Intelligent Transport Systems and Safety in Road Traffic

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ABSTRACT

Transport safety can be defined in a number of ways, including the official World Health Organisation (WHO) safety definition ‘freedom from unacceptable risk of harm’. Road safety is, however, usually defined in a negative way. Safe road traffic is characterised by the absence of crashes, injuries and fatalities. Crashes are used here instead of accidents because the word accident leads thoughts in the direction of an event that is hard to do something about “it happened by accident”. For society and for the individual, the loss of health is the most serious effect of crashes. It leads both to serious personal suffering and to huge societal losses in monetary terms. Therefore, it is essential to state at this early stage that loss of health is the main road safety criterion. Convalescence and health restoration have economic consequences as have vehicle damage and loss of vehicles and goods.

KEYWORDS: Transport safety, Accident rate, Development of road transport

1. Introduction

Road safety may be influenced along many separate dimensions and various models have been used in road safety management:

• There are three main variables that decide the road safety level in terms of health consequences: exposure in traffic, risk of a crash given the exposure, consequence of the crash.
• The health consequences of road crashes may be influenced by actions taken before the crash (active safety), during the crash (passive safety), and post-crash (rescue, treatment, rehabilitation).
• Most of the crashes are triggered by human errors, sometimes intentional but normally unintentional. There are three basic ways to reduce the human errors: selection of road users (for example, licensing), improving road users (for example, information, education, training, and enforcement), adaptation of road and vehicle engineering solutions to human characteristics and limitations (make it easier to drive, to bicycle, to walk in traffic).[3]

As is apparent from the traffic accidents, more than 95% of accidents is caused by human error, neglecting driver’s responsibilities, incorrect assessment of situation and his/her abilities etc. The characteristics of the vehicle movement are a subject of traffic flow theory, which separates the movement of a single vehicle and group of vehicles.

The above indicates that operational measures, mainly in the field of organization, regulation and traffic control, are an inseparable part of the traffic/transport system and is a condition to effective utilization of transport vehicles, transport routes and provision of steady, safe and efficient traffic.

2. Definition of ITS

ITS is generally road based, vehicle based, vehicle to road based, vehicle to vehicle based or vehicle-to-infrastructure based technologies supporting
the driver and/or the management of traffic in transport system. On the vehicle side of ITS often two major subdivisions can be found: in-vehicle information and communication systems (IVIS) and advanced driver assistance systems (ADAS). IVIS and ADAS can be then subdivided into active and passive safety systems. [5, 6]

2.1 Types of Intelligent Transport Systems (ITS) [7]

ITS can be categorized in many ways. Some of them are discussed below.

The first one categorization is on technical aspects:
- vehicle systems without interaction with data sources outside the vehicle;
- roadside systems without interaction with data of individual vehicles;
- systems that allow for interaction between individual vehicles and other data sources, such as between vehicles or between vehicle and roadside.

The last category of the first categorization seems to be the most ‘intelligent’ because these applications make it possible to communicate up-to-the-minute situations to an individual driver. This can be information about, for example, weather conditions, temporary speed limits, the exact location of the vehicle, or hazardous situations further along the road.

The second categorization could be on primary purpose:
- management of traffic flows;
- driving comfort;
- safety, subdivided into:
  › systems that prevent unsafe traffic participation;
  › systems that prevent unsafe actions while participating in traffic;
  › systems that reduce injury severity.

This classification needs taking into account that besides its primary purpose (e.g. driving comfort); an application can have positive or negative effects in other areas (e.g. traffic flow or road safety). In addition, it is sometimes possible that a particular safety ITS does not have the desired effect because the driver, deliberately or unconsciously, adapts his/her behaviour (behaviour adaptation).

3. ITS primarily focused on safety

Prevention of unsafe traffic participation

An already well-known example of systems that prevent unsafe traffic participation is the alcolock. Before drivers can start their car, they first have to take a breath test when an alcolock has been installed. If the BAC is too high (often 0.2 g/l), the car will not start. This system is already being used in various countries, especially for drivers who have been caught while driving under the influence.

The seatbelt lock is based on the same principle: if the seatbelt is not fastened, the car will not start. Many cars already have a warning system that operates via a small light, an audible signal or a talking computer. The risk of being killed or severely injured is much greater without a seatbelt than when wearing one. Currently, about 95% of drivers and front seat passengers and more than 80% of back seat passengers use their seatbelts.

A step further than the above applications is the smart card, which is a sort of individual starting permit. All sorts of data about the driver's fitness to drive can be stored on a smart card, such as information about the validity of the driving licence (vehicle type, licence suspension) and any restrictions for using the vehicle, for example in case of a graduated driving licence.

Systems that prevent unsafe situations or actions while driving

Examples of systems that prevent unsafe situations or actions during traffic participation are systems that offer support for vehicle control, record and/or prevent deliberate and unintentional offences, offer support in observing, interpreting and predicting traffic situations, and react to a (temporarily) reduced fitness to drive.

- Vehicle control
  › Electronic stability Control
  › Lane Departure Warning System
  › Lane Keeping System
- Prevention of offences
  › Intelligent Speed Adaptation
  › Electronic Vehicle Identification
  › Electronic Data Recorder (black box)
- iii. Support for observing, interpreting situations
  › Collision Avoidance System
  › Vehicle detection at intersections
  › Night time vision system

Accident Reports clearly show that especially the human factor, particularly the driver and his behaviour are a major cause of accidents. One is a central component of “human-vehicle-communication-environment”, which manages and regulates its activity, but also the least reliable article. The constant development of technology and complexity of traffic growth situation places the individual into a position where the intensity is increased to its psyche. Driving is a complex task involving many aspects such as sensorimotor
coordination, reaction time, reasoning, attention, emotion, motivation and becoming skills with learning [2,3].

It is necessary to describe the three most important characteristics of human being, that influence driving, and to this belong attention, decision making and behaviour.

4. Telematics Applications in Road Transport

Well-working control systems affecting transport in residential areas or rural zones improve the steadiness of traffic flows and reduce the numbers of accidents, congestions, psychic load of drivers and improve the comfort and quality of transportation. Three-layer hierarchy is suggested for applications in road transport. The first layer in the hierarchy of town systems is defined by individual transport nodes (traffic light systems on crossroads, parking systems, tunnel management systems etc.). The second layer is management at the area level. The third layer is constituted by head offices which are the highest stage in the hierarchy and contains several areas.

Traffic management systems combine the new and existing traffic management as well as control systems for the optimization of traffic flow on motorways and urban and suburban expressways. Primary feature is the integration of traffic control subsystems (e.g. signalization, motorway and transit control systems) and the provision of dynamic checking in real time in a way that reflects the changing traffic conditions. In the urban areas this represents so-called "intelligent communication" to be used by the "intelligent vehicle" [1].

An important function is the provision of wide range of information to drivers and passengers in the vehicles which allows for a more effective utilization of road network. Information on direction, routes and driver services are fed directly into the vehicle. Information on transport congestions as well as information regarding dynamic navigation en-route is dependent on the communication link between the vehicle and main office. This information can be transmitted anytime as a continuous traffic monitoring. The knowledge of intensity provides realistic and immediate picture of traffic situation. It delivers accurate and current information to other participants of the transport process about traffic intensity at individual sections, announcements on accidents, dynamic route information that can be supplemented with other type of information, e.g. parking options, recommendations to detours, hotels etc. The question is how much information is a driver able to evaluate in order to react optimally. The goal of mobile systems for dynamic direction finding is:

- To navigate drivers and to recommend a place for joining a lane according to current traffic intensities and average speed of traffic flow;
- To reduce the length of queues;
- To eliminate aggressive behaviour of drivers;
- To reduce negative externalities through optimal en-route navigation.

5. Why Support ITS

Effective transport of passengers and freight is becoming a serious problem of the whole society and it is required that state administration takes steps towards this issue. Ignoring these issues induces higher public expenditures for solving the consequences.

The new millennium is marked by globalization of economy and transport is undoubtedly an important part of this development. The main contribution of the implementation of ITS systems and services from the social point of view is the increase of transport safety.

The public sector should financially support such telematics applications which will increase the comfort for the user of transport services, improve the traffic management and reduce the accident rate. Furthermore, the public sector should support the development of technologies for timely saving of lives and the reduction of consequences of serious injuries caused by accidents via technology that diminishes the negative externalities and adds to the increase of quality of public mass transport of passengers.

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