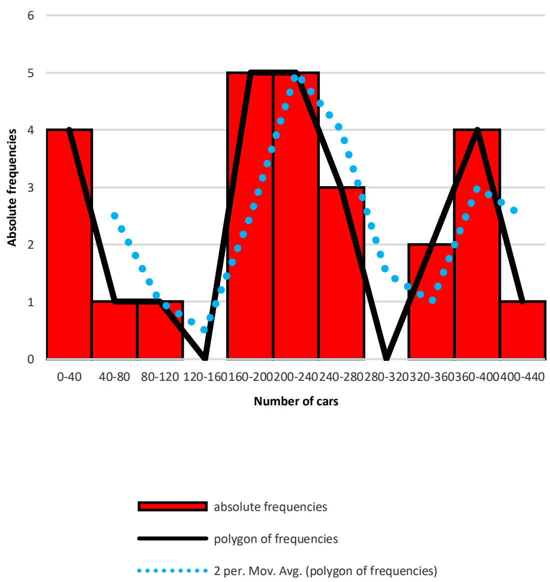
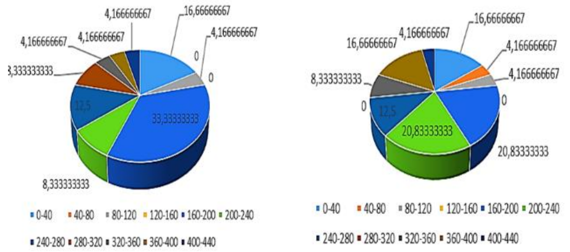


Fig. 3. *Histogram and polygon of absolute frequencies intersection 2*

Improve analysis, using relative frequency distribution or percentage distribution.

The relative frequency distribution is formed by dividing the frequency of each class to the total number of observations. The percentage distribution results by multiplying each relative frequency by 100.



(a) *(b)*

Fig. 4. *Percentage distributions at both intersections*

Measures of central tendency, dispersion and shape

Most data sets show a clear data tendency to cluster around a central point. For this reason, for any data set, a certain typical value can describe the entire set. Such a descriptive value is called a measure of the central tendency. There are three measures of central tendency such: the arithmetic mean, median, and mode [5].

The arithmetic mean represents the most used measure of the central tendency.

The arithmetic mean is calculated by dividing the sum of all numerical values of a variable from a data set by the number of data in that set. For a sample containing n observations, noted X1, X2, ..., Xn, the arithmetic mean of the sample is calculated according to the formula:

$$\overline{X} = \frac{X_1 + X_2 + X_3 + ... + X_n}{n} \qquad (4)$$

$\overline{X}_{\text{intersection 1}} = 198{,}541$ $\overline{X}_{\text{intersection 2}} = 205{,}208$

Media as well as other indicators of central tendency allow comparison between groups. The properties of the media:

- the media is a measure that is only suitable for quantitative data;

- the media is strongly influenced by observations that are far from the rest of the data, which are called eccentric observations.

The median is the measure that exactly divides an ordered string of data into two identical parts. The mediana = a (n+1)/2 observation

- if there is an odd number of observations, the median is a numeric value that is positioned exactly at point (n+1)/2.

- if there is an even number of observations, then the median is located between the two middle observations and is equal to their average.

The observation number being even, at both intersections, the median will result from the average of the central elements, respectively 180 and 170, for intersection 1, 210 and 170 for intersection 2. So the median of the first intersection is 175, and for intersection 2 is 190.

The module is the value that has the highest frequency in a data set.

In contrast to the arithmetic mean, the module is not affected by extreme values. The module is used for descriptive purposes only, as it is much more variable from one sample to another than the other measures of the central tendency [5].

The module for the intersection 1 is 180, and the intersection 2 has the values 170 and 250 with the highest frequency.

4. CONCLUSIONS

We observe that the data distribution is not symmetrical; the median is not equal to the average. Such an asymmetric distribution can be tilted right (positive), or left (negative), depending on the values of the mean and median. Thus, it is possible to determine the time required for the permissive traffic light, in each of the intervals, to fluidise the circulation between the two intersections by optimally programming the computer that controls the traffic light.

For both intersections, the value of the mean is lower than the value of the median, and thus the distribution is considered negatively tilled to left. This method, though cumbersome and costly, is within the reach of any administration and has good accuracy. It does not require specialised personnel and after the completion of the statistics; it does not require financial obligations such as the maintenance of the equipment or the remuneration of observers, which is why it is adopted in most cases in Romania.

At the technological level, the main advantage offered by the new traffic management system is the adaptive functioning of the traffic light components, the so-called intelligent operating regime.

The adaptive mode of operation consists in adjusting the traffic lights from intersections to the traffic values of each moment. At each intersection, traffic detectors are installed that provide the necessary information to the system.

There will be a permanent communication with the public transport vehicles in traffic, so the traffic lights at the intersections will be adjusted to ensure the arrival of the vehicles at stations according to the established schedule. All intersections will be connected by fibre optic to each other and also to the Control Centre. The advantages of adaptive traffic lights are:

- fluidization of traffic by improving traffic conditions by approximately 15%;
- improving the services offered by the public transport operators by complying with the scheduling of the arrival and departure of vehicles from the stations;
- instant signalling of defective equipment from intersections and the possibility of operative intervention to correct defects;
- improving the services of the intervention vehicles - Police, Ambulance, Firefighters.

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