DIGITALIZATION AND ROAD SAFETY

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Summary: Digitization and technological innovations that offer numerous savings, especially labor savings, are beginning to be felt in the transport sector and in the field of road safety. There are numerous services that are digitized and that facilitate access to users, such as public transport timetables, purchase of digital tickets, travel information, taxi services, delivery of goods, etc. In these digitized services, the challenges in the field of traffic safety are not new, and the key issue is the implementation and replacement of personnel with digitized services. The digitalisation process in the transport sector offers enormous opportunities, through the deployment of Intelligent Transport Systems, the establishment of smart grids, the deployment of smart vehicles, smart infrastructure, automated road safety management, traffic flow management, the introduction of automated driving, etc. That is why the processes of digitization, automation, robotization and the use of artificial intelligence are the future in the field of road safety as well, in order to reduce the number of traffic accidents and the consequences in these accidents. Digital skills and knowledge will play a key role in the future impact on road safety. This will be a basic prerequisite for a greater impact on all future measures in the transport and road safety sectors. These processes will significantly influence the change in behavior of road users, in particular the use of smart systems, autonomous vehicles, road safety management systems and control systems.

Keywords: digitalization, road safety, technological innovation

1. INTRODUCTION

Road safety in the European Union (EU) has been greatly improved over the past decades, thanks to strong and effective action at EU, national and local level to improve the behavior of road users, vehicles and infrastructure. This is why roads in the EU are the safest roads in the world. Active safety features and their technological development result in gradual automation of vehicles. They are considered to be key technologies for improving and supporting vehicle automation, which contributes to the digitization of the internal market.

Therefore, it is a priority of the European Commission (EC) to promote the most effective innovation, the digitalisation of the internal market by fostering safety features that are considered key technologies to improve safety and support the widespread automation of vehicles.

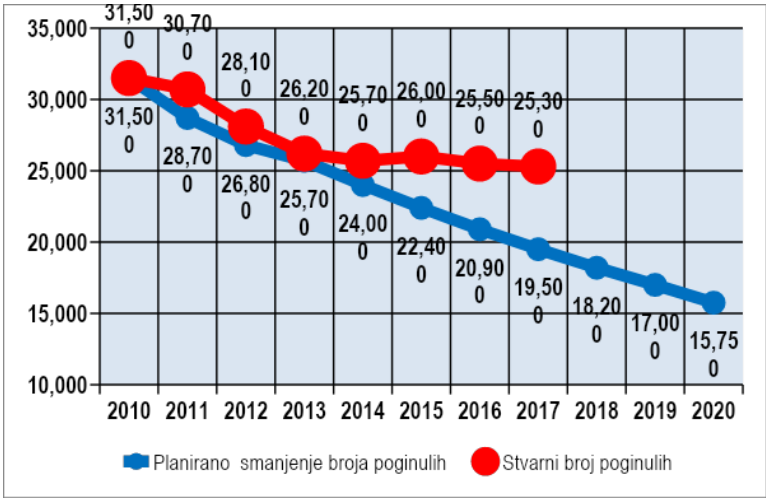
The application of technological innovations, and first and foremost digitalisation in transport, requires defining key questions about what needs to be done to define the necessary steps for digital transformation within a given timeframe. Success can be achieved in an environment that understands this process at all levels of

management and management, which are the drivers of digital initiative associated with corporate strategy. One of the prerequisites for success and understanding of the process is the education and training of the staff who initiate the initiatives and lead the processes of digitization.

In addition to the digitization process, it is necessary to revise regulations, simplify them and adapt them to new technological innovations and their application. The main problem is the contradiction in the application of regulations, and therefore raises the key question of how to solve it. Digital transformation involves the transformation of an organization based on the application of digital technology, thereby changing the business model of the organization using digital technologies. The start of the digital transformation process has been made possible by several digital technologies, such as: Cloud computing, Big Data, Social Networks, Mobile and Internet of Things. These technologies include robots, drones, artificial intelligence, 3D printing, etc. Changes in individual segments are already being felt, both in the market and in individual systems. Currently, the digital transformation of society is being carried out within and under the influence of Smart City, with a focus on digital processes that are rapidly affecting economic and social development and the development of mobility and transport security.
An example of rapid digital transformation in the transportation market and the massive deployment of a simple mobile app for shared transportation is the case of Uber start-ups. The existing and well-organized transport service system was quickly replaced by a new start-up system, which does not have any vehicles registered in its name. There are other companies whose emergence has been made possible by three new developments in the trend: the Internet and the development of high-speed networks, Big Data. connecting huge amounts of usable commercial, personal and geographic data through online platforms, and the emergence of new forms of mobile devices - mobile phones, tablets, etc.that give access to the mobile Internet at any time and place.

2. ROAD SAFETY INDICATORS

According to preliminary road safety statistics for 2017 published by the European Commission (EC), for the second consecutive year the number of road accidents fell by only 2%, after a similar decrease in 2016 and an increase of 1% in 2015. Regardless 500 people are killed per week on all EU roads (EU). Based on the analysis of the implementation of the Road Safety Program (4th Action Program)



2011-2020 so far. and the primary goal of reducing mortality by half by 2020, this goal is very unlikely to be achieved. The EU has reduced road deaths by 20% by 2017, but it is well below the 38% required to stay on track to reach the 2020 target.

2.1. Road safety indicators in the European Union

European roads remain the safest in the world, in 2017 the EU had 49 deaths per million people, against 174 deaths per million globally. According to the World Health Organization [1], about 1.3 million people are killed each year on the world's

roads, of which 25,300 lost their lives in the EU last year. According to published statistics on road safety in the EU, progress has been made in 2017, but further action is needed to further advance, in order to achieve the basic objective of reducing the number of deaths by half by 2020. Last year, EU roads were killed. 25 300 persons [2], which is 300 less than in 2016, which is a decrease of 2% and 6 200 less than in 2010, which is a decrease of 20%, Figure 1.

Despite these positive developments, it will be difficult to achieve the stated goal of halving road deaths from 2011 to 2020. In addition, an estimated 135,000 more were seriously injured last year, including a large number of unprotected road users: pedestrians, cyclists and motorcyclists. In addition to casualties, fatalities and injuries in traffic accidents also affect society as a whole. Their average socioeconomic cost is € 120 billion a year. This means that all stakeholders must do more to make Europe's roads safer. National and local authorities are taking most of the day-to-day measures such as enforcement and awareness raising, and the Commission is currently working on a series of concrete measures to encourage even further progress.

Figure 1. Planned and actual death toll on EU roads 2011-2020.
Source: Data processing by authors [1]

With an average of 49 road deaths per one million inhabitants, European roads in 2017 were still arguably the safest in the world. The lowest deaths per hundred thousand people in the EU in 2017 were reported by Sweden (2.5), United Kingdom (2.7), the Netherlands (3.1) and Denmark (3.2), respectively, per million inhabitants of Sweden (25), the United Kingdom (27), the Netherlands (31) and Denmark (32). In comparison with 2016, Estonia and Slovenia recorded the largest decreases in the number of deaths: by 32% Estonia and by 20% Slovenia. In addition, the efficiency gap between Member States in 2017 narrowed further and only two Member States reported deaths in excess of 8 deaths per hundred thousand inhabitants, Romania (9.8) and Bulgaria (9.6).

In relation to the type of road, only 8% of people died on the highways, as opposed to 55% on roads outside the settlement and 37% on roads in the settlement. According to the structure of traffic participants, 46% of motor vehicle drivers, 8% of passengers and almost half of unprotected participants were killed (21% of pedestrians, 14% of motorcyclists, 8% of motorcyclists and 3% of mopedists). More than 4,500 (4,554) young people die each year in the EU in road accidents. Almost 14% of people between the ages of 18 and 24 have died on EU roads, accounting for only 8% of the population. Due to demographic change in European societies, the death rate of the elderly is steadily increasing, 22% in 2010 and 27% in 2017.

As a follow-up to the Ministerial Declaration on Road Safety of March 2017, the EC is currently working on a new road safety framework for the period 2020-2030 and on a number of concrete measures in this area. The goal is to better respond to new challenges by focusing on closer collaboration between all factors of traffic safety, better monitoring of goal achievement and targeted financing. This new policy framework will be accompanied by a series of concrete measures contributing to safer roads and with strong

EU added value. Activities under consideration include:

- vehicle safety: take into account the latest technological developments such as driver assistance systems to avoid accidents and better protect pedestrians and cyclists,
- infrastructure security management: increasing transparency of operations and working at an equal level of road infrastructure security,
- cooperative, connected and autonomous mobility: a guarantee of a safe transition to these technologies, which offer the potential to reduce driver errors (responsible for about 90% of accidents) but also create new challenges, such as safe interaction with other road users.

Thus, this framework includes a revision of European regulations on vehicle safety and road infrastructure safety management and an initiative to secure the transition to cooperative, integrated and autonomous mobility.

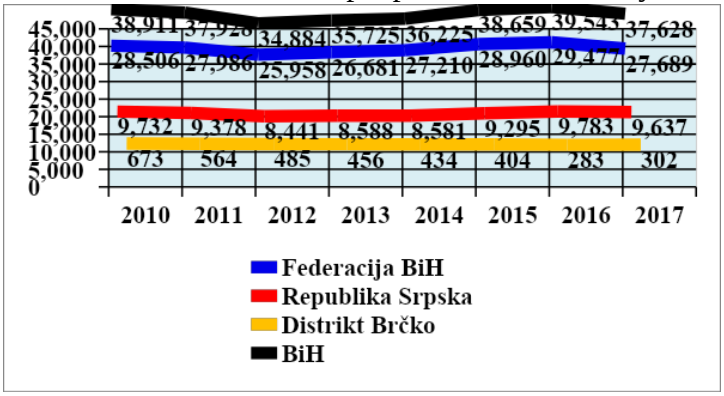
2.2. Road Traffic Safety Indicators in Bosnia and Herzegovina

According to the statistics collected from the competent institutions (FMUP, RS MoI, Brčko District MoI, Cantonal MoI), a total of 37 628 traffic accidents occurred in BiH roads in 2017, down 4.8% from 2016 , Figure 2.

Figure 2. Overview of the number of road accidents on BiH roads from 2010 to 2017
Source: Data processing by authors [3]

Of these, 7,135 accidents were recorded with deaths, down 7.5%. In these accidents, 298 people were killed, 23 less, which is 7.1% less than in 2016.

According to the data in Figure 3, there is a trend of a further decrease in the number of deaths. There were an average of 103 accidents per day in the territory of BiH, and about 720 accidents a week, with one person being killed almost daily. In addition, 10,229 people were seriously



injured or slightly injured last year, including a significant number of unprotected road users, pedestrians, cyclists and motorcyclists.

According to the available data [3], the largest number of traffic accidents in the Federation of BiH in 2017 occurred in the Sarajevo Canton, with a share of about 37.4%, followed by the Zenica-Doboj Canton with a share of about 15.3%, Central Bosnia canton with a share of 11.8%, Una-Sana canton with a share of about 10.9%, etc. Viewed from the perspective of the total number of traffic accidents by entity, it is noticeable that the mortality rate is lower in the Federation of BiH and amounts to slightly more than 6 deaths per hundred thousand inhabitants, while in the Republic Srpska it is significantly higher and amounts to more than 11 deaths per hundred thousand inhabitants. In Brcko District, there has been a significant deterioration and the mortality rate is just over 36 deaths per hundred thousand inhabitants. Analyzing data by cantons, an increase in the number of fatalities in traffic accidents occurred in the Central Bosnia, Herzegovina-Neretva, Bosnia-Podrinje and Tuzla Cantons, while in other cantons there was a significant decrease in the number of fatalities in road accidents.

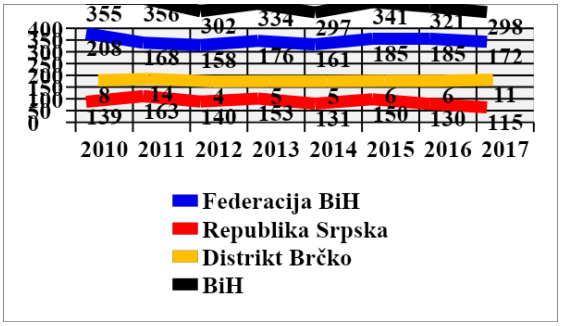


Figure 3. View of death toll on BiH roads 2010-2017.
Source: Data processing by authors [3]

Despite these positive developments, it will be difficult to achieve the set goal in BiH of halving road deaths from 2011 to 2020 (planned 177 deaths), Figure 4.

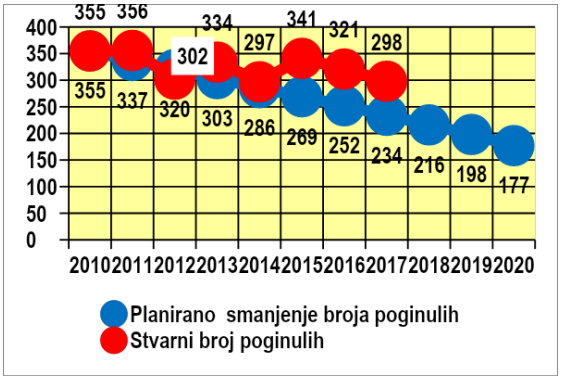


Figure 4. Planned and actual death toll on BiH roads 2011-2020.
Source: Data processing by authors [3]

With an average of 8 deaths per hundred thousand inhabitants in 2017, BiH has a much poorer security situation compared to the EU, which had 4.9 deaths per hundred thousand inhabitants, or 80 deaths compared to 49 deaths per million inhabitants. It belongs to the European Member States with the worst road safety situation.

In general, this state of road safety and the number of traffic accidents, among other things, is the result of non-compliance with traffic rules and regulations, as well as the low level of traffic culture of a large number of road users. Improper speed and unadjusted road conditions are one of the most common causes of traffic accidents (about 32.7%), followed by accidents resulting from vehicle traffic, followed by alcohol and opiate driving accidents, and other causes they include disregard for traffic signs, adverse road conditions, etc. Among the mistakes made by drivers in urban traffic conditions are the lack of distance between vehicles. The highest number of traffic accidents was recorded in the settlement / city (42.1%), on highways (22.4%), on local roads (9.0%), on regional roads (7.1%), etc.

Considering the above statistical indicators, it can be concluded that with the decrease in the number of traffic accidents, there was a decrease in the consequences, that is, a decrease in the number of casualties by 7.2% compared to 2016 severely injured by 10.6% as well as slightly injured by 8.2 %. However, looking at and analyzing these indicators in the context of achieving the primary objective by 2020, despite the fact that the number of traffic accidents and the number of deaths in those accidents occurred last year, it can be reasonably concluded that the state of road traffic remains unsatisfactory.

3. THE IMPACT OF DIGITALIZATION ON ROAD SAFETY

The world economy is rapidly digitizing. Information and communication technologies are no longer a separate sector, but the cornerstone of all modern innovative economic systems. The Internet and digital technologies are changing our way of life and work, at the individual level and in businesses and communities, as they increasingly penetrate all sectors of our economy and society. These changes happen quickly and on a large scale, and they bring many opportunities for innovation, growth and employment. Given the inability to address such issues at national level, a number of issues would be more appropriate to address at European

level. That is why the EC has identified the creation of a digital single market as one of its key priorities. The creation of a digital single market will ensure that the EU maintains a leading position in the world in the digital economy, which will help European businesses to grow globally. It has the capabilities to play a leading role in the global digital economy, but is not fully utilizing them at the moment. Fragments and obstacles that do not exist in the physical single market are slowing down EU progress. Removing these barriers in Europe could add up to an additional EUR 415 billion[3] to European GDP. The digital economy can expand markets and provide better services at better prices, offer more choices and create new sources of employment. A unique digital marketplace can create opportunities for start-ups, allowing existing businesses to grow and enjoy the benefits of the market of more than 500 million people [4].

The Digital Single Market Strategy [4] is based on these three pillars:

better access for users and businesses to goods and services on the Internet across Europe - this calls for the urgent removal of key differences between the online and offline environments in order to remove obstacles to cross-border online activities;

creating the right conditions for the flourishing of digital networks and services - this requires fast, secure and reliable infrastructure and content services, as well as appropriate regulatory conditions for innovation, investment, fair competition and a level playing field;

harnessing the full growth potential of the European digital economy - this requires investment in infrastructure and information and communication technologies, as well as better public services, inclusiveness and skills.

3.1. Digital competence and skills

In less than ten years, most economic activity will depend on digital ecosystems, integration of digital infrastructure, computer equipment and programs, applications and data. In order to maintain competitiveness, maintain a strong industrial base and make the transition to a smart manufacturing and services economy, the EU will need to implement digitization in all sectors. Although 75% of the value added of the digital economy comes from traditional industries, not manufacturers in the field of information and communication technologies, the integration of digital technology in enterprises is the weakest point in the process. Only 1.7% of EU businesses make full use of advanced digital technologies, while 41% do not use these technologies at all [4]. Digitization also offers incredible opportunities to other sectors of the economy, such as transport, such as the deployment of Intelligent Transport Systems and Energy, such as smart grids, smart metering, etc. Consequently, it is entirely necessary to implement measures to ensure that the economy has a leading position in the development and exploitation of new technologies, automation, robotics, sustainable production and adequate artificial intelligence for the markets of the future. In addition, the digital economy can make society more inclusive. Citizens and businesses still do not enjoy all the benefits of digital services, from eGovernment and eHealth to e-energy and e-traffic, which should be easily accessible throughout the EU.

Digital skills and knowledge will play a key role in the future impact on road safety. For a better quality impact of digitalisation and a greater impact on all future measures in

[3] The information is set out in a Commission staff working document A Digital Single Market Strategy for Europe - Analysis and Evidence "[SWD (2015) 100]. The document also provides more details on the type of challenges outlined and the evidence supporting the strategy.

the transport and road safety sectors, a basic prerequisite is to raise the level of digital competence of staff and labor. Changes are necessary to adapt the education and training system to the ongoing digital revolution. The EC has made this a priority. "Demand for digital skills workers is growing by about 4% annually. The shortage of ICT professionals in the EU could reach 825,000 workers by 2020 unless decisive action is taken. "(European Commission 2015).

3.2. Challenges and impact of digitalisation on driving safety

In order to emphasize the complexity and comprehensiveness of the digitalization process, it is important to highlight the impact of particular issues such as: connectivity, open systems, competences and skills, networks, data sharing and collaboration, integration of industries and services through intelligent factories, energy systems, mobility, transport and smart cities; automation, robotics, artificial intelligence, learning machines; innovative services, booming mobile applications to better meet needs; a jobless future; the emergence of large databases; protection of personal data; job cuts and computerization; digital management and process control.

Innovative digitalization technologies and processes are increasingly influencing road safety and future improvements, especially in the areas of active vehicle safety and automated and networked driving. Experts say that approximately 95% of road accidents involve some level of human error, while an estimated 75% of accidents are caused solely by human error. Greater attention should also be paid to the increased use of technologies that use driver-vehicle, vehicle-driver (ITS) interactions, contributing to developments in the digital field in line with the Digital Single Market Strategy. Improving the vehicle's minimum safety standards is one of the most effective ways to reduce mortality and serious road injuries. The application of these proposed technologies can necessarily have a major impact on security, such as artificial intelligence, computers that operate cars, Figure 5, etc. For example, the prevailing technology that helps drivers maintain their current driving speed is intelligent speed assistance, which is already offered for sale.

Figure 5. Artificial intelligence and computers drive cars in the future [5]

E-learning is becoming increasingly interesting and popular for road safety education. It could potentially complement education, especially when it comes to learning about the risks (fatigue, inattention, alcohol, etc.). Intelligent vehicle systems are designed to alert the driver and include the functions of collision warning, off-roading, vehicle re-routing, pedestrian detection and more. If the driver responds improperly to light or sound alerts, systems can take control of the vehicle's control. Intelligent vehicle solutions include automatic vehicle control, keeping a safe distance, and the electronic management of buses and trucks by special traffic lanes. According to research, the most effective new technologies in the area of active vehicle safety that can be avoided by road accidents can contribute to a significant improvement, especially IntelligentSpeedAssistance-ISA, Autonomous Emergency Braking-AEB, emergency alert Lane Departure Warning (LDW / LCA), driver vigilance and distraction monitoring system, and Alcohol

Interlocks, engine lockdown devices if the driver is under the influence of alcohol.
In the area of passive safety, as a measure to mitigate the effects of road accidents, a seat belt reminder system on all seats, as well as improving pedestrian injuries in the event of a head-on-front impact, and detection of cyclists in the event of an immediate collision, which are feasible as required technologies and already available on the market with effective conditions of use. Other areas of great interest relate to improving direct visibility and removing blind spots on trucks to protect unprotected road users.

4. CONCLUSION

The process of digitalisation and the use of technological innovations in the field of road safety are becoming increasingly prominent. The purpose is to enable simplicity, speed, time, energy and safety. The issue of road safety in the context of the implementation of digitalisation and smart devices plays a key role in the future.
Digital transformation, driving and process automation, robotics and artificial intelligence can all be greatly improved in road safety. The purpose is to enable the driver to drive safely, as well as to perform certain tasks and processes instead of the driver. Therefore, in the future, these processes and technological innovations will play a crucial role in the context of improving road safety. The Internet and digital technologies are changing the way we live and work at all levels. Therefore, creating a single digital market is one of the key priorities.
Digital skills, competencies and knowledge will play a key role in the future impact on road safety. For the better quality impact of digitalization, because changes are necessary, raising the level of digital competence of personnel and workforce is a priority of management.

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CROWD PARTICIPATION IN URBAN DECISION MAKING AND PLANNING: AN EXTENSIVE URBAN CROWDSOURCING LITERATURE REVIEW

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Summary: Urban crowdsourcing has been gaining attention from research communities due to its presumed capability of enabling citizens to be city *prosumers* of data, opinions, and ideas about their city (Lea & Blackstock, 2014). Recently, several urban crowdsourcing investigations and various experiments have been conducted with a view to engaging citizens in order to produce information about their cities and their communities. This article reports on a research based on a systematic analysis of the literature on "urban crowdsourcing" conducted by the authors. Following the general guidelines of the systematic literature review method (Moher et al., 2009), we analysed the current literature available online, searching for combinations of keywords on ISI listed proceedings as well as on databases of leading world publishers. We also used Google scholar to evaluate the popularity of articles, taking account of their citations. The process of identifying and reviewing the literature was conducted in two phases, from September 2017 to February 2018. From our research emerges the potential benefits of crowdsourcing, especially for urban decision making and planning. However, a few of concerns related to crowdsourcing processes have been raised: difficulties in involving people; risks for privacy; quality and accuracy of information gathered.

Keywords: urban crowdsourcing, urban livability, citizen participation, city prosumers