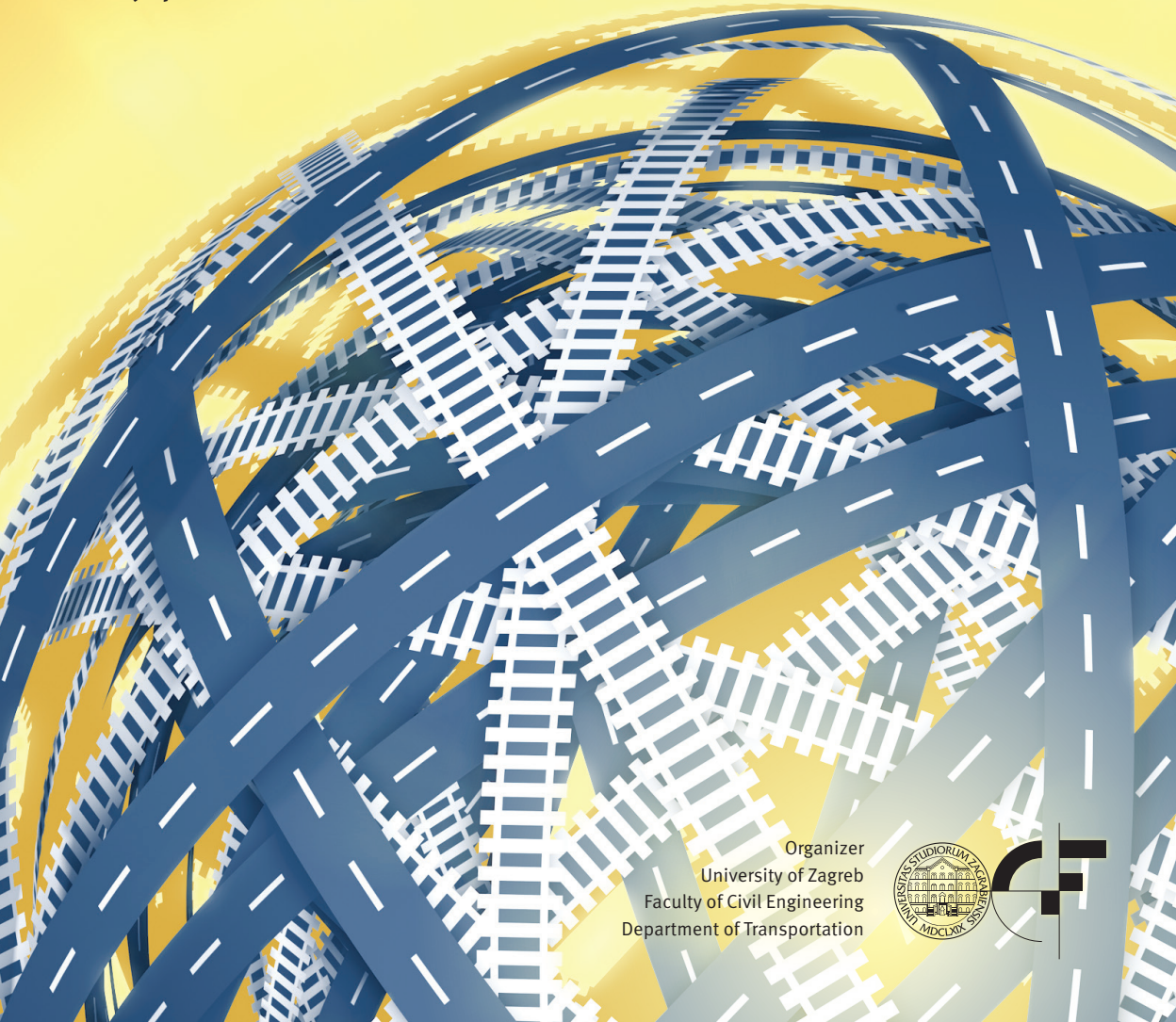CETRA²⁰¹⁶

**4ᵗʰ International Conference on Road and Rail Infrastructure**
23–25 May 2016, Šibenik, Croatia

# Road and Rail Infrastructure IV

**Stjepan Lakušić** – EDITOR

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# Road and Rail Infrastructure IV

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# EXPLOITATION OF NEW TECHNOLOGIES FOR COLLECTION AND PROCESSING OF MOTORWAY TRAFFIC DATA

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## Abstract

The transportation section is of paramount importance for a society and for that reason is directly connected to growth from every aspect. The implementation of new technologies in transportation systems, known as Intelligent Transport Systems (ITS), came into reality during the last decades, functioning effectively in combination with the new high standard motorways and are expected to grow considerably in the following years. The planning, design and implementation of such systems is an interesting field for researchers involved in transport infrastructure projects and equipment. Through this study, which deals with the issue of new technologies in the area of collection and processing traffic data, an attempt to analyze comprehensively the traffic measurement data at all stages is made, with emphasis on new and technologically advanced means of ITS. These systems comprise a combination of information and communication technologies applied to the transport sector in order to secure efficient and economical movement of people and goods using new technologies. The aim of the present paper is, therefore, the in-depth investigation of these systems, the presentation of all their aspects, such as the advantages of their use, their area of application and especially their prospects of development and wider use, particularly in Greece.

*Keywords: Intelligent Transportation Systems, Traffic Data, Traffic Data Measurement*

## 1    Introduction

During the last decades, the population and the economy of Europe have undergone great development, which resulted the expansion of transport networks, the mobility and the economic activities increase as well as significant productivity benefits. Considering that mobility is a prerequisite for progress, social and economic prosperity and definitely a basic social need, the challenge of effective and efficient transport has become a great necessity for the economies of the European countries and for the society as a whole, especially at the actual economically unstable environment. The increasing demand of people and goods mobility should be satisfied and managed by measures aiming at optimizing the use of existing infrastructure. New technologies and innovations, whether they concern the infrastructure design or the management, either the fleet technology (vehicles, trains, airplanes etc.), are the key element for the development and the regular function of transport system. Due to the great increase of the traffic volume occurring in recent years in each and every road network worldwide, the importance lies in the new requirements in the field of operative roadwork management. However, the implementation of such management initially requires the acquisition of relevant traffic data through the road infrastructure itself. These conditions have led to the development of yet another road equipment field, the traffic monitoring equipment. So far, this field includes only the sensors considering traffic lights, as well as closed circuit television cameras in dangerous places such as tunnels or bridges. Modern monitoring utilizes

both existing and new technologies for its purpose, which is the measurement of every kind of traffic data (speed, volume, density etc.) and the traffic monitoring.

## 2 Systems and equipment for measuring and recording traffic parameters

The main traffic parameters on a road network are:
• The traffic volume Q (vehicles per hour) and traffic composition-classification;
• The speed of vehicles Vt, Vs (km per hour);
• The traffic density $K$ (vehicles per hour) or average spatial or temporal separation of vehicles;
• The number and the type of accidents;
• The parameters regarding parking.

The awareness of the current state of a road network, namely the traffic conditions and habits that prevail during the study period, allows the prediction of future traffic demand and simultaneous investigation of a variety of options for its support. Moreover, almost every day, many elements about the different traffic and mobility characteristics required, in order to address the traffic and take immediate measures to improve traffic conditions [1].

### 2.1 Traffic speed measurement methods

The main methods of traffic speed measurement in one specific point are [2]:
• Measurement with speedometer-radar: This instrument uses the principle of the radar operation and when it is directed to a vehicle, it automatically shows to a suitable counter its speed in miles or kilometers per hour;
• Measurement with electronic speedometer: Two probes-detectors, either elastic with pneumatic tube or magnetic, are placed at a distance about 2 km the one from the other on a road pavement. The instrument records the time required for a vehicle to arrive from the first detector to the second and through that time it calculates the speed;
• Measurement with observer: In this method, one or two observers measure the time required for a vehicle in order to cover a given distance.

### 2.2 Traffic volume measurement methods

The traffic volume measurements are divided into those made by observers and those made by automatic devices. Therefore, the categories of traffic volume measurements are (Table 1): [3]
• Observer methods;
• Photographic methods;
• Automatic counting methods;

The most common automatic measurement method is the pneumatic road tube sensor, especially for short-term measurements, such as 24-hour or 48-hour traffic volumes. Other automatic counters are:
• Magnetic detectors;
• Detection sectors outside the roadway;
• Closed circuit television (CCT);
• Digital image processing.

**Table 1**  Summary comparative presentation of the traffic volume measurement methods [4]

| Method | Advantages | Disadvantages |
|---|---|---|
| Observers | More  detailed (Classification, turning movement); The number of the observers can be adjusted to traffic volume; Low cost for short duration | High cost for long duration; Difficulty in long duration 24/7 is impossible; In high volume points many observers required; Weather problems |
| Photographic | Measurements made in the office; Repetition of every photo take; Acquisition of more data | Devices cost; Long duration of analysis; Finding suitable and accessible installation site |
| Automatic counting | Low cost for long duration; Ability of unlimited duartion, consecutive function 24/7; Function during bad weather and environmental conditions | Difficulty in classification; High cost for short duration; Difficulty in turns recording; Possibility of destruction; Every section requires a device |

## 3   Intelligent Transportation Systems (ITS)

ITS contain many combined technologies, such as the use of video camera, views of information messages, digital wireless broadcasting, closed-circuit monitoring and other specialized communication devices in order to record the traffic volume, to decode the passenger information in real time and to warn in case of emergency, Figure 1. Today, transport application that utilize such intelligent systems are broader and more complex, including traffic management systems, route control, information for the passenger or the operator which contributes to the optimization of the flow by allowing the diversion to alternative routes with space availability. [5]
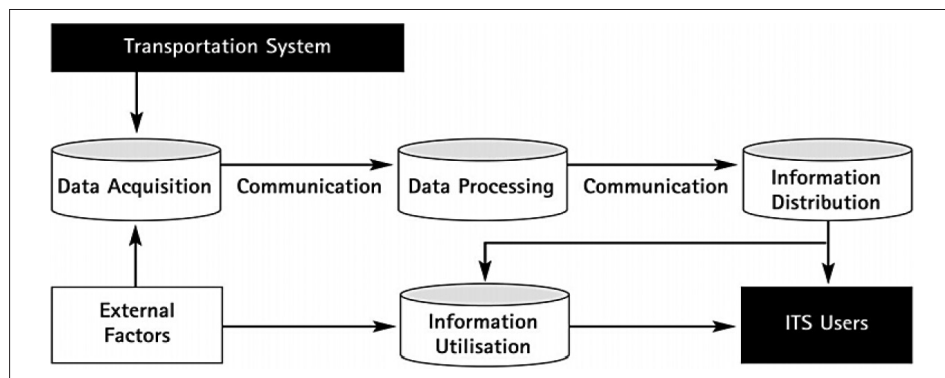


**Figure 1**  ITS data chain [6]

### 3.1  ITS Applications

#### 3.1.1  Traffic data collectors
Many different instruments and tools are available in order to be used for the traffic data collection and recording. These data could be used for many different purposes and be exploited in many ways, Table 2. The most common traffic data collectors are: [7]
• Loop detectors;
• Microwave detectors;
• Ultrasound detectors;

- Active infrared detectors;
- Passive infrared detectors;
- Layser detectors;
- CCT (Closed circuit television);
- Digital image proccesing;
- Radar;
- Transponder data collection (Probe Data);
- Response cards in car interior;
- Global Positioning System (GPS);
- Cellular phones.

**Table 2**  Modern traffic data collection methods [8]

| Data collection method | Traffic flow | Traffic jam | Car Category | Velocity | Travel time | Accident detection |
|---|---|---|---|---|---|---|
| Loop Detector | Yes | Yes | If speed is availbale | With 2 con-secutive loops | No | Yes |
| Pneumatic tube | Yes | Indirectly | Partly | With 2 probes – not concise | No | No |
| Camera | Yes | Yes | Yes | Yes | No | Under conditions |
| Radar | Yes | Yes | Yes | Yes | No | Yes |
| Infrared detectors | Yes | Yes | No | No | No | No |
| Floating Car Data (FCD) | No | No | Yes | Yes | Yes | Yes |

### 3.1.2  Traffic management centers

After the collection of traffic data, their processing is the key element of all ITS. Those data, in order to be useful, must be able to be converted in information and this is possible only if they are in forms and times suitable to be used in a particular decision, Figure 2. Therefore, information should be provided to the decision makers at the appropriate time and in perceptible forms. Hence, there are centers where information is collected. Then, an appropriate processing is made, and this information is sent through suitable systems to the recipients each time [9].
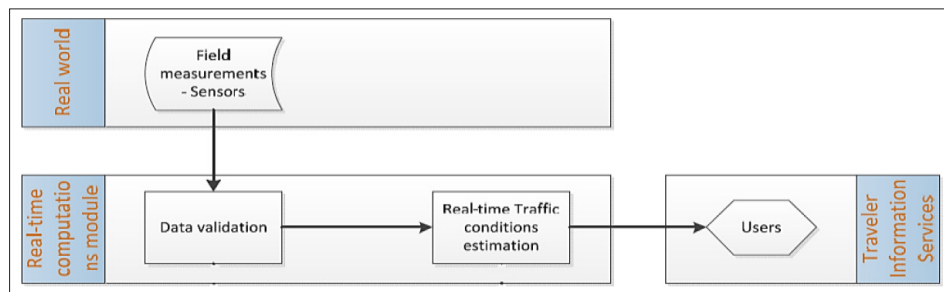


**Figure 2**  Function of user information system [10]

## 4 Conclusions

ITS applications are very effective and advantageous with multiple benefits for both society and economy. Therefore, it is necessary to become a high priority, especially regarding the use of available resources. The use of ITS is beneficial for the passengers that travel, the businesses, the government agencies, the transport systems administrators and finally the society and the environment. The strategic objectives set out under the policy of Intelligent Transport Systems (ITS), namely the road safety, the sustainable mobility with the components of energy saving and environmental protection, the resource conservation, the development of the economy and the social cohesion, become achievable with the development and the spreading of ITS. Consequently, the evaluation of ITS through various assessment techniques is really useful and almost necessary for the improvement of traffic conditions.

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