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THE IMPACT OF USING MODERN INFORMATION AND COMMUNICATION EQUIPMENT AND SERVICES ON DRIVING SAFETY

ABSTRACT

With the development and application of modern information and communication equipment and services (ICES), global society has undergone significant development and progress in everyday life. Along with the positive, negative aspects of their usage have evolved. One of the problems is the new sources of driver distraction, which ultimately results in a serious, growing daily threat to traffic safety. Simultaneously with the development of ICES, the number of distracters (mobile terminal devices, laptops, smart watches, and others) has increased as well, which also reduces the level of safety and affects the quality of driving. With the increase in participation and ownership of mobile terminal devices, as well as the implementation of modern multimedia information and communication systems in vehicles, this problem will further escalate in the coming years. The unfavorable factor comes from the fact that distraction factors influenced by using ICES belong to bio-mechanical, cognitive, auditory, and visual categories, which directly affects essential human functions for successful and safe vehicle operation. This paper provides insight into the issue of distraction factors that affect drivers with an emphasis on those caused by using modern ICES.

KEY WORDS

information and communication; equipment; services; mobile terminal devices; nomadic devices; traffic safety; distraction; driver;

1. INTRODUCTION

Nowadays, people are accustomed to real time access to adequate and relevant information enabling a multitude of types of tasks at once (multitasking) to be performed in a quality manner [1]. This is made possible by using modern information and communication equipment and services (ICES) and mobile terminal devices (MTDs). In addition to the positive, such habits and activities lead to negative aspects of daily/permanent use of ICES. One of these aspects is driver distraction during vehicle operation by using ICES.

Driver distraction is a serious threat to traffic safety. One of the many definitions of distraction defines it as any activity that could distract the driver's attention from driving, which is his or her primary task [2]. The phenomenon of distraction is a real problem and one of the key factors that have a negative impact on traffic safety. This is evident from the results of field research and official statistics of traffic accidents [3, 4]. The impact of distractions can "force" drivers to look away from the road they travel, remove their hands from the wheel or overlook critical information from the environment, which could result in an increased risk of traffic accidents [2]. According to [5], 16% of traffic accidents in the United States (US) in 2012 was caused by some kind of distraction factors, including conversations with passengers in vehicles, managing multimedia systems, consumption of food and/or beverages, and the use of MTDs.

The influence of using MTDs while driving was investigated as a distraction factor as early as in the 1960s. In this ground-breaking research it was discovered that secondary activities while driving, such as conversations through MTDs, result in degradation of drivers' characteristics [6]. According to a 2002 study [7], out of 4,000 surveyed drivers, 47% of them reported a conversation with passengers, 33% reported adjusting a music player, 14% reported food and beverage consumption, and 8% reported a conversation via an MTD. In a similar study conducted in 2010, 52% of respondents reported a conversation with passengers, 34% adjusting a music player, 14% the consumption of food and beverages, and 15% reported the conversation via an MTD [8]. On the other hand, almost a third of drivers (32.2%) reported handheld conversations and 43.7% admitted to text messaging with an MTD,

according to a study [9]. The above shows that the frequency of the usage of MTD while driving increases, while the level of distraction from other factors remains the same.

Along with frequency, the average duration of different factors of distraction while driving has also been documented. For example, it has been found that drivers spend 54% of the time driving the vehicle while doing another activity, a distraction [10]. Furthermore, through the implementation of modern in-vehicle infotainment systems (IVIS), the number of distraction factors that depend on modern technology has grown (technology-based distraction), and they have become subjects of detailed studies that indicate the impact of using IVIS on driver distraction [11-13].

The purpose of this paper is to review the current research to provide a comprehensive view of the impact of increasing ICES-based distraction factors on driving ability. In our review of the relevant literature and knowledge acquisition, the scientific methods of analysis and synthesis, deduction, induction, and compilation were used. By analyzing distractions caused primarily by using ICES, the relevant forms of distraction factors have been deduced. The factors will lead to recommendations for future research.

2. MODERN ICES

Mobile communication systems (MCS) are of particular importance in connecting people and modern provision of information and communication (IC). They have been improving the world with their progress for almost four decades now. At present, the development of MCS is directed by the Internet of Everything (IoE) concept, moving towards complete connectivity for all things and objects from the daily life and creating a society which is absolutely connected as a whole [14].

MCS development has been followed by that of terminal devices (TD). Over generations, they have become portable and extremely usable regardless of location and conditions of the end user. Such TDs are called MTDs, and most often these are mobile phones, smart MTDs (smartphones) and tablet computers (tablets). TDs are the end devices in an IC network, converting different types of information into electrical signals and vice versa [15]. The purpose of TDs is the use of systems, services and applications by end-users in a self-explanatory way. Today, working with various MTDs is a quite normal and generally accepted activity [16]. Thus the development of MTDs adapts to specific customer requirements and operating conditions.

The number of MTDs has surpassed the total world population [17]. In 2016, the number of smartphone users surpassed the number of users of MTDs with basic functions (feature phones), primarily because smartphones have become more affordable for end users [18]. The number of MCS users is growing globally by about 35% annually [18, 19]. The increase of smartphone usage is partly a result of reduced prices of those devices [18, 20]. The penetration of smartphones is among the largest in the world. A forecasting of the changes in the number of different types of MTDs in the period from 2015 to 2021 is shown in *Table 1*. [19, 21].

Table 1 – Comparison and prediction of the number of mobile terminal devices from 2015 to 2021

Type of terminal devices	Number of devices (in billions)	
	2015	2021
Mobile phones with basic functions	3.6	1.3
Smart mobile terminal devices	3.4	6.4
Laptops, tablets	2.4	2.8

It is anticipated that the number of smartphone users in Europe will be at about 95% by 2021 [21]. IC services on the move, which were until recently limited to smartphones, will gradually introduce devices such as smart watches and smart glasses. This will result in the use of dozens of devices per person [14, 16]. With the social development and the creation of an entirely new ecosystem this obvious progress will result in an increase of driver distraction factors.

Even today there are IVIS platforms that enable the integration of private TDs in vehicles (connected vehicle). TDs, which are currently considered as portable or nomadic devices while in a vehicle (devices that are not integrated into the vehicle) [22], will be fully integrated in the vehicle which will participate as a private facility in the Internet of Things (IoT) concept. Some projections consider that the figure of 30 to 50 billion networked devices, vehicles, and things will be reached until 2021 [14, 18]. Predictions are that all services and applications (location-based services, instant messaging applications, etc.), which are currently used on various TDs and are acceptable as distraction factors, will indeed become a constant, rather than secondary phenomenon in vehicles [11, 14, 23].

3. DRIVER DISTRACTION

Driver distraction and inattention are perennial problems in the field of road safety [24]. There are clear indications that inattention and distraction are among the main factors in creation of high-risk traffic situations that often end in traffic accidents [10].

3.1 The concept of inattention

Distraction and inattention are two separate but related concepts. Driver inattention can be defined as a lack or loss of attention to the actions that are critical/essential for safe vehicle operation. On the other

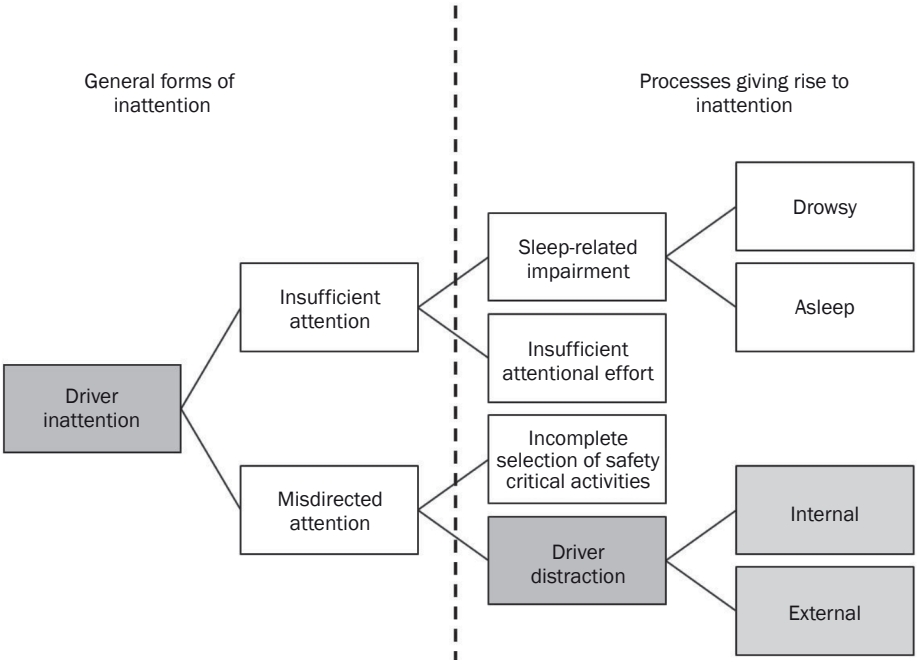

Figure 1 – Taxonomy of driver inattention

hand, driver distraction can be defined as a state of diverted, misdirected attention, for example attention diverted to activities other than those essential for safe driving [25].

Figure 1 shows the taxonomy of inattention, providing a clear insight into the categorization of the terms distraction and inattention [26].

According to [25], the concept of driver inattention is defined as insufficient level of attention to activities that are critical to safe vehicle operation, whereby distraction is cited as one form of driver inattention. Therefore, distraction can be distinguished from inattention on the basis of the existence or non-existence of a secondary task or competitive activities.

3.2 The concept of distraction

Vehicle operation is an activity that requires continued focus on the road, traffic conditions, and vehicle control. In the event that the driver is occupied with other activities, attention is reduced, and vehicle operation becomes risky. This reduction of attention may result in the occurrence of various distraction factors such as talking on an MTD, putting on/ listening to music, talking to passengers, consuming food or beverages. Furthermore, distraction factors may occur in the form of things or events in or outside the vehicle, such as a traffic accident in the opposite lane, conspicuous people on the sidewalk, striking billboard ads next to the road, the emergence of fatigue, thinking about things other than driving, or daydreaming ("wandering thoughts"). The terms of driver inattention and distraction are defined in different ways depending on how we look at the problem. Based on a conceptual analysis of common elements in different definitions of distraction, there is a need for a general definition, which would be: *Driver distraction is any diversion from the actions which are critical for safe driving toward competitive activities* [27].

3.3 The sources of distraction

Driver distraction can arise from a number of internal or external sources (in vehicle or outside the vehicle). In-vehicle distractions include eating, drinking, smoking, talking, beauty treatment, as well as the use of embedded multimedia entertainment systems [28, 29] (detailed in *Table 2*).

With the development of ICES emerge distraction factors known in traffic safety as progressive risk factors. This mainly refers to devices that are not integrated into the vehicle (except IVIS), nomadic devices such as MTD, smartphones, laptops, tablets, portable media devices, portable/handheld satellite navigation (PNA – Personal Navigation Assistant), smart watches, smart glasses, etc. [30]. Internal sources of distraction also include IVIS integrated systems that are being implemented in new vehicles and are another source of distraction factors among drivers.

External distractions occur when the driver focuses on the surrounding buildings, people, situations or billboards outside the vehicle instead on the road itself. Billboards, which are considered successful from the

Table 2 – Overview of the most common sources of in-vehicle distraction

	In-vehicle distraction
Technological sources	Managing the air conditioning
	Adjusting the music player
	Dialing a phone number or sending / receiving messages on mobile terminal devices
	Using mobile terminal devices
	Using the information and communication devices integrated into the vehicle (multimedia devices, navigation devices, devices for maintaining the vehicle speed, etc.)
	Using the information and communication devices brought into the vehicle (e.g. tablet, navigation system, etc.)
Non-technological sources	Smoking
	Food or drink consumption
	Retrieving and moving objects within the vehicle
	Talking with other people in vehicle
	Beauty treatments
	Daydreaming

marketing angle, are an exceptional threat in terms of driver behavior from the traffic safety angle because they are an irrefutable distraction factor [31].

3.4 Categories of distractions

With sources of distractions that can take different forms, there are categories of distraction factors that occur during vehicle operation. An overview of possible sources of distractions and categories is shown in *Table 3* [32].

These categories are bio-mechanical/physical distraction (e.g. manually adjusting radio volume), cognitive distraction (e.g. being lost in thoughts), visual distraction (not being aware of the road), and auditory distractions (responding to a call via MTD) [33]. In addition to leading to one or more distractions, listening to music or talking can change the mood or thought process and as such can affect driver's behavior.

4. DISTRACTION FACTORS DURING VEHICLE OPERATION

In modern vehicles, drivers can use a wide range of ICES-based devices. These devices can be specifically designed for transport, such as PNA units, or for more general use, such as smartphones. These modern devices can be integrated into a vehicle, such as IVIS, or heads-up display (HUD) devices that display information via the driver's windscreen. The presence of distractions caused by ICES in vehicles increases over the years.

4.1 Using mobile terminal devices

Research on the subject of the impact of MTDs on creating distractions while driving usually includes the topic of using cell phones for talking or messaging, the impact of using different input control units (physical keyboard, touch screen, voice control), as well as consequences of using smartphones to access information usually related to entertainment (real time online gaming), browse social networks (e.g. Facebook, Twitter), SMS or instant messaging (e.g. Viber, WhatsApp), etc.

Using MTDs while driving belongs to the four categories of driver distractions with serious disruptions for the end user. It has become common to think that using cell phones with accessories such as headsets (hands-free) has a smaller distraction effect than holding the device in one's hand (hand-held) during driving. Therefore, it is interesting to review the studies which compare such usage of MTDs, together with other forms of distraction factors. Burns et al. [34] tested twenty participants in a driving simulator, comparing their driving skills when using handheld and hands-free MTDs to their abilities while under the influence of alcohol. The results showed that driving ability was under the same threat either with or without a handset while communicating via MTDs. In addition, it is indicative that this type of distraction (talking on MTDs) in some situations had a more favorable impact on drivers' attention than when they were under the influence of alcohol [34].

Table 3 – Various sources and categories of distraction

			Traffic-related	Self-initiated distraction	Based on information and communications technology	Inside the vehicle	Category of distraction
Distraction factors during driving caused by the use of modern information and communication equipment and services	Talking and listening	Mobile terminal device	No	Yes	Yes	Yes	Auditory / Cognitive
		Passengers	No	Yes/No	Yes/No	Yes	Visual / Auditory / Cognitive
		Music	No	Yes	Yes	Yes	Auditory / Possible Cognitive
	Handling equipment and monitoring equipment	Messaging, dialing a phone number	No	Yes	Yes	Yes	Visual / Cognitive / Bio-mechanical
		Controlling multimedia devices	No	Yes	Yes	Yes	Visual / Cognitive / Bio-mechanical
		Entering a destination in the navigation application	Yes	Yes	Yes	Yes	Visual / Cognitive / Bio-mechanical
		Following navigation instructions	Yes	Yes	Yes	Yes	Visual / Auditory / Cognitive
		Responding to warnings	Yes	No	Yes	Yes/No	Visual / Auditory / Cognitive
Distraction factors during vehicle operation that are not dependent on technology	Other	Looking at billboards	No	No	No	No	Visual / Cognitive
		Eating, drinking, smoking, retrieving objects, beautifying	No	Yes	No	Yes	Visual / Bio-mechanical
		Snoozing, daydreaming	No	Yes/No	No	Yes/No	Cognitive

According to Crisler et al. [35], when comparing manual SMS messaging to talking via MTDs, the advantage of SMS communication is that the driver has more control and influence on the action compared to voice communication.

In particular, while driving in a simpler way, the driver can decide when and where to write an SMS while in voice conversations drivers often feel obligated to continue such actions, even though this may distract them from safe vehicle operation. However, many studies have proven that sending/receiving messages while driving reduces driving ability. Most often this type of research is aimed at young drivers. The results of such research have showed that the use of MTDs for SMS communication while driving (for example, with a handheld cell phone) results in poorer vehicle control and slower responses to stimuli from the traffic environment [36].

There are also indicative results for MTD use in SMS communication while driving, coming from a study in which twenty eight young people (aged 18–21) were required to do two runs per route in driving

simulator scenarios containing eight critical points for testing (scheduled events such as avoiding pedestrians, changing lanes according to traffic sign instructions, etc.). The results showed that, due to these distractions, drivers' attention to the road was quadruply reduced, they often failed to notice signs or change lanes, and generally had poorer vehicle control than drivers free of such distractions [36]. Similar results were obtained in a research simulator where young drivers used social networking applications through MTDs while driving [37]. Through an analysis [38] it was concluded that SMS communication while driving affects a wide range of driver actions needed to successfully manage vehicles.

In a study where different ways of messaging while driving were compared, the conclusion was that writing messages by using voice control and voice input text (speech-based texting, speech-to-text, text-to-speech) had smaller distraction effects on drivers' attention than manual input, but that such MTD use became a significant distraction factor [39].

Furthermore, comparing manual messaging while driving with using voice input in an IVIS integrated interface led to the conclusion that driving ability was declining in both distraction factors [40, 41].

In [12], distraction factors derived from classic (manual) and voice communication using an IVIS system (including an integrated phone, navigation system and audio system) as well as distraction-free driving were compared. The conclusion was that voice control through the IVIS system reduced drivers' distraction.

4.2 Using navigation systems

Of all the distraction factors caused by in-vehicle ICES use, navigation devices (especially the latest generation) have the least effects on driver distraction, as has been found through research. But the irrefutable fact is that these devices can be a source of distraction, including smartphones, which today often serve as nomadic navigation devices in vehicles. In [42], the focus was on measuring driver distraction when using a navigation device while maneuvering. Each subject passed the same route twice, once without using the navigation device and once while monitoring the navigation device. In order to examine all ways of receiving instructions from the navigation system that guides drivers through a route, instructions were issued in three different ways (randomly and without warning to subjects). The navigation system offered either only visual information, only verbal information, or visual and verbal information (participants would experience only one of these conditions). The main conclusion was that the drivers (in any of the tested conditions) were not distracted so much that the distractions would result in a reduced level of vehicle operation. However, among the three conditions, the maximum deviation in operating the vehicle was observed when receiving both verbal and visual information from the navigation system. Interestingly, verbal instructions caused virtually no distractions to the tested drivers.

Over a period of three months, various authors researched the effects of using navigation systems on the occurrence of driver distractions [43]. The study included nomadic and integrated navigation devices. Respondents (99 of them) drove for a month with a nomadic device, for a month with an integrated navigation system, and for a month without the use of such distractors. The results showed that the respondents would most commonly use and operate the devices in less stressful and demanding situations, otherwise, if necessary, they would adjust the speed of the vehicle and increase the distance between vehicles so those actions would not affect traffic safety. The study has shown, under real conditions, that the use of these modern technological solutions does not significantly affect the distraction factor levels [43].

4.3 Using IC multimedia systems

IVIS systems are becoming standard in modern vehicles [11, 44]. Such systems are becoming the IC center for providing relevant information about vehicle status and driving route (service information about the vehicle, the air conditioning control system, the navigation system management, driving safety systems, etc.), a multimedia entertainment center (music, videos, TV, etc.), and a TD providing communication services (telephone, SMS communication, web browsing, e-mailing, etc.) to the driver and passengers in the vehicle [11, 45]. The scope of IVIS systems is the least explored because the expansion of such systems is yet to happen, but there is a certain knowledge [40, 44].

When discussing entertainment while driving, this is mostly related to the consumption of music content through various nomadic or integrated devices in the vehicle. The effects of listening to music on driving skills depend on the type of music. Laboratory and simulated research shows that particularly noisy, high tempo and emotional music has an effect on driving ability and can be considered a distracting factor. Drivers who listen to this kind of music react more slowly and commit more traffic offenses than others [46]. Emotional music (happy or sad) influences drivers so as to reduce vehicle speed [47]. On the other hand, music can help drivers remain cautious, as shown by research [48]. In [49], the influence of music on drivers' mood and psychological state while driving was examined. It was found that the impact of music on the mood and psychological state when driving did not necessarily act as a distraction factor that impaired driving skills. In addition, this study shows that music can effectively calm drivers in demanding driving

situations, as well as that positive music can prevent the accumulation of anger in stressful and demanding traffic situations.

Research has shown that listening to in-vehicle music devices sometimes has a greater impact than distraction caused by MTD use. This was found by comparing the use of MTDs and music players while driving [50]. A similar survey showed that manipulating music players, changing media devices (compact discs), choosing tracks or changing radio stations were responsible for more accidents than usually shown on simulated routes [28].

The results of comparing the influence on the creation of driver distraction between (hands-free) MTD conversations and the use of an integrated IVIS system in the vehicle have shown that both actions may affect and impair driving ability. However, the same study concluded that manipulating the IVIS system in the vehicle reduces driving ability more often [50].

5. DRIVER DISTRACTION IN CROATIA

As shown in the preceding sections and analyzed according to the available literature, there are several sources and categories of distraction, but MTD use while driving is considered the most dangerous. This section provides an overview of these issues through the state in the Republic of Croatia (Croatia).

Research on driver distraction in Croatia is extremely rare, although some information is available [51, 52]. In the territory of Croatia MTD use while driving is prohibited, in accordance with the provisions of the Road Traffic Safety Act. Article 196, paragraph 3, of the Act reads: "While driving, the driver of the vehicle may not use a cell phone or other devices in a way that would minimize the possibility of reaction and safe driving" [53]. Paragraph 4 of the same Article provides: "A cell phone may be used while driving when using a device that allows the use of hands-free mobile devices". It is not clear from the cited text what are those "other" devices apart from "cell phones" which must not be used, and if such device allow hands-free use because it is not specified whether they are wireless, wired, or voice-operated, or even a hand-operated device. The provisions of this Act do not apply to vehicles of emergency services, emergency transport vehicles, fire service, civil defense, internal affairs and military police, as well as when special devices provide light or sound signals, in accordance with Article 149, paragraph 1 [53]. In Croatia, in accordance with the provisions of the Road Traffic Safety Act Article 196, paragraph 6, a fine is prescribed in the amount of 500 HRK (approx. 65 €) against drivers if they act contrary to the provisions of paragraph 3 of the same Article [53]. A review of legislation in other countries shows which countries have already introduced or are considering legislation and whether they have already banned the use of MTDs while driving. In most cases, the legislation prohibits the use of MTDs, but the ban does not apply to the handset or the MTD being on while driving [54].

According to the Croatia Road Safety Bulletin, a total of 32,571 road traffic accidents occurred in 2015 [55]. However, there is no clear indication of the exact number of accidents caused by the use of MTDs and the factors of their use which may affect the occurrence of traffic accidents. The primary problem is that it is difficult to subsequently identify MTD use as the main cause of traffic accidents. This is due to the specificities of determining the cause of a traffic accident, for example, from identification of participants to data acquisition from telecom operators. According to the data of the Ministry of the Interior, the number of offenses on an annual basis due to the use of MTDs while driving doubled between 2010 and 2014, from 19,850 to 40,425 [56]. According to the 2014 data [56], there was an increase in offenses due to MTD use while driving by 27.2%, compared to 2013 when there were 31,772 offenses. However, the latest data for 2015 indicate 38,988 committed MTD-related offenses, which is a 5.7% decline compared to 2014 [55].

According to the National Road Safety Program of the Republic of Croatia 2011–2020, the riskiest group in terms of MTD use are drivers involved in passenger and transit traffic, including truck drivers and bus drivers [57]. Along with "ordinary" drivers, these groups of professional drivers are increasingly becoming the subjects of research [58]. It is important to include taxi drivers as well, because they need to use MTDs in order to stay competitive on the market [59]. To reduce the number of traffic accidents, one of the possibilities is preventive action to raise drivers' awareness as well as knowledge about the negative impact of ICES on driver behavior while driving. This can be achieved by better provision of information about the harmful effects of the use of such devices in terms of driver distraction.

6. THE NEED FOR A MULTI-FACTOR MODEL

The impact of ICES on driver distraction has thus far been investigated in real and laboratory conditions. The subject of such research was usually the use of ICES, mostly MTDs, smartphones, PNA, integrated navigation devices, entertainment devices, IVIS, and so on. Research was conducted by measuring the probability and/or consequences of distraction of certain ICES in situations that are critical for road safety. Research in real terms in the current period has been relatively scarce. This is an area where there is certainly room for improvement, and it will surely in the future be the focus of the research community.

Most of recent studies have focused on the effects of individual distraction factors caused by using ICES on the driving abilities. This focused research has resulted in extensive understanding of the impact of distraction factors on drivers' abilities [60]. Such studies have also revealed that distracted driving is a phenomenon seen across age groups. Furthermore, the findings have revealed that middle-aged adults engaged in distracted driving behaviors just as frequently as young adults [61]. Preventive action is needed, but it would be necessary to develop a multi-factor model. In other words, this model would include a combination of distraction factors affecting the drivers' tendency to use MTDs while driving. Future studies are needed for better understanding of these relationships.

All things considered, there is a need for future research in which there would be an investigation of the real conditions regarding the level of drivers' motivation to use ICES. In this context, the term "motivation" means a stimulating factor (call, SMS, IM, e-mail, etc.) or an activity (a trigger for the use of services and applications) which encourages the use of ICES while driving a vehicle. The level of motivation can be quantified by conducting a questionnaire in which respondents on a scale of discrete values (0–100) express their motivation for the offered combination of incentive circumstances or activities. Thus obtained survey results would be possible to connect in some functional form and determine the individual scenarios by using ICES for motivation (e.g. using conjoint analysis) [62].

The aim would be to develop a multifactorial model to investigate the effect of distraction factors on the motivation to use ICES during vehicle operation.

Distraction factors affecting drivers' tendency to use MTDs while driving and driving ability decrease are in the cause and effect relationship. Even while aware the negative impact of ICES use during driving and legal measures that limit (to some extent) the use of such technology solutions, drivers deliberately expose themselves and other traffic participants to risk and harm. It is assumed that the results of this research would give an insight into which IC services drivers use, whether and what kind of TDs they actually use, and why do they use ICES although they are aware of the effects of distraction on their driving skills. This is important because most previous studies have shown that the use of ICES adversely affects driving ability, and it would enable preventive action to raise awareness of the problem and reduce ICES use while driving.

7. CONCLUSION

ICES have become a comprehensive part of everyday life and are integrated into all aspects of business and private life. One of the results of technological advances is the use of MTD and IC services during vehicle operation, which clearly implies many negative aspects, particularly the creation of distraction factors that influence driving safety. With all the positive aspects of using ICES and their almost constant personal accessibility and availability of relevant information to end users, it is difficult to change their habits and to act virtually only with repression methods. Educational campaigns are there to influence public awareness and enhance the understanding of the public about the negative impacts of driving distraction. In addition, their aim is to foster the increase of traffic safety, which is a huge part of the common goal of the professional and scientific communities with the unequivocal support of state institutions.

The use of MTDs in vehicles is a significant cause of driver distraction. It is one of the most common reasons for increased risk of accidents. The most prominent forms, which drivers can use to communicate while driving and which at the same time can cause distinct distractions are answering/making calls, sending/receiving SMS/IM, browsing social networks, and using vehicle navigation. Those are the negative aspects and dangers caused by the ICES use which are observed and studied from different points of view.

Different studies have shown that ICES use during vehicle operation results in creation of various sources of distraction. Based on the analysis of relevant studies, the need to quantify user motivation has been observed. This is because previous studies were focused on identification of individual distractions and affected by drivers' abilities rather than factors that influence ICES use while driving (e.g. calls, SMS, IM, social networks, etc.). All of these indicate the need for a multi-factor model that would include several individual distractions caused by ICES while driving, because today's circumstances require user multitasking. By doing so, an insight into the impact of individual distractions on driver motivation while using ICES can be obtained.

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UTJECAJ PRIMJENE SUVREMENE INFORMACIJSKO-KOMUNIKACIJSKE OPREME I USLUGA NA SIGURNOST UPRAVLJANJA VOZILOM

SAŽETAK

Razvojem i primjenom suvremene informacijsko-komunikacijske opreme i usluga globalno društvo je doživjelo značajan razvoj i napredak u svakodnevnom životu. Uz pozitivne, razvijali su se i negativni aspekti korištenja. Jadan od problema je pojava novih izvora odvraćanja pažnje vozača

(distrakcija) od upravljanja vozilom na nešto sasvim drugo, što u konačnici rezultira ozbiljnom, rastućom i svakodnevnom prijetnjom sigurnosti u prometu. Usporedno sa razvojem suvremene informacijsko-komunikacijske opreme i usluga povećava se i broj distraktora (mobilni terminalni uređaji, prijenosna računala, pametni satovi, i drugi) koji unošenjem u vozilo i korištenjem za vrijeme vožnje smanjuju razinu sigurnosti i utječu na kvalitetu upravljanja vozilom. Uz porast broja zastupljenosti i posjedovanja mobilnih terminalnih uređaja, kao i implementaciju suvremenih multimedijskih informacijsko-komunikacijskih sustava u vozila, ovaj problem će dodatno eskalirati u narednim godinama. Nepovoljan čimbenik proizlazi iz činjenice da distrakcijski faktori uvjetovani korištenjem suvremene informacijsko-komunikacijske opreme i usluga pripadaju u bio-mehaničke, kognitivne, slušne i vizualne kategorije distrakcija, čime se izravno utječe na funkcije čovjeka koje su najbitnije za uspješno i sigurno upravljanje vozilom. Ovaj rad daje uvid u problematiku distrakcijskih faktora koji utječu na vozača s naglaskom na one uzrokovane korištenjem suvremene informacijsko-komunikacijske opreme i usluga.

KLJUČNE RIJEČI

informacijsko-komunikacijska; oprema; usluge; mobilni terminalni uređaji; nomadski uređaji; sigurnost u prometu; distrakcija; vozači;

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