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Risk identification of implementation of ITS to real traffic

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Abstract

Intelligent Transportation System is one of the concepts of modern sustainable transport in Smart Cities, which increases flow and safety of road traffic with use of information and communication technologies. The use of smart technologies such as Internet of Things, BigData, Artificial Intelligence and so on, requires strengthening or even creating a new communication infrastructure in the field of traffic. This paper discusses the risks of ITS implementation by analyzing the current state, identifying the key risk factors and showing possibilities in reduction of these risk using system methodology. It can be assumed that this transformation will be time-consuming, not only in policy and construction areas, but also in putting these systems into operation. In this meantime, when smart and non-smart systems will come in contact, there should be expected risk situations, that could cause difficulties for large-scale ITS to emerge, for example for large cities. An important part is also early awareness of the population which is affected by the situation of putting the system into operation, especially trainings for professional drivers. A participant in traffic, who are not affected by smart technologies as so-called "internet generation" should be taken into account, as possible source of risk situations. Determining the potential risks on all the above-mentioned case is a current problem because of the rapid development and onset of ITS.

Keywords: Intelligent Transportation System; Smart Cities; Risk Identification

1. Introduction

Intelligent transportation systems such as transport telematics systems combine information and communication technology and transport engineering, including other supportive sectors such as economics, transport theory, automotive engineering, etc. The combination of these areas is designed to improve existing transport infrastructure

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in order to increase transport efficiency, safety and transport comfort. Services, that traffic telematics offers, by source SDT (2018) can be divided into several levels:

- Passenger and driver services
- Infrastructure manager services
- Services for transport operators
- Public administration services
- Rescue system services
- Services for financial and control institutions

Connecting the individual services, an information structure extension is created that will enable traffic management similar to production management (logistics). In this case, benefits will be derived not only for transport telematics users, i.e. passengers, drivers and carriers, but also stakeholders in terms of facilitating the performance of the state transport policy for more profitable investment strategies. In addition, the interconnection will offer private sector entry into transport infrastructure. However, the question is whether this combination will only bring positive or negative effects on transport telematics, and whether these negatives can be revealed before the actual implementation of telematics systems into actual operation (SDT, 2018).

2. Current state of implementation

Currently, the concept of cooperative telematics systems (C-ITS) is emerging in the European Union, extending the basic idea of ITS towards mutual communication between units in individual vehicles and transport infrastructure (C-Roads Czech Republic, 2018).

Information transfer is facilitated by wireless communication technologies such as Wi-Fi, LTE, ZigBee and other transmission technologies that are essential in the Internet of Things (IoT). According to the way of communication, C-ITS can be divided into the following categories:

- Vehicle-vehicle (V2V)
- Vehicle-infrastructure (V2I)
- Infrastructure-vehicle (I2V)
- Infrastructure-infrastructure (I2I)

In some cases, categories V2V and V2I are marked as Car-X (C2X).

C-ITS technologies have already been developed in research projects and have been or are being tested in pilot studies (Data Linking Vehicles, 2017). Much of the traffic telematics is already standardized. ITS Technical Committees (ISO / TC 204, 2019) dealing with ITS present 261 published ISO standards and 82 standards that are being developed, and among them co-operative systems (C-ITS) standards.

Among other projects, standardization was supported by COMeSafety2 (COMeSafety2, 2010), which used EU-US cooperation to enhance support for the implementation and possible development of active C-ITS safety systems.

The Netherlands, Germany and Austria are participating in the European Union's co-operative systems, working together to create an international ITS corridor between the cities of Rotterdam, Frankfurt and Vienna. Two ITS services are used, namely roadwork on highway warning and probe data collection, i.e. data from vehicles (location, speed vector, acceleration vector, weather conditions, etc.). All the information is transferred from on board unit (OBU) to a road side unit (RSU) using 5.9GHz wireless transmission (ETSI G5) and then sent to control centers where information is used to warn drivers or to dynamically control traffic flow (Data-linked vehicles, 2017). This data flow is described in the following figure (C-Roads Czech Republic, 2018).

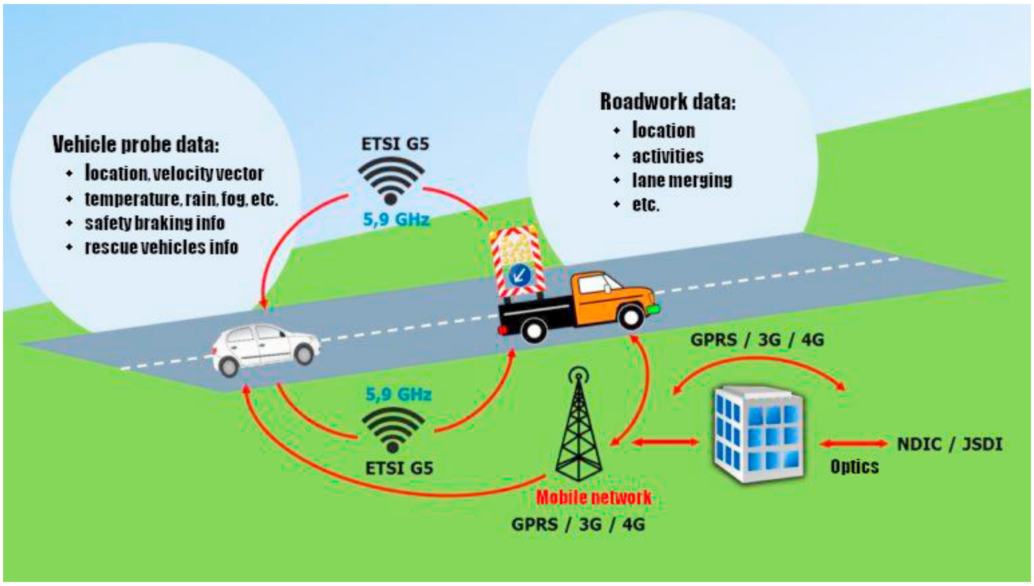

Fig. 1. Data flow of C-ITS (C-Roads Czech Republic, 2018; edited by the author)

In Czech Republic the C-ROADS Czech Republic project (C-Roads Czech Republic, 2018), based on the C-Roads international platform, focuses primarily on harmonization and cooperation in the implementation of C-ITS in European Member States. It is not only about the introduction of C-ITS on motorways, but also on the backbone transit routes in cities. Specifically, implementation is currently being tracked at six locations across the country:

- Prague City Circuit (DT0)
- Brno agglomeration (DT1)
- City of Brno (DT2)
- Motorways D1, D5, D11 and D52 (DT3)
- Public Transport of the City of Ostrava and Pilsen (DT4)
- Railway Crossings in the Pardubice Region (DT5)

In general, the implementation of ITS systems can be divided into four basic phases, therefore the contribution of individual time phases to the use of services being described in figure 2. Initially, sensorics probing will be involved that will send the measured information to both control centers and drivers, but decisions will always be on users. Over time, there will be more autonomy and the information will be transferred between vehicles and infrastructure so that the OBU or RSU will make overall management decisions. However, if the correct and timely implementation of C-ITS systems is not ensured, the systems will not be reliable, safe and therefore less interesting to the public. These facts could slow down the deployment of systems (Sjoberg, et al., 2017).

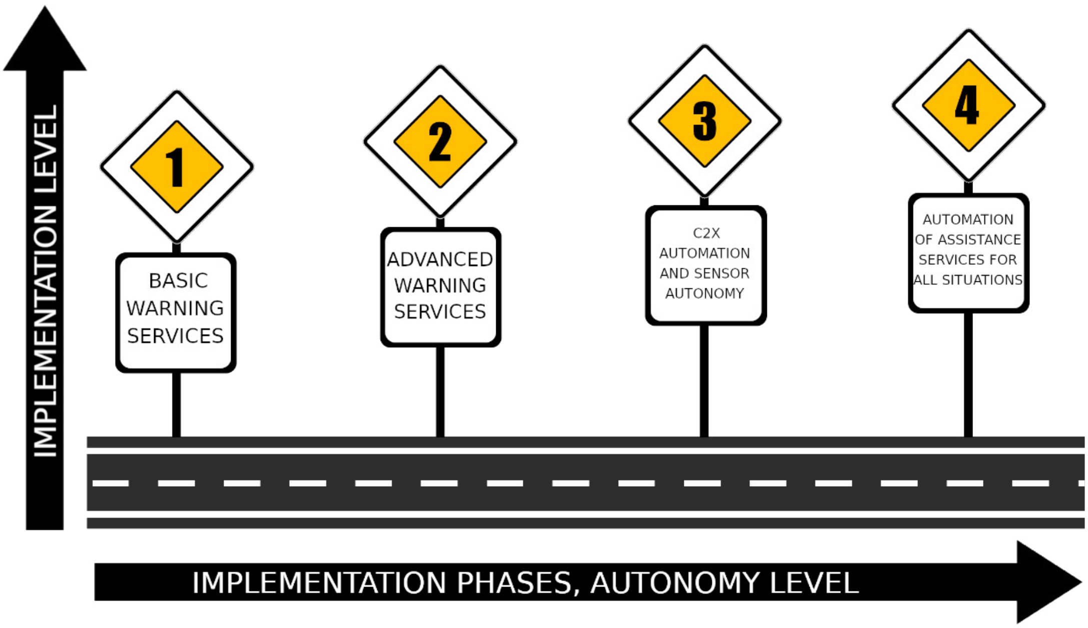

Fig. 2. Infographic of implementation level and phases (Sjoberg, et al. 2017; edited by the author)

The ITS services (C-ROADS, 2016) that are planned for deployment and testing (DT) in this project include:

- Road works alerts
- Information in vehicle
- Vehicle probe data
- Information about slow and standing vehicles
- Warning of IRS vehicles
- Traffic jam alert
- Traffic lights violation control
- Public transport preference
- Warning of dangerous areas
- Weather information
- Information on railway level crossing

3. Identification of key risk factors

Identification of key risk factors helps to identify barriers of ITS systems implementation. Its application is suitable before deploying these systems into actual operation. In such a case, it is possible to include a risk factor in the project in order to reduce the risk factor. This will facilitate system deployment and increase ITS security and reliability. A similar approach has already been taken in the CVIS project, where non-technical problems have been examined that could create barriers to the safe and successful deployment of CVIS itself, both in terms of risk identification and accountability analysis. Using the brainstorming method, a database of risks and threats has been created, divided into several categories (CVIS, 2009).

The case study (Bus Karo 2.0, 2019) on the implementation of ITS in urban bus transport already highlights the fact that poor harmonization between the involved parties can cause total ITS collapse and malfunction. It also points to other risk factors that may appear when deploying:

- Lack of resources for operation and maintenance
- Lack of technical capacity of control centers to analyze information
- Lack of knowledge of the city about ITS in the procurement of private sector
- Favoring low-priced public procurement rather than quality ones

3.1. Methodology

This article focuses primarily on identifying key implementation risks in the areas of ITS own infrastructure, smart and non-smart technology compatibility, systems knowledge for users, especially professional drivers, logistics companies and users outside the so-called Internet generation (iGen). To identify risks, the "What-if analysis" method was chosen, which is an analytical method for identifying potential risks and assessing potential impacts. The methodology is based on the definition of already mentioned areas of interest and the definition of target interests through the generation of questions and answers (ISO 31000: Risk management, 2018).

3.2. Results

The results are recorded in the form of questions and answers to the tables. These are divided into four groups of areas of interest:

- ITS infrastructure
- Users – professional drivers
- Users – logistic companies/carriers
- Users out of iGen

The answers point to possible impacts in the implementation of individual risk factors.

Table 1. Area of interests – ITS infrastructure

What if?	Answer
Wired transmission required by systems	New infrastructure construction required
Financial unavailability for cities	Incomplete implementation of ITS (busy sections only), insufficient traffic information
Low reliability of systems	Frequent fault states, necessary maintenance, economically disadvantages
Software will often require updates	Instability of the systems in the implementation, possibly a compatibility error, a possible reduction in security
Fails to ensure system compatibility from different vendors	C-ITS elements connection failure, system will lose cooperation
Insufficient standardization of deployments / elements / systems	Incompatible systems
Insufficient protection against misuse	Frequent attacks, possible loss of information, misuse of data and systems
Poor procedures of implementation	Chaos, reduced or lost system functionality
Insufficient control centres	Invalid reception and processing of information, system overload
Creating complex systems	Poor control, management, susceptibility to difficult to detect errors
Faulty / inadequate data of real situation	Influencing feedback, dynamic guidance
Insufficient infrastructure coverage	Irrelevant statistical data
Strong electromagnetic fields are created	Affecting electromagnetic-sensitive devices, signal interference
Inconsistency of telematics and physical traffic signs	position of the driver in an uncertain situation

Table 2. Area of interests – users (professional drivers)

What if?	Answer
Insufficient training of drivers on new systems and legislation	Low usability of elements and reduced system efficiency, negligent violation of law
The driver relies only on ITS systems	In places without ITS the driver loses mindfulness to external stimuli
The driver does not rely on systems at all	Reduced ITS efficiency
Insufficient protection of driver information	Theft of personal information
Driver forced to use C-ITS	Need for training, economic burden
Low reliability of systems	Reduced ITS efficiency, position of the driver that relies only on ITS in an uncertain situation
Software will often require updates	Financial demands, possible reduction of safety, more frequent training

Table 3. Area of interests – users (logistic companies/carriers)

What if?	Answer
Insufficient training of drivers on new systems and legislation	Economic burden, reduced ITS efficiency
Systems will not be cost effective	Low element usability and reduced system efficiency
The carrier relies only on ITS systems	Susceptibility to system outages
Theft of carrier information	Market abuse
Carrier forced to use C-ITS	Need for training, economic burden
Low reliability of systems	Reduced work efficiency, more logistical demands
Software will often require updates	Financial demands, more frequent training required (drivers / dispatchers)

Table 4. Area of interests – users outside internet generation

What if?	Answer
Users overloaded with vehicle information (not user-friendly)	Worse inattention, accident rate
Refusal to adapt, mistrust in ITS	Low element usability and reduced system efficiency
Fear of stealing information and tracking	Low element usability and reduced system efficiency
Users forced to use C-ITS	Misuse of systems, low familiarity
Low reliability of systems	Rapid loss of confidence in ITS
Software will often require updates	Misuse of systems, low familiarity

The analysis shows that the risks arising from the deployment of C-ITS systems are not only in the area of communication between the components of the system that is most analyzed in the studies. However, there are also risk factors for system reliability, standardization and harmonization of implementation procedures. In case of insufficient coverage of ITS services, data may be affected, which is completely inadmissible at an advanced stage of autonomy. In the categories of users (professional drivers / carriers), the risk factor is missing or insufficient training of drivers and dispatchers, which would reduce the efficiency of the use of ITS and hence the positive impact of these systems. Another important risk factor is the protection of data and information about both the driver and the transport company itself. This is now a key requirement associated with the implementation of the GDPR. It is also necessary to eliminate the possibility of misuse of acquired data in a market abuse. For less experienced users outside the so-called internet generation, risk factors can be expected to be associated with either user overload with information from the ITS or refusal by the user to adapt to ITS deployment. Reducing system efficiency can also cause user concerns about theft of personal data (as well as professional drivers) and fear of being tracked so-called the Big Brother phenomenon (Zureik, Salter, 2005).

4. Possible precaution

In all the cases mentioned above, there may be serious complications in implementing ITS systems. This could ultimately lead to a slowdown in the development of these systems and a reduction in their use to increase transport sustainability. The list of risk factors implies that ITS needs to be standardized at both national and international levels, especially for compatibility of individual systems. The aim should be to create a single ITS system for both states and manufacturers and service providers. This precaution would consequently simplify the necessary training for professional drivers and carriers. A key factor is also early awareness of other users, traffic participants, with a particular focus on less experienced users and users outside the Internet generation. Finally, the unification of the systems would also enable the ITS deployment process to be harmonized.

5. Conclusion

C-ITS is a very actual issue. Most of the projects deal mainly with its positive impact on transport sustainability and the associated improvement of services for users. However, the pilot studies mentioned in this article suggest that ITS systems may not always only improve the situation when used poorly. In order to make the deployment of ITS systems as effective as possible, it is also necessary to focus more on the associated risk factors. In this paper, only a narrow area of key risk factors that can be reflected in the implementation of ITS is mentioned, both in the area of own transport telematics infrastructure and in the user area. Because C-ITS is in the early stages of implementation, it appears necessary to perform a comprehensive risk analysis of all available pilot studies that could already be based on quantitative analytical methods. This analysis could then be used to create a uniform ITS risk assessment methodology.

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