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Intelligent Transport Systems as a Tool for the Improvement of Quality, Safety and Efficiency of Transportation

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Abstract

The article focuses on Intelligent Transport Systems (ITS), which serve as a tool for improving the quality, safety and efficiency of transportation. These systems include a wide range of technology, software and infrastructure that make city travelling more efficient and better from the perspective of all stakeholders. ITS represent one of the main Smart Cities concepts. Through these new advanced tools, we can reduce adverse effects and in turn increase the desired benefits with regards to funding.

Keywords: Intelligent Transport Systems, ITS, traffic, congestion, smart

Introduction

According to various sources, the urban population today significantly exceeds the population living in the countryside. This trend of urbanization will continue to grow. It is estimated that by 2050, nearly 70% of the world's population will live in the cities. At the same time, traffic volumes will increase and with the population, the number of vehicles will grow as well. The traffic load on most of major routes in cities is already critical and their expansion in built-up areas is often economically challenging and it is therefore necessary to streamline certain transport processes, either in terms of saving investment costs or in terms of improving the quality of transport of people and cargo. In many cases, the expansion of infrastructure in urban areas is not possible in terms of the build-up rate in the given area.

The current state of the infrastructure is not capable of providing sufficient carrying capacity for traffic flows. Based on the facts above, there is the premise for the constant upgrading of transport infrastructure, transport facilities and technologies.

One of the progressive and modern tools to solve this issue represents the Intelligent Transport Systems. ITS should provide the integration of the activities of transport operators, carriers, infrastructure administrators, suppliers as well as road users themselves. The application of ITS is economically very demanding and requires the involvement of several parties, where an important role in the individual countries is played by the state itself.

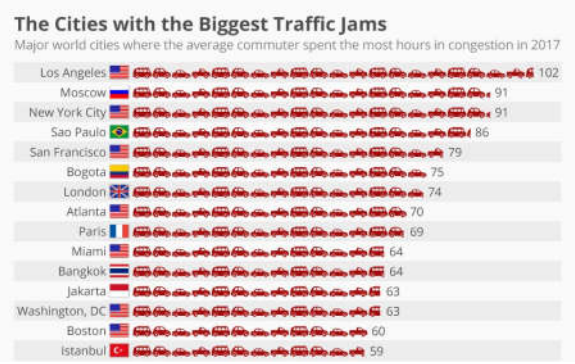

Figure 1 – Major world cities where the average commuter spent the most hours in traffic jams in 2017 [1].

The chart on figure 1 shows the major world cities where the average commuter spent the most hours in traffic jams in 2017. New analysis by INRIX shows that on average last year, each commuter in Los Angeles spent a huge 102 hours stuck in traffic - considerably more than second-placed Moscow and New York with 91 hours each. [1]

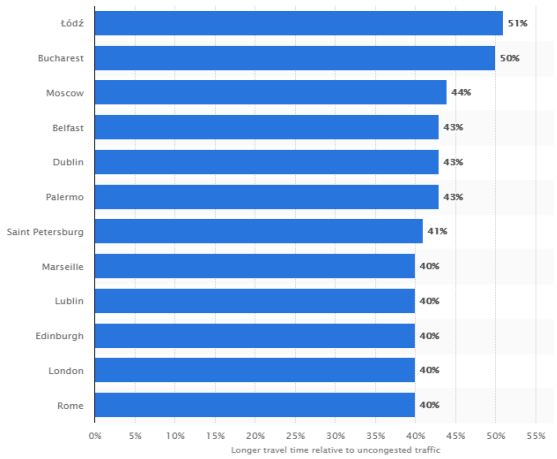

Figure 2 The most traffic jam prone cities in Europe (as of 2018; longer travel time compared to uncongested traffic) [2].

The statistics on figure 2 shows the most traffic jam prone cities in Europe in 2018. With an overall congestion level of 50 percent, Bucharest was the second most congested city in Europe. Here, a trip that might take 60 minutes in non-congested traffic will take 57 minutes longer during rush hour. TomTom used GPS data to compare travel times during the whole day and during peak periods to travel times during non-congested periods. It includes cities with a population of 800,000 or over. 2018 figures are based on 2016 TomTom traffic data. [2]

Setting of main objectives of Intelligent Transport Systems

For the ITS implementation, the main goals need to be set to make it clear, what the technology should bring us. ITS are a specific area, where effective applications can provide a great deal of benefits. The main goals of ITS are [3]:

- to increase the safety of the traffic/transport process,
- to increase the efficiency and quality of transport provided by travel time savings,
- to reduce negative impacts on the environment and to reduce the energy intensity of transport,
- to improve the productivity of commercial activities of entities involved in the traffic/transport process,
- to improve the access to traffic information for various traffic/transport subjects for their rational decision-making,
- to increase the quality of transport infrastructure and to reduce the costs involved in building of a new transport infrastructure (in particular the road network).

ITS architecture

The term "architecture" describes a structured framework, in which ITS components are associated so that the whole complex can work efficiently. The architecture determines the requirements for the operation and function of individual components of the system and shows, where they can bring the benefits of a standardized interface. Architecture analysis helps to define how the systems work together and clarifies the positions of the individual involved stakeholders in the implementation process. It is based on an analysis of functions and system activities according to user requirements. The architecture does not stipulate the use of specific ITS applications, technologies, or components. It should be common to give developers the freedom to design, what they think is the optimal solution.

The ITS architecture defines:

- **Functions (**e.g., collecting traffic or route information**)**
- **Physical elements or subsystems, where these functions work (**such as a route or a vehicle**),**
- **Information and data flows linking these functions and physical subsystems into an integrated system.**

Successful ITS applications

Today, it is already a well-known fact that technology is advancing at a rapid pace and we will have to keep up with them. Intelligent systems integrate technologies with elements of artificial

intelligence. They represent the highest degree of technology in general because they work with knowledge. Intelligent transport systems are derived from the interaction of a number of existing industries (automotive, electronics, logistics, defence, telecommunication, transport, road and construction) and further increase the value of the transport product. Intelligent transport systems are the result of the rapid development of information and communication technologies. Today, they support the integrated transport networks, vehicle network management and efficient planning of activities utilised within transport (including individual route planning and fleet logistics).

As a result of the constantly evolving technological environment, we are witnessing a parallel increase in technology that we can characterize as Intelligent Transport Systems.
Among the ITS components and technologies that can have an effect on efficiency, safety or quality of transport, we can include:

- Detection of exceptional phenomena and warning systems
- Systems for faster response within rescue actions
- Camera systems to force the change of speed and light signals
- Anti-collision systems
- Automatic control of walking and cycling
- Adaptive speed control for undisturbed traffic flow
- Air pollution monitoring devices
- Automatic Vehicle Location (AVL)
- Automatic tracking of freight transport
- Monitoring of driver's equipment
- Real time traffic information
- Dynamic guidance of vehicle to the destination
- Tracking of security or rescue vehicles
- Real-time mass transport information
- Payment by magnetic / chip cards in public transport
- Intelligent traffic lights (Smart traffic)
- Intelligent radar traffic lights
- Smart street lighting - Intelligent public lighting
- Infrastructure sensing / monitoring
- Electric cars and charging stations
- Measuring sensors
- Intelligent parking
- Passenger counting systems and electronic fare systems
- Carpooling, carsharing, ridesharing
- Passenger information system
- Ramp metering
- Weight in motion systems
- Bicycle Route Planner
- Warning and planning system for truck drivers
- Electronic wagon warning system
- Acoustic monitoring of tunnels
- Intelligent identification and signalling systems on railway crossings without technical systems
- e-Logistics
- C-ITS/Cooperative Intelligent Transport Systems
- Human-Machine Interface - HMI (speech recognition and synthesis, minimizing driver's attention while driving)
- Universal on-board unit UOBU
- Electronic Fee Collection (EFC)
- Interconnected vehicles
- DSCR Microwave system
- Alcolock in the vehicle
- Belt reminders or locking system
- Cell phone locks or jammers, cell phone detectors
- Automatic number-plate readers
- Electronic keys
- Electronic log or Electronic Driving License
- Remote vehicle engine immobilizers
- Automatic number-plate recognition
- Software for automated offense processing

Conclusion

The problem of most countries in the world today is the ever-increasing population and hence the enormous increase in the number of vehicles and traffic volumes, resulting in increased congestions. Even today, the carrying capacity of infrastructure is not sufficient to provide smooth traffic with regard to the quality, safety and efficiency of the transport process. The United Nations estimates that 54% of the world's population currently lives in urban areas. By 2050, this figure will grow to 66%. In Europe, this proportion is even higher - according to the United Nations, 73% of the European population currently lives in urban areas and this is expected to grow to 80% by 2050.

It is an imperative to continually search for progressive and innovative tools that, in the current trends, can eliminate undesirable effects as a result of the development. ITS should provide the integration of the activities of transport operators, carriers, infrastructure administrators, suppliers as well as road users themselves. When implementing ITS, it is important to set the main goal in order to achieve the desired effect. As already mentioned, ITS projects are

very costly and therefore we need to look for suitable implementation models that can provide us with the right balance of funding and benefits.

An important role in this process is played by the given state. The state has the potential to support the achievement of the basic transport objectives (to reduce congestion by up to 25% and to increase travel quality, to increase safety by up to 25%, thereby contributing to the overall European goal of reducing the number of people killed by 50% and reducing CO_2 emissions by 10% especially in urban areas [4]) directly and indirectly. Direct support includes operation (or provision of operation) of specific ITS services; indirect support consists of promotion, financial policy and legislation.

In order to ensure the efficiency of ITS operation, cooperation of people from the transport and information sectors, as well as urbanists and public is essential. Studies show that the implementation of ITS has significantly increased the efficiency of traffic/transport in terms of safety, efficiency, productivity and environmental quality improvement by 20% to 30%. Based on the past experience (USA, Germany, Italy, UK) it can be estimated that ITS will achieve a 25%-50% reduction in traffic accidents, reduce travel time in cities by 20%-40% and increase traffic flow fluency by 8% to 22%.

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