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Editorial

This issue of the Journal of Criminal Justice and Security consists of six quite diverse analyses of important aspects of the criminal justice field. In-depth studies in the areas of information and cyber security, private security, road safety, school violence and nuclear security are presented.

Damjan Fujs and Simon L. R. Vrhovec in the first paper ***Cyber Landscape of Trust, Fear and Surveillance Concerns: How Slovenians Around the Globe Perceive the Cyberspace*** present results of the survey conducted to capture the perceptions of Slovenians around the globe regarding trust in government, fear of government intrusions into privacy and government surveillance concerns in the cyberspace. The average trust in government seems to be relatively low. It appears that respondents moderately fear government intrusions into their social network accounts.

Limiting Privacy by Using Smart Meters – Information Security Perspectives is the next paper by Uroš Jelenc and Blaž Markelj, where authors present the key features of smart energy meters and analyse how they interfere with user privacy. Collected information can be used to identify devices, identify the presence or absence of individuals in apartments, their habits and activities. According to the survey results, the awareness of privacy risks among respondents using smart energy meters is low.

Lavra Horvat, Matevž Bren and Andrej Sotlar in the paper ***Ljubljana Residents' Knowledge of and Satisfaction with Private Security Guards' Work*** present how residents of the capital of Slovenia know, understand and evaluate the work of private security guards. Respondents assess private security guards' work as stressful and dangerous, however, they believe that security guards lack education and professionalism. Nevertheless, Ljubljana residents are satisfied with the work performed by private security guards; the level of satisfaction depends on their trust in security guards' work, the help and assistance provided by security guards, security guards' attitude towards residents and residents' experience with security guards' work.

Residents' Views on Cyclist Safety and Cycling Infrastructure in the City Municipality of Celje were analysed by Nastja Vodeb and Kaja Prislan. Authors present the results of two research studies analysing the views of different target populations on cyclist safety and the adequacy of preventive measures. Results show that respondents are generally unsatisfied with cyclist safety, as most believe that municipal efforts to ensure it are insufficient. It was observed that cycling infrastructure needs to be properly regulated and that a positive traffic culture should be promoted at the municipal level, including through the promotion of preventive activities.

In the penultimate article Marko Prpić analyses the ***Students' Violence Against Teachers in Relation to School Climate.*** The aim of his study was to analyse the correlation between experiencing violent behaviour of students directed at teachers and school climate, measured through four dimensions: nature of the teacher-student relationship, nature of the relationship among students, extent to which students have decision-making autonomy, and clarity, consistency

and fairness in school rules. The results indicate that there is a difference in the perception of three out of four dimensions of school climate between the students who have experience with violent behaviour directed at teachers and those students who do not have such experience.

The last paper in this issue was written by Saša Kuhar, Igor Sirc and Metka Tomažič. The paper ***Ensuring Nuclear and Radiation Safety in the Republic of Slovenia*** presents the nuclear and radiation safety in Slovenia, operations of the Slovenian regulatory body, the Slovenian Nuclear Safety Administration (SNSA), and its Emergency Response Team. SNSA employees conduct expert, administrative, control and development tasks in the field of nuclear and radiation safety. An essential part of ensuring nuclear and radiation safety is emergency preparedness though regular trainings, monthly checks of communication channels and equipment, preparation of procedures, development of tools and exercise participation.

The editorial board at the Journal of Criminal Justice and Security trusts you find the articles worth reading and a good source of new ideas for both your future research and hopefully new papers. Last but not least, editorial members wish all readers a beautiful and successful 2020.

Prof. Branko Lobnikar, PhD
Editor of English Issues

Uvodnik

Zadnja letošnja številka revije Varstvoslovje prinaša v branje šest raznovrstnih znanstvenih razprav s področja informacijske in kibernetske varnosti, zasebnega varovanja, varnosti v cestnem prometu, nasilja v šolah ter zagotavljanja jedrske varnosti.

Damjan Fujs in Simon L. R. Vrhovec v članku ***Cyber Landscape of Trust, Fear and Surveillance Concerns: How Slovenians Around the Globe Perceive the Cyberspace*** predstavljata rezultate raziskave o zaznavah Slovencev po svetu glede zaupanja v vlado, stopnji strahu pred vladnimi vdori v njihovo zasebnost in glede vladnega nadzora v kibernetskem prostoru. Ugotovila sta, da je v povezavi z analiziranimi vsebinami zaupanje anketirancev v vlade posameznih držav razmeroma nizko.

Uroš Jelenc in Blaž Markelj v članku ***Limiting Privacy by Using Smart Meters – Information Security Perspectives*** predstavljata ključne značilnosti delovanja pametnih merilnikov energije z vidika možnega posega v zasebnost uporabnikov. Ugotovila sta, da se lahko zbrani podatki s pomočjo pametnih merilnikov uporabijo za prepoznavanje naprav, prisotnosti ali odsotnosti posameznikov v stanovanjih, za analizo njihovih navad in aktivnosti. Glede na rezultate raziskave je ozaveščenost o tveganjih z vidika posega v zasebnost med anketiranci, ki uporabljajo pametne števce energije, nizka.

Lavra Horvat, Matevž Bren in Andrej Sotlar v članku ***Ljubljana Residents' Knowledge of and Satisfaction with Private Security Guards' Work*** predstavljajo ugotovitve raziskave, kako prebivalci slovenskega glavnega mesta poznajo, razumejo in ocenjujejo delo zasebnih varnostnikov. Anketiranci ocenjujejo delo zasebnih varnostnikov kot stresno in nevarno, vendar menijo, da varnostniki nimajo primerne izobrazbe in niso dovolj strokovni. Kljub temu so Ljubljančani zadovoljni z delom varnostnikov; stopnja zadovoljstva je odvisna od njihovega zaupanja v njihovo delo, pomoči, ki jim jo nudijo varnostniki, njihovega odnosa do prebivalcev in izkušenj prebivalcev z delom varnostnikov.

Nastja Vodeb in Kaja Prislan v članku ***Residents' Views on Cyclist Safety and Cycling Infrastructure in the City Municipality of Celje*** predstavljata ugotovitve dveh študij o zagotavljanju varnosti kolesarjev. Rezultati njunih študij kažejo, da anketiranci na splošno niso zadovoljni z varnostjo kolesarjev, saj večina meni, da prizadevanja občinske uprave na tem področju niso zadostna. Ugotovljeno je bilo, da je treba ustrezno urediti kolesarsko infrastrukturo in spodbujati pozitivno prometno kulturo na občinski ravni, tudi s spodbujanjem različnih preventivnih dejavnosti.

V predzadnjem članku ***Students' Violence against Teachers in Relation to School Climate*** Marko Prpić analizira povezave med nasilnim vedenjem učencev do učiteljev in šolsko klimo, merjeno s pomočjo štirih dejavnikov: odnosa učitelj-učenec, odnosa med učenci, stopnje avtonomnosti odločanja in jasnost, doslednost ter pravičnost šolskih pravil. Rezultati kažejo, da obstajajo razlike v dojemanju treh od štirih dejavnikov šolske klime med učenci, ki imajo izkušnje z nasilnim vedenjem do učiteljev, in tistimi, ki takšnih izkušenj nimajo.

Zadnji članek v tej številki je delo Saše Kuhar, Igorja Sirca in Metke Tomažič. V članku ***Ensuring Nuclear and Radiation Safety in the Republic of Slovenia*** so predstavljeni ukrepi za zagotavljanje jedrske in radiološke varnosti v Sloveniji skozi prizmo delovanja Uprave Republike Slovenije za jedrsko varnost ter Skupine za obvladovanje izrednega dogodka. Zagotavljanje varnosti na jedrskem in radiološkem področju je ena od nalog Uprave Republike Slovenije za jedrsko varnost. Bistven del zagotavljanja jedrske in radiološke varnosti je pripravljenost na izredne dogodke. Avtorji poročajo, da je v Sloveniji dobro poskrbljeno za zagotavljanje pripravljenosti in odziva ob morebitnem jedrskem ali radiološkem izrednem dogodku, kar je 2017 potrdila tudi mednarodna pregledovalna misija za to področje.

V uredništvu upamo, da boste med predstavljenimi članki našli kakšnega, ki bo dober vir informacij in inspiracija za vaše prihodnje raziskave in, upajmo, tudi nove članke. Na koncu pa člani uredništva vsem bralcem želimo lepo in uspešno leto 2020.

Prof. dr. Branko Lobnikar
Urednik številk v angleškem jeziku

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Cyber Landscape of Trust, Fear and Surveillance Concerns: How Slovenians Around the Globe Perceive the Cyberspace

Damjan Fujs, Simon L. R. Vrhovec

Purpose:

The purpose of this paper is to study the differences between countries regarding their residents' trust in government, fear of government intrusions into their privacy and government surveillance concerns in the cyberspace.

Design/Methods/Approach:

A survey has been conducted to capture the perceptions of Slovenians around the globe. Respondents from 58 countries were reached ($n = 629$) although the results were reported only for countries with at least three respondents. Descriptive statistics were used to describe the sample and measured variables. Graphic illustrations made with MapChart are used to visualize the results.

Findings:

The findings of our study show that perceptions of trust in government, fear of government intrusions into the privacy of country residents and government surveillance concerns vary from country to country. Countries are ranked according to these three criteria. The average trust in government seems to be relatively low. It appears that respondents moderately fear government intrusions into their social network accounts and seem to be concerned about government surveillance over their online activities.

Research Limitations/Implications:

The research contributes to an understanding of the perceptions of Slovenians around the world of trust in government, fear of government intrusions and government surveillance concerns. Although a limited number of countries was reached, the results present some interesting insights into different regions of the world. The study targeted the population of Slovenians around the world thus the readers should be extremely cautious when trying to generalize the results, also due to snowball sampling employed.

Originality/Value:

This paper presents one of the first studies on perceptions of Slovenians around the world regarding their trust in the government of the country of their residence, fear of government intrusions into their privacy and their government surveillance concerns.

UDC: 342.7:004.738.5

Keywords: cyber space, Slovenians abroad, migrant, emigrant, immigrant, expatriate, wiretap, supervision

Kibernetska pokrajina zaupanja, strahu in skrbi glede nadzora: kako Slovenci po svetu dojemajo kibernetski prostor

Namen prispevka:

Namen prispevka je analizirati ključne razlike med državami glede zaupanja v vlado njihovih prebivalcev, njihovega strahu pred vdori države v zasebnost prebivalcev in njihovimi skrbmi zaradi državnega nadzora v kibernetskem prostoru.

Metode:

Da bi zajeli dojemanja Slovencev po svetu, je bila izvedena anketa. Doseženi so bili anketiranci iz 58 držav (n = 629), čeprav so rezultati poročani le za države z vsaj tremi anketiranci. Za opis vzorca in merjenih spremenljivk je bila uporabljena opisna statistika. Grafične ilustracije, narejene s programom MapChart, so bile uporabljene za vizualizacijo rezultatov.

Ugotovitve:

Rezultati raziskave nakazujejo na to, da se dojemanja zaupanja v vlado, strahu pred vdori države v zasebnost njenih prebivalcev in skrbi zaradi državnega nadzora v kibernetskem prostoru od države do države razlikujejo. Države so razvrščene v skupine glede na te tri kriterije. Povprečno zaupanje v vlado se zdi relativno nizko. Zdi se, da se anketiranci srednje močno bojijo vdorov države v njihove račune na družbenih omrežjih in da so zaskrbljeni glede nadzora nad njihovimi aktivnostmi na spletu.

Omejitve/uporabnost raziskave:

Doprinos raziskave je uvid v dojemanje Slovencev po svetu glede zaupanja v vlado, strahu pred vladnim vdorom in strahu pred nadzorom vlade v državi, v kateri živijo. Čeprav smo dosegli omejeno število držav, predstavljajo rezultati nekaj zanimivih vpogledov v različne regije sveta. Študija se je osredotočila na populacijo Slovencev po svetu, zato morajo biti bralci izjemno previdni pri posploševanju rezultatov, tudi zaradi uporabljene metode snežne kepe.

Izvirnost/pomembnost prispevka:

Prispevek predstavlja eno prvih študij dojemanj Slovencev po svetu glede njihovega zaupanja v vlado države, v kateri prebivajo, njihovega strahu pred vdori države v zasebnost njenih prebivalcev in njihove zaskrbljenost zaradi državnega nadzora v kibernetskem prostoru.

UDK: 342.7:004.738.5

Ključne besede: kibernetski prostor, Slovenci po svetu, migrant, emigrant, imigrant, izseljenci, prisluškovanje, nadzor

1 INTRODUCTION

The cyberspace and its services, such as social networks, are connecting people with similar interests and opinions while removing the borders of the physical world thus providing a global place that offers a diverse set of opinions (Bakshy, Messing, & Adamic, 2015). Several cyberspace actors may be active in the cyberspace. For example, some countries may try to use (or misuse) social networks for political and surveillance purposes, for reasons that are either legitimate or not (Stoycheff, 2016). When talking about surveillance in the cyberspace, it may be necessary to distinguish between harmful and harmless surveillance (Trottier, 2011). Harmless surveillance is not inherently harmful to the one being under surveillance and can be performed daily (e.g., checking what someone's friends are doing, commercial surveillance, etc.). However, some authors posit that there is no entirely harmless surveillance (Macnish, 2018). Therefore, it may be better to consider the distinction between those cases that have ethically justifiable reasons for exercising surveillance and those that do not (Huey, 2014; Palm, 2014). Monitoring of cyberspace activities without someone's explicit consent may be against the his or her wishes as it would compromise his or her privacy either way (Humphreys, 2011). Nevertheless, several high-profile examples of state surveillance over citizens surfaced in the past, such as the Snowden disclosures (Johnson, 2017), Iran (Morrison, 2015), Japan (Abe, 2004), China (Wang & Hong, 2010) and various other cases trying to justify surveillance after the 9/11 terrorist attacks on the United States (Michelman, 2009). Surveillance may be done by both, intelligence services which are in the domain of the state and private companies as a form of privatized intelligence (Bures & Carrapico, 2017; Helgesson, 2011).

Trust in the benevolence of cyberspace actors and fear of their surveillance of cyberspace users' online activities may be sensitive factors for cyberspace users that may affect their experience in the cyberspace. Is it possible to trust cyberspace actors that they are working in the best interest of cyberspace users (e.g., tackling terrorism, providing relevant ads) or are they working in their own interests (e.g., tackling political dissent, selling cyberspace users' data for own profits)? Similarly, do cyberspace users fear cyberspace actors and their actions, such as surveillance of their everyday online activities, which may be happening on a large scale according to publicly disclosed information? Social networks may be considered as a honeypot for monitoring and acquiring data given the immense amount of data and their ever-increasing number of users. For example, users post a lot of their personal information, political beliefs and other intimate beliefs on these pages (Semitsu, 2011) which may not be publicly disclosed still present on social networks (e.g., marked as private or posted "only for me"). Currently, social networks play an important role in the political cyber ecosystem as well as a tool for communication and expression of opinion for many politicians, ministers, presidents, activists and others (Zeitzoff, 2017). However, some expressed opinions, such as calls for protests, hate speech and incitement to violence, cannot be considered as positive. Let's highlight just some cases of leveraging social networks for political purposes: Kashmir jihadist recruitment (Kaura, 2017); protest movements in Libya, manipulating public opinion in Russia and Syria, and

paid online commenters in China (Zeitzoff, 2017); protests in Hong Kong (Chan, 2016); Gezi protests in Turkey (Haciyakupoglu & Zhang, 2015); protests in Spain (Hermida & Hernández-Santaolalla, 2018); etc. All these and similar cases may give countries convincing ethical reasons to exercise surveillance over cyberspace users in order to draw up tactics of fighting against protesters and to provide greater security (Zeitzoff, 2017).

In this paper, we focus on the perceptions of cyberspace users regarding the governments of their residing country. Namely, we focus on their trust in government, their fear of government intrusions into the privacy of country residents and their surveillance concerns. In our study, we try to answer our research question:

RQ: Are there differences between countries regarding the perceptions of their residents about trust in government, fear of government intrusions into their privacy and government surveillance concerns?

The aim of this study is to gain an insight into the studied topic, provide possible answers to our research question, and complement existing research on secure and privacy-preserving behavior in the cyberspace (Fujs, Mihelič, & Vrhovec, 2019; Fujs, Vrhovec, & Mihelič, 2018). To achieve this, we developed a research framework and empirically tested it using a survey. We chose the population of Slovenians around the world because they created a new life abroad, were able to adapt well to new living conditions (Celec, 2019; Kuzmič, 2001), and especially because they use information-communication technology in the cyberspace as a tool to communicate with those who are not spatially close to them (Milharčič Hladnik, 2008). To conform to the widely accepted definition of Slovenians around the world, the study includes immigrants, namely people who are working abroad but return to Slovenia daily.

The rest of the paper is organized as follows. In Section 2, we describe the research methods used. In Section 3, we present the main results of our study. Finally, we discuss the results in Section 4 and present some concluding remarks in Section 5.

2 METHOD

We conducted an online survey among Slovenians around the world. The survey was advertised via private contacts and business contacts of researchers, through mailing lists and groups on social platforms, such as Facebook. Snowball sampling (i.e., respondents were asked to further advertise the survey among their peers) was employed to maximize the reach of the survey. Due to the sensitivity of the topic, respondents were informed before taking the survey that their participation in the research is voluntary and that the collected data will be used only for research purposes. They were also informed that there were no right or wrong answers to the questions, and that they could stop filling in the questionnaire at any time. The questionnaire was available in Slovenian and English. A total of 629 responses were received from February to June 2019. 39.3 percent of respondents were male, 59.8 percent were female, and the rest did not disclose their gender. The age of respondents ranged from 16 to 110 years (M = 41.49, SD = 15.92).

Respondents were generally well-educated as 14.1 percent had competed high school or less, 33.5 percent had completed a Bachelor's degree (first cycle), 36.4 percent finished their Master's (second cycle) and 14.5 percent obtained a PhD (third cycle). Most respondents were active as 12.9 percent were students, 67.6 percent employed, 5.7 percent unemployed and 11.9 percent retired.

The questionnaire consisted of 3 constructs measuring trust in government (TiG), fear of government intrusions into privacy (FoGI) and government surveillance concerns (GSC). Each construct was measured with three items that were adopted from previous studies: TiG (Harrison McKnight, Choudhury, & Kacmar, 2002), FoGI (Osman, Barrios, Osman, Schneekloth, & Troutman, 1994) and GSC (Nam, 2018). Respondents were asked to rate the items using a five-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). IBM SPSS Statistics version 26 and Microsoft Excel were used to perform statistical analyses of the results. The reliability of the constructs was evaluated by calculating the Cronbach's alpha (CA) coefficient. CA values above 0.80 indicate good *reliability*. Items of construct with adequate reliability were aggregated into new construct variables on which subsequent analyses were conducted.

3 RESULTS

In this section, we first summarize the results of descriptive statistics analysis. Then, we provide the visual presentation of the results.

Table 1 presents the descriptive statistics for all 9 variables measured in the survey. Descriptive statistics and Cronbach's alpha for constructs were also calculated. At the beginning it is worth mentioning that this is aggregated data of respondents from several countries and does not represent any single country.

Table 1: Descriptive statistics for aggregated constructs

Code	Construct	*M*	*SD*	*CA*
TiG	Trust in government	2.61	0.97	.881
FoGI	Fear of government intrusions	3.00	1.13	.904
GSC	Government surveillance concerns	3.16	1.15	.952

M = mean, *SD* = standard deviation, *CA* = Cronbach's alpha

We analyzed each construct across countries where the respondents resided. Results of analysis for only 36 countries are presented as we excluded all countries that were represented with less than 3 respondents to avoid a bias due to a low number of respondents. First, averages for each country were calculated. Next, countries were ordered according to their mean values for each construct. The first third of all countries were assigned a *Low* rank, the second third were assigned the rank *Medium*, and the rest were ranked as *High*. Table 2 presents the boundary mean values for ranks of individual constructs.

Table 2: Boundary mean values for ranks of individual constructs

Rank	*TiG*	*FoGI*	*GSC*
Low	1.515 – 2.415	1.833 – 2.741	1.667 – 2.915
Medium	2.578 – 2.865	2.743 – 3.076	2.933 – 3.290
High	2.866 – 3.833	3.198 – 3.933	3.333 – 4.300

TiG = Trust in government, *FoGI* = Fear of government intrusions, *GSC* = Government surveillance concerns

The results of country rankings are shown in Table 3.

Table 3: Country rankings according to mean scores of individual constructs

Country	*TiG*	*FoGI*	*GSC*
Argentina	Low	Low	Medium
Australia	Medium	Medium	High
Austria	Medium	Medium	Medium
Belgium	High	Low	Low
Bosnia and Herzegovina	Medium	High	High
Brazil	High	Medium	Medium
Canada	Medium	High	High
China	Low	High	High
Croatia	Low	High	High
Czechia	Low	Medium	High
Finland	High	Low	Low
France	Medium	Medium	Medium
Germany	Medium	Low	Medium
Greece	Low	High	Low
Hungary	Low	High	High
Ireland	High	Low	Medium
Italy	Medium	Medium	High
Luxembourg	High	Low	Low
Montenegro	High	Medium	Low
Netherlands	High	Low	Medium
New Zealand	High	Low	Low
North Macedonia	Medium	High	High
Norway	High	Low	Low
Poland	Low	High	High
Portugal	Medium	Low	Low
Serbia	Low	High	High
Slovakia	Low	High	Low
Slovenia	Low	Medium	Medium
Spain	Medium	Medium	Medium
Sweden	High	Medium	Low
Switzerland	High	Medium	Medium
UK	Medium	Low	Low
US	Low	High	Medium

TiG = Trust in government, *FoGI* = Fear of government intrusions, *GSC* = Government surveillance concerns

To make it easier for readers to comprehend the results of our study, we visualized them by creating a figure of ranked countries for each construct. Included countries are colored with different shades of gray. A darker shade means a higher mean score for the country. Namely, light gray, dark gray and

black represent *low*, *medium* and *high* rank, respectively. Countries not covered by our study due to not having enough respondents and thus not being included in our analyses are colored white.

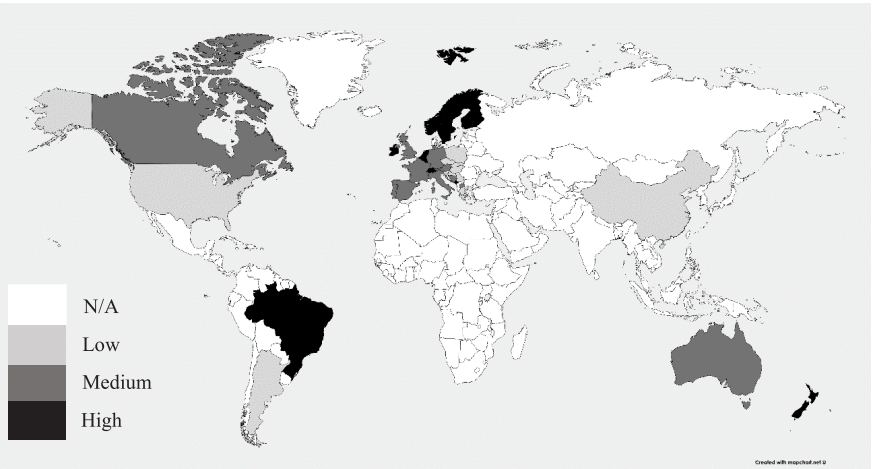


Figure 1: Distribution of the perceptions regarding respondents' trust in government (TiG)

Figure 1 shows the country ranks according to perceived trust in government of respondents. Slovenians around the world appear to trust especially some governments of Northern, Central and Western European countries (i.e., Belgium, Finland, Ireland, Luxembourg, Netherlands, Norway, Sweden and Switzerland). Additionally, Montenegro, Brazil and New Zealand, are completing this club. Trust in governments seems to be relatively low for countries in Eastern Europe and the Balkans (i.e., Croatia, Czechia, Greece, Hungary, Poland, Serbia, Slovakia and Slovenia), China, Argentina and US.

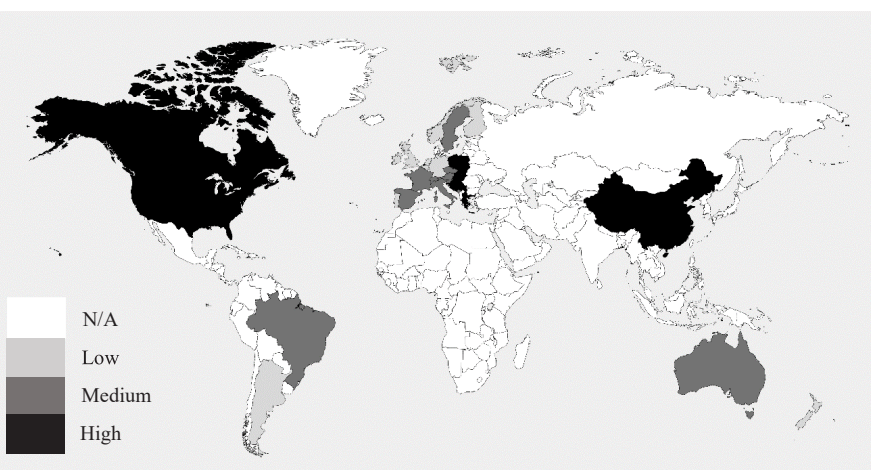
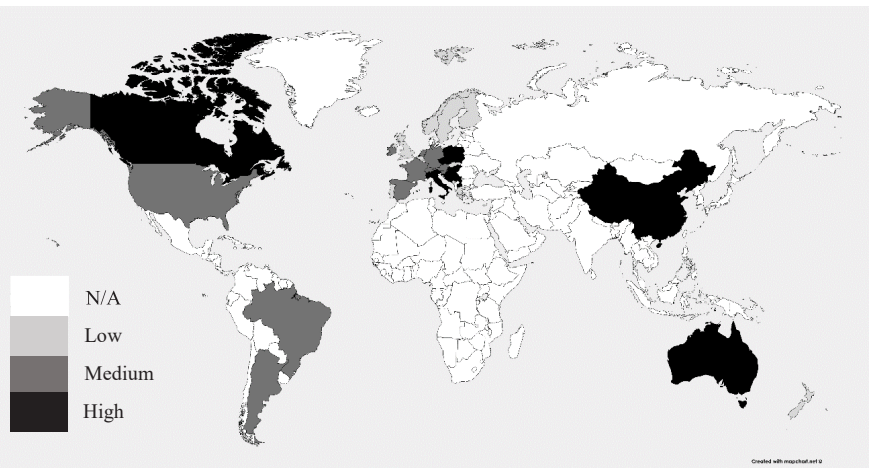


Figure 2: Distribution of the perceptions regarding respondents' fear of government intrusions into their privacy (FoGI)

As can be seen in Figure 2, fear of government intrusions into privacy is especially present in Eastern Europe and the Balkans (i.e., Bosnia and Herzegovina, Croatia, Greece, Hungary, North Macedonia, Poland, Serbia and Slovakia), Africa (i.e., Sierra Leone), China and North America (i.e., Canada and US). Complementary

to our findings regarding trust in governments, fear of government intrusions is relatively low in several countries in Northern, Central and Western Europe (i.e., Belgium, Finland, Germany, Luxembourg, Netherlands, Norway, Portugal and UK), Argentina and New Zealand.

Figure 3: Distribution of government surveillance concerns of the respondents (GSC)



Government surveillance concerns of respondents are shown in Figure 3. Countries with high surveillance concerns can be found in Eastern Europe and the Balkans (i.e., Bosnia and Herzegovina, Croatia, Czechia, Hungary, North Macedonia, Poland and Serbia), Italy, Canada, Australia and China. Surveillance concerns appear to be low mostly in various countries in Europe (i.e., Belgium, Finland, Greece, Luxembourg, Montenegro, Norway, Portugal, Slovakia, Sweden and UK). Only respondents in New Zealand have comparably low surveillance concerns in studied countries outside of Europe.

4 DISCUSSION

A brief view at the mean values gives an interesting overview over the perceptions of the respondents. First, the average trust in government seems to be relatively low (i.e., below the middle value 3 on a 5-point scale). Second, it appears that respondents moderately fear government intrusions into their social network accounts which may be a consequence of well-known leaks about government activities described above. Cyberspace users may therefore perceive governments as surveillance actors with notable capabilities. Third, people seem to be concerned about government surveillance over their online activities. This paper has several theoretical and practical implications discussed in the next subsections.

4.1 Theoretical Implications

Countries often measure trust in the government as form of mining public opinion. Trust of immigrants in government may however differ from the trust shown by locals. Trust in government may be an indication of the government policy on

immigrants or a sign of widespread dissatisfaction with the elected politicians who rule the country. The results of our study suggest that trust in government of countries with right-wing political options (e.g., Hungary, Poland, Serbia, USA, Slovakia and Croatia) is low which may be related to their anti-immigrant policies and/or propaganda. Trust in government may be also related to income, life expectancy and life satisfaction in general. For example, trust in governments of countries that have among the highest incomes and life expectancy (e.g., Ireland, Finland, Belgium, Switzerland, Luxembourg, Norway, Netherlands, New Zealand and Sweden) is high. Nevertheless, some other countries, such as Brazil and Montenegro, with a high level of trust somewhat stand out and future work would be needed to determine if there really is an association between these factors (Gapminder Foundation, 2019).

A quick glimpse at the world map of fear quickly suggests that the fear of government intrusions may be high at the border between East and West, namely in Eastern Europe and the Balkans. On one hand, fear may be a legacy of the iron curtain without proper justification. On the other hand, such fear may be aroused due to the perceived motivation of some European governments to monitor their citizens for security reasons. For similar reasons, China, Canada and US may also be highly motivated. A sufficiently motivated and resourceful country may be able to develop or otherwise acquire (e.g., by buying spyware) the means needed to eavesdrop on their residents and especially immigrants. Future qualitative studies (e.g., interviews) may be highly beneficial to gain a deeper understanding of the factors leading to high levels of government intrusions in these countries.

One might expect there to be a high level of fear of government intrusions when the level of trust in a government is low. Some cases appear to confirm this hunch (i.e., China, Croatia, Greece, Hungary, Poland, Serbia, Slovakia and US). China is one of the largest countries in the world by population and is known to have a powerful apparatus, resources and puts a lot of effort into surveilling its people. Similarly, US is also known to have vast surveillance resources and similarly to some European countries low trust in governments may be a consequence of a right-wing anti-immigrant government. Nevertheless, we observed that Argentina has both low trust in government and low fear of government intrusions diametrically contrary to such common sense-making. Simply put, residents in Argentina do not appear to trust their governments however they are also not afraid of these governments' intrusions into their privacy. This may be explained by a perceived lack of governments' capabilities or motivation (or both) for intruding the privacy of residents in these countries.

Finally, we also studied respondents' concerns regarding government surveillance online (e.g., emails, social networks, searching and browsing habits). Surveillance concerns appear to be high in similar regions as fear of government intrusions is high although they do not appear to be always aligned. Government fear may be more related to the perceived motivation of governments to monitor the residents. Surveillance concerns may however incorporate the capability and willingness of the governments to monitor residents in practice. For example, fear of government intrusions into privacy are relatively high while surveillance concerns seem to be quite low in Greece and Slovakia. Slovenian immigrants there

do not appear to be too concerned about government surveillance although their fear of government intrusions is high. Either they do not perceive the government capable of doing such monitoring or they simply think that the probability of such an event is very low even though the government is able to surveil them. To better understand the discrepancies between fear of government intrusions and surveillance concerns, more research using qualitative methods would be needed.

An interesting question stemming from results on surveillance concerns arises. Do surveillance concerns affect the adoption and use of technology? Although we cannot give a definitive answer, we can try to provide some insights for the readers. The use of certain technologies is forbidden in some countries. For example, it is forbidden to use social networks, such as Facebook, in China. In Turkey, it is forbidden to use Wikipedia, and in Saudi Arabia, it is forbidden to use WhatsApp, Skype and SnapChat among others. The use of end-to-end encrypted communication is also frequently forbidden (e.g., Telegram in Iran and Russia). We can therefore safely assume that use of technology depends on the country of residence. This may not appear to be related to surveillance concerns. However, surveillance concerns may be high in such countries. Even though it may affect the use of certain types of technology, it may not affect the use of different technologies in general. If cyberspace users cannot use Facebook, they may simply use VK.

4.2 Practical Implications

The data we have obtained through this body of research allow us to draw some practical implications. First, the results emphasized that there are different levels of perception (from low to high) regarding government activity in the cyberspace. This indicates that people should protect themselves against surveillance (e.g., by using encrypted communication, adequately secured wireless networks, secure applications) in countries where surveillance concerns are higher and government trust is lower to feel more comfortable in the cyberspace. This may hold even more when communicating with their friends and family outside of the country of residence as governments might be interested in monitoring these connections more closely.

Next, the same measures may be used by Slovenians living in Slovenia when communicating with their friends and family abroad. Especially when sharing sensitive data with residents of countries where government fear is high, trust in government is low, or surveillance concerns are high.

Finally, the identified differences between countries suggest that residents and visitors to different countries around the world would benefit from some advisory on this topic. The Ministry of Foreign affairs may include a cyber landscape assessment and recommended countermeasures in their advisory for Slovenians living or travelling to different countries around the globe. This may be however a sensitive diplomatic issue especially if a government would like to keep a low profile over their activities in the cyberspace. Therefore, non-governmental organizations may help to complement the official channels.

4.3 Limitations

This paper has some limitations the readers should note. First, we have uneven population patterns across countries. It would be highly beneficial to improve the samples for underrepresented countries. Second, we reached a limited number of different countries in our study. Future studies providing insight into other countries would offer a more holistic view of the research subject. Third, snowball sampling was employed thus caution is needed when generalizing its results.

5 CONCLUSION

Our study provided some important insights into how Slovenians around the world perceive the governments in the countries where they currently reside and their concerns regarding those governments' surveillance. The results of our study enable us to answer our research question positively. Not only there are differences between countries regarding the perceptions of their residents about trust in government, fear of government intrusions into their privacy and government surveillance concerns, but there appear to be differences regarding the relations between these three constructs depending on the country. As one of the first studies on perceptions of Slovenians around the world regarding their trust in the government of the country of their residence, fear of government intrusions into their privacy and their government surveillance concerns, the study seems to open more new questions than it answers calling for more research on the topic. First, how does the type of the political regime affect trust, fear and surveillance concerns. Second, does the regulation of human rights and known government interventions (e.g., mass surveillance) affect these constructs. Third, how much does being a minority and feeling a different legal treatment influence these same constructs. Finally, does the media coverage of high-profile cases of data misuse, surveillance technologies, loss of privacy, etc. impact the perceptions of cyberspace users regarding their trust in government, their fear of government intrusions and their government surveillance concerns.

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Limiting Privacy by Using Smart Meters – Information Security Perspectives

Uroš Jelenc, Blaž Markelj

Purpose:

The purpose of this paper is to present the key features of smart energy meters, their strengths and weaknesses. In addition, the paper aims at establishing how they interfere with user privacy and determine the users' level of awareness.

Design/Methods/Approach:

For the purpose of this paper, existing literature was reviewed and analysed, and a questionnaire was distributed in a digital form. 229 respondents participated in the survey.

Findings:

It has been found that smart energy meters collect very accurate information about users' electricity consumption at short intervals. The information can then be used to identify devices, identify the presence or absence of people, their habits and activities. According to the survey results, the awareness among people using smart energy meters is low.

Research Limitations/Implications:

The limitations stem from the survey sample, as only people who are users of online social networks, e-mail and internet messaging applications (Viber, WhatsApp) were included in the survey.

Practical Implications:

The paper presents key findings in the field of smart energy meters and their potential for compromising individuals' safety and privacy. The paper discusses different ways in which energy consumption information can be exploited and used to harm users, as well as methods for establishing a secure and reliable network.

Originality/Value:

Due to the increasing share of smart energy meters installed in Slovenia, there is an increasing risk of privacy intrusions and threats to the safety of individuals. The research findings will help increasing users' awareness about smart energy meters and prevent potential abuse of their data.

UDC: 004.056

Keywords: smart meters, information security, privacy, energy consumption

Omejevanje zasebnosti s pametnimi merilniki – informacijskovarnostni vidik

Namen prispevka:

Namen prispevka je predstaviti ključne lastnosti pametnih merilnikov energije, njihove prednosti in slabosti ter ugotoviti, kako posegajo v uporabnikovo zasebnost in kakšno zavedanje o tem imajo ljudje.

Metode:

Za namen članka je bila pregledana in analizirana obstoječa literatura ter posredovan vprašalnik v digitalni obliki. V raziskavi je sodelovalo 229 anketirancev.

Ugotovitve:

Ugotovljeno je bilo, da pametni merilniki energije zbirajo zelo natančne informacije o uporabnikovi porabi električne energije na kratkih časovnih intervalih. Z informacijami se lahko nato identificirajo naprave, ugotavlja prisotnost ali odsotnost oseb, njihove navade ter dejavnosti. Glede na rezultate ankete je med osebami nizka ozaveščenost o pametnih merilnikih energije.

Omejitve/uporabnost raziskave:

Omejitve izhajajo iz raziskovalnega vzorca, saj so bili v anketo vključeni le uporabniki spletnih družabnih omrežij, elektronske pošte in internetnih aplikacij za sporočanje (Viber, WhatsApp).

Praktična uporabnost:

V prispevku so predstavljene ključne ugotovitve na področju pametnih merilnikov energije in njihov potencial za ogrožanje varnosti ter zasebnosti oseb. Prikazani so načini, kako lahko informacije o porabi energije izkoristijo in uporabijo za škodovanje uporabnikom, ter načini za vzpostavitev varnega in zanesljivega omrežja.

Izvirnost/pomembnost prispevka:

Zaradi vse večjega deleža nameščenih pametnih merilnikov energije v Sloveniji obstaja vedno večja verjetnost za poseg v zasebnost in ogrozitev varnosti oseb. Ugotovitve raziskave bodo pripomogle k večjemu ozaveščanju uporabnikov o pametnih merilnikih energije ter možnih načinih zlorabe njihovih podatkov.

UDK: 004.056

Ključne besede: pametni merilniki, informacijska varnost, zasebnost, poraba energije

1 INTRODUCTION

Technological development contributes to the introduction innovations and novelties in every sphere of our day-to-day lives. Numerous devices have been transformed from the analogue to the digital format. Wireless technologies used for sending and receiving information, as well as internet services are widely used today. Thus, our personal data are becoming less private and ever more public.

Such a transition to the latest technologies is also observed in the field of energy (Véliz & Grunewald, 2018). In the past, analogue meters were mostly used to measure household energy consumption. However, the emergence of smart homes and smart networks also contributed to the modernisation of systems and devices (Souri, Dhraief, Tlili, Drira, & Belghith, 2014). Due to the increasing demand for electricity, the development of the energy sector has been focusing on optimisation, which means that power plants usually generate as much energy as necessary to meet consumers' demand. In doing so, they are lowering their impact on the environment and cutting the costs for consumers. Smart energy meters are one of the most prominent innovations in this respect, since they are designed to achieve efficiency, reliability and safety (McLean, 2016).

Smart energy meters represent a step towards the modernisation of electricity grids. They are devices designed to supply the information regarding energy consumption to both consumers and providers or energy services in a fast, efficient and reliable manner (Horne, Darras, Bean, Srivastava, & Frickel, 2015). While analogue meters only provide energy consumption data at the end of each month, smart meters are able to transmit such data every hour, minute or second. Thus, they provide accurate information on how many watts or kilowatts of electricity an individual consumes at a specific time and place. In this context, large quantities of sensitive data are being collected, which represent a significant challenge for managing such data and safeguarding user privacy (Asghar, Dán, Miorandi, & Chlamtac, 2017; McKenna, Richardson, & Thomson, 2012).

2 USE AND IMPLEMENTATION

Due to technological developments and the increasing environmental awareness, the use of smart meters across the globe has been dramatically increasing. EU Member States have already introduced such smart meters. By 2020, smart meters are estimated to replace 80% of all meters or metering points. In the EU, approximately 182 million smart meters will be installed in the period between 2016 to 2020, amounting to an investment of USD 37.8 billion (Sprinz, 2018).

The main reasons for the implementation of smart meters in EU Member States arise from the commitments made when adopting an EU Directive (Directive 2009/72/EC) and the desire to boost energy efficiency and grid modernisation. This will contribute towards a significant growth in the quantity of user-related data. Before introducing smart meters and grids, Member States must adopt appropriate legislation (privacy and data security) and roll-out plans, as well as conduct cost-benefit analyses. The trend of smart meter implementation in the EU has been rising steadily, however, the rate of their introduction varies greatly among Member States (European Smart Grids Task Force, 2016; USmartConsumer, 2016).

Certain countries, such as Finland, Spain, Sweden, Estonia and Malta, have already completed their smart meter implementation, adopted suitable legislation and support policies, and provided for an adequate regulation of information collected from energy consumers. Thus, they have removed (almost) all barriers and are providing various services to consumers. Other countries, such as Austria,

France, Ireland, Norway, Poland and Slovenia, have embarked on a clear path towards a complete roll out of smart meters and have already started or plan to start introducing smart meters and offering related services. In Cyprus and Poland, smart meter implementation is not prescribed by law, however, they are being installed because state bodies and energy companies see them as an advantage or because of consumer demand. Countries, such as Germany, Greece, Hungary and Romania, have already adopted the necessary legal bases, albeit only some distribution system operators (DSOs) in these countries decided to implement smart meters. Last but not least, countries, such as Bulgaria, Croatia, Czech Republic, Latvia, Lithuania and Slovakia, have shown an interest in smart metering, however, corresponding initiatives are still in relatively early stages of development (European Smart Grids Task Force, 2016; USmartConsumer, 2016).

In the USA, the number of smart meters started growing rapidly after 2007. In 2016, 72 million smart meters were installed, which represented 60% of all households in the USA. By the end of 2020, the total number of smart meters is estimated to reach around 90 million (Zheng, Gao, & Lin, 2013).

3 FUNCTIONS AND BENEFITS

Every individual feature offered by smart meters is considered as an advantage when compared to conventional energy meters, as they allow for several potential applications. The benefits of smart meters are multifaceted, as they not only bring advantages at the level of individual users, but also in terms of power transmission and distribution, marketing, grid load forecast, billing, etc. (Asghar et al., 2017; Kabalci, 2016).

The functions of modern smart energy meters include (Sun et al., 2016; Zheng et al., 2013):

- bi-directional communication between energy suppliers and consumers;
- data collection and storage;
- automatic and two-way metering and service charging;
- detecting and diagnosing systemic errors;
- load management.

All of the aforementioned functions produce improvements at various levels, which is why they can be divided into the following three sets of benefits.

Benefits at the level of consumers (Sun et al., 2016; Zheng et al., 2013):

- access to and insight into electricity consumption data, which allows consumers to review the available data and thus manage their electricity consumption more efficiently;
- more accurate and timely information regarding electricity consumption and billing;
- faster power restoration in the event of power failure;
- possibility to delay/defer high electricity-consuming devices to specific time slots during which the price of electricity is more affordable.

Benefits at the level of energy management and distribution (McKenna et al., 2012; Sun et al., 2016; Zheng et al., 2013):

- better energy managements during peak demand;
- higher efficiency with respect to energy consumption and the use of energy resources;
- larger quantity and better quality of data necessary for grid load forecasting and decision-making;
- error and energy theft detection;
- reduction of costs related to data acquisition.

Benefits at the level of environmental protection (Sun et al., 2016; Zheng et al., 2013):

- higher investments into renewables;
- reduced impact on the environment or lower CO_2 emissions.

Smart energy meters represent a significant step forward in comparison with electromechanical meters. Due to their aforementioned benefits, they promote progress in the field of further development of electricity grids. It is estimated that smart meters will soon be installed in every building. By acquiring data directly from consumers, which takes place every single day, usually at an 1–60 minute interval, they enable the creation of specific consumer profiles, thus providing for a more accurate forecast and better management of grid demand (Sun et al., 2016). This leads to more efficient electricity grids and reduced energy consumption.

4 CONSUMER PRIVACY

The previous chapter focused on the advantages and benefits of smart energy meters. While they contribute to reduced energy consumption and thus lower the adverse impacts on the environment, the security and privacy of grid users must not be neglected. In fact, security is one of the most important goods, which one becomes fully aware of only after it is gone.

The advantages of technological innovations may be observed in all spheres of life, however, such innovations also decrease the potentials for preserving one's privacy. The ever greater presence of smart energy meters brings about certain threats, which may jeopardise individuals' privacy and security (Hou, Qu, & Shi, 2019).

Smart meters usually record and collect data at an interval between 15 and 60 minutes. They also enable metering at the interval of one second. The efficiency and reliability of such grids depend on the metering interval. At the same time, the metering interval corresponds to the quantity and accuracy of data regarding individual consumers and their households. By way of comparison, conventional electromechanical meters submit a single total sum of energy consumption for the whole month, while smart meters perform between 24 and 100 (or more) measurements in a single day, which corresponds to approximately 750–3,000 measurements per month. When data regarding the power usage of various devices in individual households is submitted at such frequent intervals, it may be used to reveal occupants' habits and behaviours (Harvey, 2014). Devices and appliances that are consuming energy at certain points in time can also be identified. In fact, different devices and appliances are drawing power in different

or rather unique ways – for instance, a refrigerator or water heater draws power in a different way than a television set or a radio. As a result, it is possible to develop a unique energy consumption pattern of activities performed by household occupants (McLean, 2016).

Smart energy meters collect extremely accurate information on the consumers' electricity consumption at very short time intervals. Therefore, it is possible to obtain data regarding the quantity of consumed energy in Watts and the time at which a certain quantity of energy had been used. This allows for the monitoring of consumers' activities in their own homes, the monitoring of their habits and the identification of appliances and devices in the household. A simple overview of the metering performed by a smart meter allows one to clearly identify the activity of household occupants; energy consumption is generally steady during the day but peaks when the user is active within the home

Smart meters could thus be used to monitor individuals' activities not only at home, but also at the workplace. The intrusion into one's privacy at the workplace may occur in various ways: by checking e-mails, controlling internet activity and phone calls, video surveillance, etc. (Lobnikar & Golmajer, 2016). Smart energy meters could serve as a stealth method of establishing, for instance, whether individuals are actually at their place of work, etc. Naturally, the accuracy and level of detail of such data depends on the interval of smart energy metering.

In their study, Greveler, Glösekötterz, Justusy, and Loehr (2012) found that taking measurements at an interval of two seconds is sufficient to identify which television programme an individual is watching, provided there are no major interferences of other home appliances. By measuring and testing the power consumption of a television set and monitoring the sequence of pictures it shows, researchers were able to use the RGB colour notation to accurately identify which channel or film an individual was watching.

Data on energy consumption may be used for different purposes (Farokhi & Sandberg, 2018; McKenna et al., 2012):

- Illegal purposes:
  - persons wanting to break into a household to perform a robbery would have precise knowledge of the owners' absence; and
  - stalkers could easily follow and monitor their targets at home and would be able to tell if they were home alone.
- Advertising purposes:
  - on the basis of collected data, targeted/behavioural advertisements could be published in a certain time-frame, i.e. while the person concerned was at home. On the basis of energy consumption data, consumers could be bombarded with advertisements of devices and appliances boasting lower energy consumption, etc.; and
  - insurance undertakings could monitor and adapt their premiums based on whether consumers posed a risk (due to leaving devices and appliances switched on when leaving their home, etc.).
- For the purposes of State authorities:
  - police and other state bodies could use such data to investigate illegal activities and acts (production of marihuana or other stimulants, etc.); and

  - police and other state bodies could use such data to check individual's alibi (verify whether they were actually at home at the time they claimed to be).
- For the purposes of individuals' statutory benefits:
  - child custody (checking if a father/mother often leaves their child at home alone); and
  - in landlord-tenant relationships (checking whether a rented accommodation is used by more people than prescribed by the tenancy agreement).
- For family purposes:
  - monitoring the activities of other family members (checking whether a child is asleep or playing computer games); and
  - monitoring partner's activities (checking whether the partner lied or whether they were actually at home at the time they claimed to be, etc.).

Slovenia's Information Commissioner, Mojca Prelesnik, noted that smart meters are contentious in terms of personal data protection, since there are no legal bases for such a detailed metering they provide (Prelesnik, 2019). Smart meters allow rapid and accurate collection of data, however, such data may be abused for various purposes (device or appliance identification, personal habits, individuals' absence, etc.). All of the aforementioned activities represent a substantial intrusion into privacy. In terms of information security, it is therefore crucial that such data be adequately protected and regulated. It is also vital that the main elements of smart energy meters be examined in order to identify potential threats or risks for information leaks and find appropriate solutions.

4.1 Threats to Privacy

The use of smart energy meters may jeopardise data protection and consumer privacy in various ways. Threats are observed at all four areas of the metering infrastructure. The first area relates to consumers, i.e. contract users of energy services and own a smart meter, often together with a display enabling them to monitor energy consumption. The second area encompasses communication technologies linking smart energy meters and metering data management systems. The most common communication technologies include Power Line Communication (PLC), ZigBee and mobile networks. The third area of metering infrastructure refers to the system for managing meter data, which collects, manages and stores data generated by smart energy meters. The fourth area is linked to the use of information. Energy consumption data are used for billing, increasing the efficiency and reliability of energy distribution and providing value-added services (recommendations for lowering energy costs, diagnostics, etc.) (Asghar et al., 2017; Jin, Jia, & Spanos, 2017).

Each of these four areas is characterised with its own set of vulnerabilities, which pose a threat to information security.

- Consumers

Consumers, who are part of the smart grid, have a smart energy meter installed in their building. Smart meters are usually installed at an easily accessible

location (to enable potential maintenance) and are often unprotected or exposed. Therefore, they represent a risk for the materialisation of potential threats, since third parties could obtain a physical or remote access to the smart meter and exploit the vulnerabilities or shortcomings of the meter's software. Smart meters also contain cryptographic keys. Therefore, if an individual gained access to the meter, they could extract metering data and cryptographic keys, thus jeopardising consumers' privacy (Asghar et al., 2017).

Individuals could exploit the shortcomings of smart meters to steal electricity. Furthermore, they could reduce the quantity of consumed electricity by changing and manipulating available data. As a result, they could offer this "service" to others, thus causing the inefficiency and unreliability of the energy distribution (Asghar et al., 2017). It is therefore important to prevent any unauthorised access to smart meters. It is crucial to protect smart energy meters, so that they may only be accessed by authorised persons (different passwords for individual smart meters) (Asghar et al., 2017; Desai & Upadhyay, 2014).

- Communication technologies

The main risk related to communication technologies arises from information leaks. Data encryption is often used to prevent the leaking of information and ensuring confidentiality. Communication channels between the smart meter and the corresponding database must be adequately protected in order to ensure data confidentiality and consumer privacy. This typically leads to the use of Public Key Infrastructure (PKI), which establishes and maintains network security by using encryption keys, thus providing for sender authentication and the detection of unexpectedly modified data (Asghar et al., 2017; Tonyali, Munoz, Akkaya, & Ozgur, 2018).

- Meter data management

Data, which is stored and collected, must only be accessible to duly authorised persons. Data integrity must also be guaranteed, particularly in order to ensure the accuracy of measurements and billing. The use of PKI for sending and storing data could guarantee data security. It is vital to be able to verify and validate the accuracy of data regarding individual measurements (Asghar et al., 2017).

- Use of information

The consent of an individual consumer should be obtained every time their information is being used. However, even if consumers agree that service providers may use their information for specific purposes, it is extremely difficult to check whether such data were actually used only for that express purpose. In such cases, data may be modified or restricted, so that they can only be used for the specific purpose for which consumers' consent has been obtained (Asghar et al., 2017; European Smart Grids Task Force, 2016).

Various techniques geared towards preserving consumers' privacy are usually applied with respect to elements, such as billing, improving efficiency and reliability of energy distribution and value-added services. For instance, the charging and billing of consumed electricity require extremely accurate data, which may reveal a great deal about consumers. One way of protecting privacy is to make sure that the smart meter submits data regarding the total quantity of consumed energy at the end of each month, without disclosing the data on individual measurements (Asghar et al., 2017; McKenna et al., 2012).

In terms of improving grid efficiency, it is important that energy service providers are familiar with the most current situation of the entire grid (energy demand and energy supply). This is why they need a continuous supply of data. In order to safeguard consumers' privacy, energy companies could collect data regarding the entire neighbourhood, thus protecting the privacy of individual consumers. This would mean that the greater the number of consumers, the greater the degree of security; however, this could affect grid efficiency. Another possible solution would be to programme the smart meter in a way that it would provide a specific consumer profile for the purposes of billing and an anonymous consumer profile for ensuring grid efficiency (Asghar et al., 2017; Rial, Danezis, & Kohlweiss, 2018).

Value-added services are aimed at optimising energy consumption on one hand and identifying errors in individual appliances and devices on the other. In this respect, an intrusion into one's privacy does not represent a major risk, since such services do not require a continuous supply of data, but only a certain segment of collected data (Asghar et al., 2017).

4.2 Preservation of Privacy

Due to large quantities of sensitive data, which may be used to be benefit of cyber-attackers and third parties, it is vital for smart meters to provide information security. In order to guarantee information security and consumers' privacy, smart meters must feature certain characteristics, such as confidentiality, integrity, availability, authenticity, non-denial and verifiability. All of these features contribute to the security and efficiency of distribution networks and smart meters. Thus, individual consumers' measurements can be protected from unauthorised persons (Desai & Upadhyay, 2014; Souri et al., 2014). It is important to ensure:

- Confidentiality: ensures that information cannot be accessed by unauthorised persons. It prevents access to generated data regarding individual consumers, smart meters, networks, etc. Confidentiality must be guaranteed in the scope of data transmission (between smart meters and the database), within the database itself, as well as in the scope of data usage. Encryption is often used to provide data confidentiality. Thus, unauthorised persons cannot extract the content of such data by eavesdropping or bugging (Asghar et al., 2017; Desai & Upadhyay, 2014; Souri et al., 2014).
- Integrity: ensures that measurements taken by individual smart meters remain accurate, correct and reliable during data transmission, storage and use. It prevents any modification of data. In fact, every potential data modification should be detected (Asghar et al., 2017; Hou et al., 2019).
- Availability: is crucial for the correct, constant and continuous functioning of electricity distribution networks. It enables a fast and timely detection of errors in the network and guarantees a successful delivery of energy (Desai & Upadhyay, 2014).

- Authenticity: enables the validation of data sources or, in other words, the identification of a source (Asghar et al., 2017; Hou et al., 2019).
- Non-denial or nor-repudiation: guarantees that a data source (i.e. a smart meter) cannot deny the generation of such data. At the same time, non-denial or non-repudiation ensures the integrity and authenticity of data (Asghar et al., 2017; Lee & Brewer, 2009).
- Verifiability: enables the possibility to verify, whether a request has received a correct response or, in other words, whether measurements taken by the smart meter are accurate and correct (Asghar et al., 2017).

The aforementioned features must be guaranteed in order to establish a secure and reliable grid. It is vital that energy service providers are aware of all types of threats and methods for their prevention. Consumers have a right to privacy. Therefore, they expect all data related to their energy consumption and energy activity to be adequately stored and protected (Weaver, 2017). Lobnikar, Prislan, and Markelj (2012) state that security culture ought to be an integral part of every organisation. Security must be maintained constantly and consumers must be informed in a clear and comprehensible manner of their rights and the use of their data.

If providers fail to guarantee a suitable level of protection to their consumers, this will have a negative impact on grid efficiency and reliability. Furthermore, individual consumers will not agree with the installation of smart meters, if these are untrustworthy and unreliable. Consumers must be familiar with smart meters and their functions, since their knowledge of both positive and negative features, as well as of the importance of consumption data, and personal data in general, will contribute to their safety and security. If a consumer, for instance, realised that an energy service provider is unable to explain the purpose of data collection or finds that their data are being used for purposes other than those they consented to, they would understand that this represents a risk and would most likely demand the installation of a conventional meter (Horne et al., 2015). In fact, in most countries, consumers have to right to reject the installation of a smart meter, as this is not obligatory (USmartConsumer, 2016).

5 METHODS

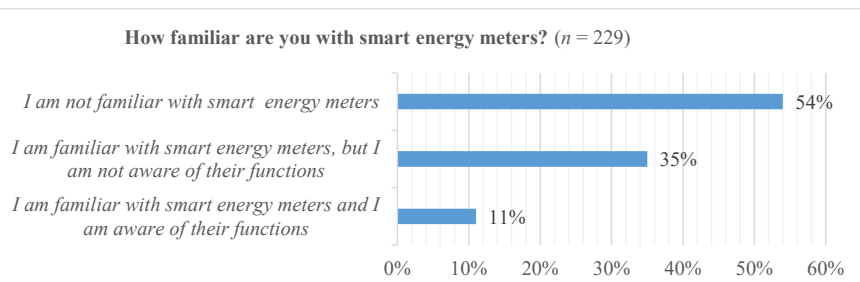
To obtain additional data and to estimate users' awareness of smart energy meters, a survey questionnaire was used. The survey questionnaire was used to acquire information regarding the degree of knowledge that respondents had of smart energy meters, particularly their level of awareness about potential threats posed by smart energy meters. Furthermore, respondents were asked whether data that may be generated by smart energy meters are of any relevance to them. The survey questionnaire was composed by using the *1ka* online tool. Data were collected by publishing the questionnaire on online social media – the sample consisted of Facebook, Viber and e-mail users. The questionnaire comprised a total of 15 questions, which were divided into two sets. The questions required either *yes/no* answers or answers provided on a 5-point Likers scale, where 1 stood for *I completely disagree* and 5 corresponded to *I fully agree*. The first set of questions was

aimed at establishing respondents' familiarity with smart meters, their perception of smart meters, as well as smart meters' positive and negative characteristics. The second part of the questionnaire comprised demographic questions referring to respondents' gender, age and qualifications. 229 respondents participated in the survey. 200 respondents completed the questionnaire in its entirety, while 29 respondents did not complete the questionnaire. 124 (62%) of respondents were female and 76 (38%) respondents were male. The highest share of respondents was aged between 21 and 40 (56%), as well as between 41 and 60 (33%), while the lowest share of respondents was over 61 (8%) and under 20 years of age (4%). The majority of respondents completed general secondary education (44%), followed by tertiary-level education or higher (41%), vocational or technical secondary education (14%) and primary-level education or lower (2%).

6 RESULTS

The objective of the questionnaire was to establish whether respondents were familiar with smart energy meters, whether they recognised potential threats and positive features, as well as whether they believed that energy consumption data were at all relevant.

Figure 1: Familiarity with smart meters



Respondents were asked whether they were familiar with smart energy meters. The question was answered by 229 respondents. 123 (54%) respondents were not familiar with smart meters or had never heard of the term "smart meter". The number of respondents who were familiar with smart meters, but are not aware of their functions, amounted to 80 (35%), while 26 (11%) respondents were familiar with smart meters and their functions.

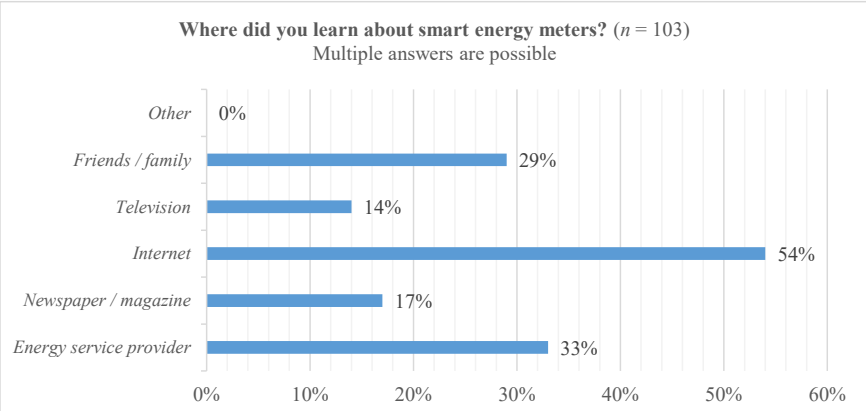


Figure 2: Where did respondents learn about smart meters

Respondents were asked where they learned about smart meters. This question was answered by 103 respondents. They were able to choose among several answers. 54% of respondents stated that they learned about smart meters on the internet, 33% learned about smart meters from their energy service providers, 29% learned about smart meters from their friends and family, while 17% learned about them from newspapers or magazines and 14% heard about them on television.

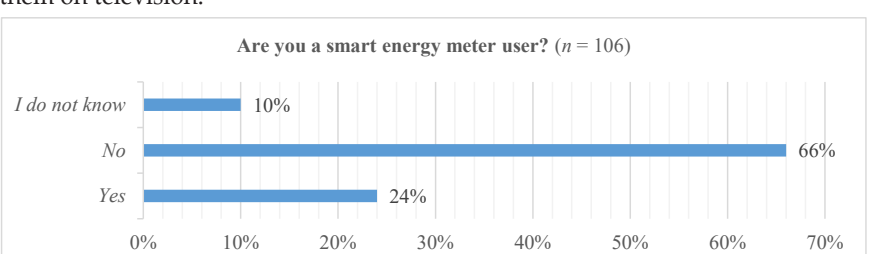
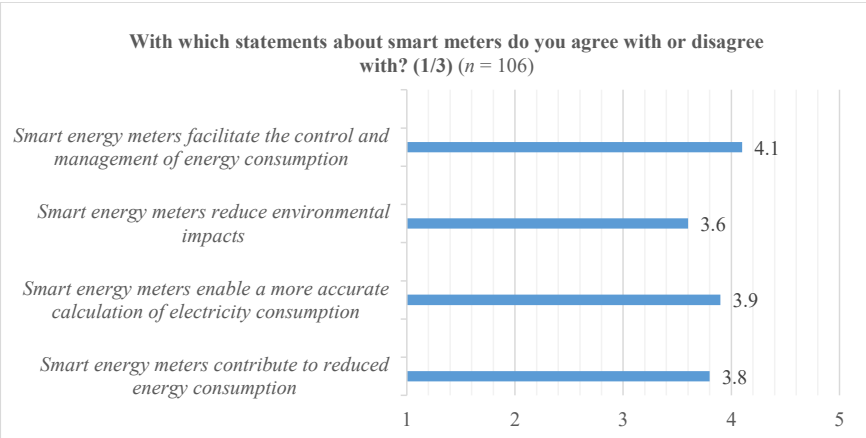


Figure 3: Smart meter usage

Respondents were asked whether they had used a smart energy meter. This question was answered by 106 respondents. 70 (66%) respondents stated that they had not used a smart energy meter. 25 (24%) respondents were users of smart meters, while 11 (10%) respondents did not know whether they had used a smart meter or not.

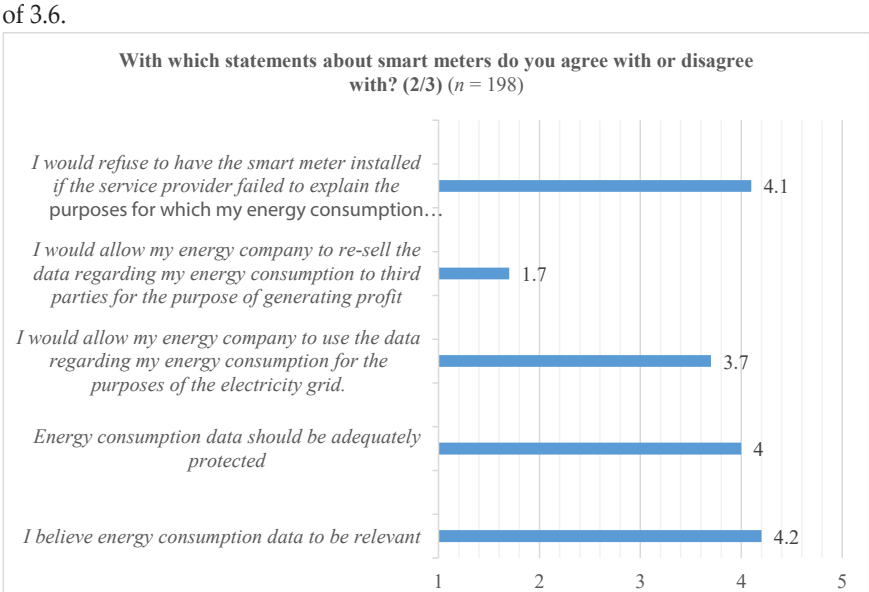
Figure 4: Positive statements about smart energy meters



Legend: 1 – I completely disagree; 2 – Disagree; 3 – Neither agree nor disagree; 4 – Agree; 5 – I fully agree

The following question contained several statements regarding smart meters, which were assessed by respondents by selecting answers from 1 (*I completely disagree*) to 5 (*I fully agree*). 106 respondents provided their positive answer regarding individual statements. The statement *Smart energy meters facilitate the control and management of energy consumption* received an average grade of 4.1. Respondents gave a 3.9 mark to the statement *Smart energy meters enable a more accurate calculation of electricity consumption*. The statement *Smart energy meters contribute to reduced energy consumption* was marked with an average of 3.8, while the statement *Smart energy meters reduce environmental impacts* received an average of 3.6.

Figure 5: Statements regarding the relevance of data on energy consumption



Legend: 1 – I completely disagree; 2 – Disagree; 3 – Neither agree nor disagree; 4 – Agree; 5 – I fully agree

Respondents were asked about the relevance of energy consumption data. The statement *I believe energy consumption data to be relevant* received an average grade of 4.2, while the statement *Energy consumption data should be adequately protected* received and average of 4. Respondents mostly agreed with the statement *I would allow my energy company to use the data regarding my energy consumption for the purposes of the electricity grid* (3.7), while respondents predominantly disagreed with the statement *I would allow my energy company to re-sell the data regarding my energy consumption to third parties for the purpose of generating profit* (1.7). The statement *I would refuse to have the smart meter installed if the service provider failed to explain the purposes for which my energy consumption data would be used* received an average response of 4.1.

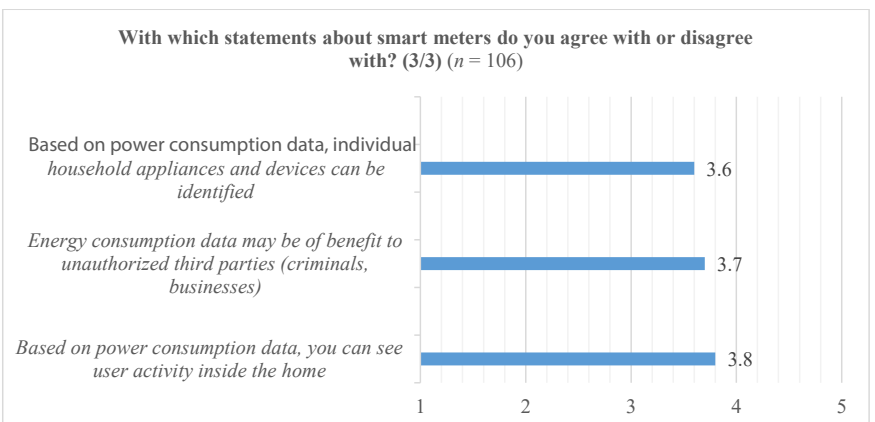


Figure 6: Statements regarding potential threats posed by smart energy meters

Legend: 1 – I completely disagree; 2 – Disagree; 3 – Neither agree nor disagree; 4 – Agree; 5 – I fully agree

106 respondents answered questions regarding threats posed by smart meters. The statement referring to the fact that smart meters may disclose consumers' activities received an average response of 3.8. Respondents also mostly agreed with the statement that energy consumption data may be used to the benefit of third parties (3.7) and with the statement claiming that electricity-related data may be used to identify individual household appliances and devices (3.6).

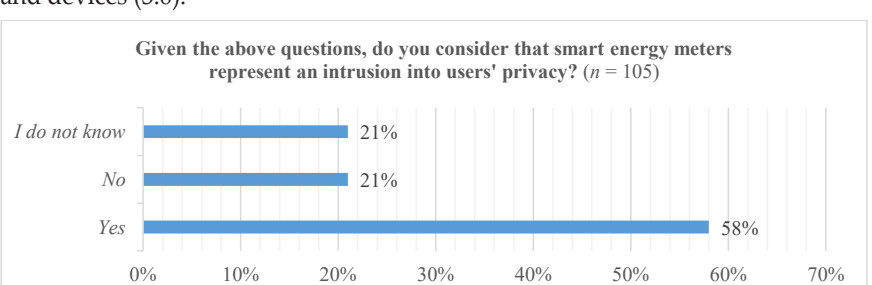
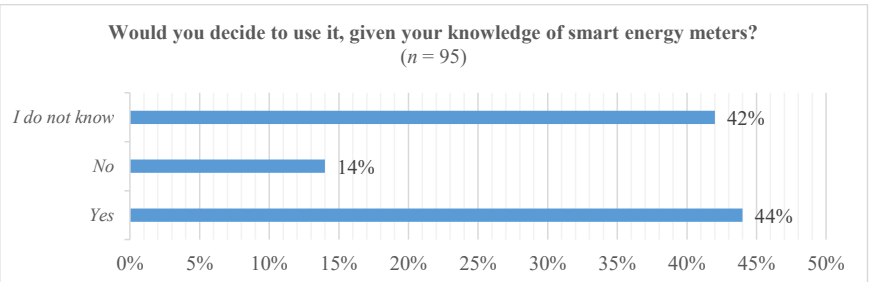


Figure 7: Privacy and smart energy meters

Respondents were then asked whether they believed that smart meters represented an intrusion into their privacy. A total of 105 respondents answered the question. They were able to choose between the following answers: Yes, No,

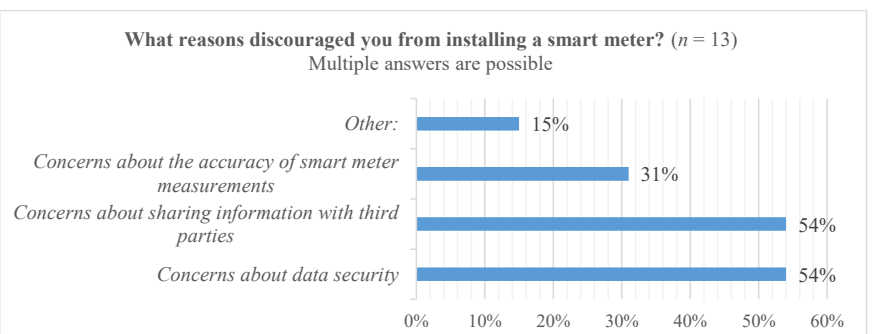
and I do not know. 61 (58%) respondents considered smart meters to be an intrusion into their privacy, 22 (21%) respondents answered that they did not have an opinion about that, and 22 (21%) respondents believed that smart meters did not represent an intrusion into their privacy.

Figure 8: Decision to use a smart energy meter



The next question referred to the familiarity with smart meters and respondents' decision to use them. 95 respondents answered the question. They were able to choose between *Yes*, *No*, and *I do not know*. 42 (44%) respondents stated they would decide to install a smart meter, 40 (42%) respondents did not know whether they would do so, and 13 (14%) respondents claimed they would not decide to install a smart meter.

Figure 9: Reasons for refusing to install a smart energy meter



The majority (54%) of respondents who claimed that they would not install a smart meter, stated that the reason for rejecting the smart meter installation arises from their concerns regarding data security, as well as from their concerns with respect to the sharing of data with third parties. 31% of respondents reported they had concerns about the accuracy of metering, while 15% states that they would not install a smart meter because they simply had no need for it.

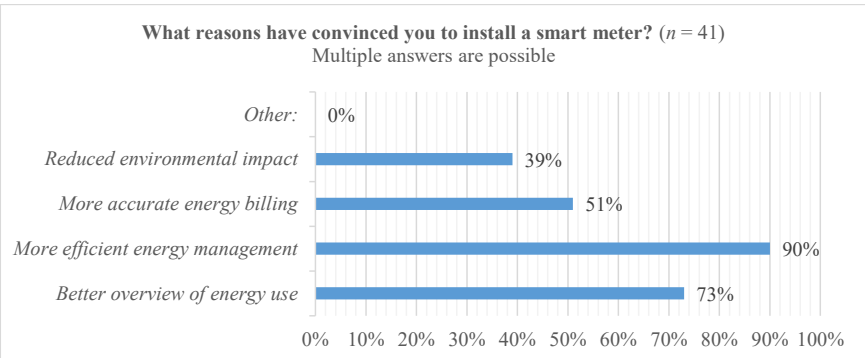


Figure 10: Reasons for installing a smart meter

The vast majority (90%) of all 41 respondents, who would decide to have a smart meter installed, stated that they would do so for the purpose of a more efficient management of energy consumption, 73% of respondents stated that they would thus obtain a better overview over their energy consumption, 51% of respondents would use a smart meter because it provides a more accurate billing of electricity, while 39% wanted to install smart meters in order to reduce environmental impacts.

7 DISCUSSION

In the future, smart energy meters will be an integral part of every household. They bring about certain advantages, however, they also pose threats, which may harm unaware consumers. Research results show that the vast majority of respondents appreciate receiving information about energy consumption and are aware of the need for protection. The survey also shows that, in certain cases, respondents would be willing to give consent to their energy service providers to use their data for the purpose of enhancing grid efficiency. In contrast, a relatively high resistance can be observed in cases where energy companies would provide consumers' energy consumption data to third parties. Respondents would also react negatively if energy service providers would fail to explain the purpose of using their data. Indeed, if companies abuse consumers' data or if consumers become wary of smart energy meters, this would cause a strong reluctance towards smart meters and thus produce a negative impact on the further development of smart grids.

Out of 106 respondents in our survey, only 25 (24%) of them actually used a smart energy meter, and 11 (10%) respondents did not know whether they had it installed or not. According to Slovenia's Energy Agency (Agencija za energijo, 2019), the share of installed smart energy meters in Slovenia in 2018 amounted to 66%. At the same time, research results show that more than half (54%) of 229 respondents were not familiar with smart meters. Out of 106 respondents, who answered the question regarding the use of smart meters, 70 (66%) respondents believe that they did not use it. Given the widespread use of smart energy meters in Slovenia and elsewhere in the EU, these results are rather surprising. One would assume that the number of people, who are familiar with smart meters,

would be at least equal to the share of installed smart meters (Agencija za energijo, 2019). Nevertheless, results show that the level of awareness about smart energy meters in Slovenia is quite low, despite the fact that Slovenia boasts a 66% share of installed smart meters.

In the survey, 44% of 95 respondents stated that they would have a smart energy meter installed, particularly in order to ensure to a more efficient management and a better overview of energy consumption. 42% of respondents were not convinced whether they would want to have a smart meter installed or not, and 14% of respondents would not install a smart meter. Respondents, who would not want to use a smart meter, listed two main reasons for their decision, i.e. concerns related to data security and concerns regarding the sharing of such data with third parties. Therefore, we may conclude that respondents, who were not convinced whether to install a smart meter installed or not, lack trust or confidence in smart energy meters.

Despite the low level of awareness about smart energy meters, 106 out of 229 respondents (46%) were familiar with the functions of smart energy meters. They mostly recognised their positive and negative features and were aware of potential intrusions into privacy. They also recognised situations, which could lead to the abuse of their data or jeopardise their privacy and security. This clearly shows that the vast majority of respondents appreciate the relevance of energy consumption data and are aware of the need to protect such data.

8 CONCLUSION

Technological progress brings about numerous opportunities for advancing all spheres of life and, in particular, improving people's lives and reducing our impact on the environment. However, technological progress also means that devices, applications and other services enabling interaction and allowing us to perform everyday tasks require a great deal of sensitive data.

The main objective of this paper was to present smart energy meters, discuss their strengths and weaknesses, and establish whether individuals were familiar with smart energy meters. This is undoubtedly an important issue, since it is vital that individuals value their data, particularly their privacy and security.

The survey, which saw the participation of 229 respondents, shows that individuals, who might become users of smart meters in the future, are very cautious when it comes to sharing their data. This is important, since energy service providers will be required to adequately process and protect consumers' data. Otherwise, consumers will reject the use of smart energy meters. Unsecured data pose a great risk, which may compromise consumers' security and privacy. Consumers may become targets of burglars, large corporations and other parties wishing to abuse their vulnerabilities.

Data regarding energy consumption may reveal the life of individuals in their own homes, their habits, activities, etc. It is therefore crucial for smart energy meters, their communication channels and the corresponding database to be adequately secured and protected. It is also important to be familiar with threats to individual fields and resulting vulnerabilities, and, most importantly, have the

knowledge necessary to prevent such threats. This is the only way to ensure the necessary protection of smart energy meters and the resulting security of their users, as well as to guarantee their trust and confidence in smart meters.

Smart energy meters represent a crucial element in reducing and optimising energy consumption and promoting the use of renewable energy sources. This is why smart meters will soon become an integral part of every household and every building. Frequent metering of consumers' energy consumption will enable a more efficient energy management. However, this requires a great deal of consumer data which must be adequately protected.

The survey revealed that only a limited number of respondents were familiar with smart energy meters, and even fewer respondents had knowledge of their functions. Since smart energy meters have numerous positive features, it would be favourable if people's awareness had been much higher. At the same time, consumers ought to be made aware of the importance of data and related threats. Due to the relatively low number of research studies in the field of consumers' awareness of risks posed by smart meters and the potential abuse of their data, further research ought to be carried out in the future.

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Ljubljana Residents' Knowledge of and Satisfaction with Private Security Guards' Work

Lavra Horvat, Matevž Bren, Andrej Sotlar

Purpose:

The purpose of the paper was to present out how Ljubljana residents know, understand and evaluate the work of private security guards.

Design/Methods/Approach:

A survey by internet and telephone was conducted among Ljubljana residents. The sample included residents between 18 and 75 years of age. A combined weights method was used in order to assure the representativeness of the sample by gender and age.

Findings:

Residents of Ljubljana are satisfied with the work performed by private security guards. Residents' satisfaction mainly depends on their trust in security guards' work, the help and assistance provided by security guards, security guards' attitude towards residents and residents' experience with security guards' work. Residents assess their work as stressful and dangerous, however, they still believe that security guards lack education and professionalism, which is a finding, common to many other studies.

Research Limitations/Implications:

The survey is limited to the Ljubljana area, so a similar survey should be carried out nationwide.

Practical Implications:

Findings could be used by private security companies to plan adequate processes of training, professional socialisation and public relations strategies, thus increasing the degree of security guards' professionalism. In turn, the improved professionalism would contribute greatly to a more positive assessment of security guards by residents.

Originality/Value:

In Slovenia, this kind of survey was conducted for the first time among the general population, as so far similar surveys have been carried out mainly among the student population.

UDC: 351.746.2(497.4)

Keywords: private security guards, satisfaction with work, knowledge, professionalism, residents, Ljubljana

Poznavanje dela zasebnih varnostnikov in zadovoljstvo z njihovim delom med prebivalci Ljubljane

Namen prispevka:

Namen prispevka je raziskati, kako prebivalci Ljubljane poznajo, razumejo in ocenjujejo delo zasebnih varnostnikov.

Metode:

Med prebivalci Ljubljane je bila izvedena anketa po spletu in telefonu. V vzorec so bili vključeni prebivalci med 18. in 75. letom starosti. Reprezentativnost vzorca po spolu in starosti je bila zagotovljena z metodo kombiniranih uteži.

Ugotovitve:

Prebivalci Ljubljane so z delom, ki ga opravljajo zasebni varnostniki, zadovoljni. Na to najbolj vplivajo zaupanje v delo varnostnikov, pomoč varnostnikov, odnos varnostnikov do prebivalcev in izkušnje z delom varnostnikov. Prebivalci ocenjujejo delo varnostnikov kot stresno in nevarno, po drugi strani pa menijo, kar izhaja tudi iz podobnih raziskav, da varnostniki niso dovolj izobraženi in profesionalni.

Omejitve/uporabnost raziskave:

Raziskava je omejena na območje Ljubljane, zato bi bilo koristno podobno raziskavo izvesti tudi na ravni celotne države.

Praktična uporabnost:

Zasebnovarnostna podjetja bi lahko na osnovi ugotovitev raziskave načrtovala ustrezne procese usposabljanja, profesionalne socializacije in strategije odnosov z javnostmi, s čimer bi prispevala k večji profesionalnosti zasebnih varnostnikov, ki bi v veliki meri pripomogla k pozitivnemu vrednotenju varnostnikov med prebivalci.

Izvirnost/pomembnost prispevka:

Avtorji so tovrstno raziskavo prvič v Sloveniji izvedli med splošno populacijo, saj so bile doslej podobne raziskave opravljene predvsem med študentsko populacijo.

UDK: 351.746.2(497.4)

Ključne besede: zasebni varnostniki, zadovoljstvo z delom, poznavanje, profesionalizem, prebivalci, Ljubljana

1 INTRODUCTION

The police have not been the only organisation entrusted with the provision of security for quite some time (Trstenjak, 2017). During the past few decades, several tasks related to the provision of security have been taken over by other legal

entities and natural persons. The protection of individuals, society and property has thus become the core activity of numerous private companies and sole traders performing various tasks related to the security and protection of people and property in the scope of a contractual relationship and against payment. This type of security provision is considered as private security.

The private security sector started prospering in the 20th century as a result of an increase in individuals' wealth, which coincided with the development of modern private security companies around the world, even though their initial evolution was hindered by the prevailing public policing and the public regulatory system (Johnston, 1992). The development of the first contemporary private security companies was mainly spurred by the need to protect fast-growing production sectors, such as the coal, iron and steel industries (Couch, 1981; Spitzer & Scull, 1977; Weiss, 1978). Private security companies were primarily established with the view of maintaining a smooth production process in such industrial facilities, since their security personnel made sure that workers remained obedient and carried out their tasks. The period after World War II saw the rapid development of the so-called modern private security industry. Since then, the number of employed private security guards has been increasing to such an extent that today, the number of private security guards in many countries around the world exceeds the number of police officers (Moreira, Cardose, & Nalla, 2015). The rapid development of private security companies mainly resulted from social changes, which led to new forms of ownership and, at the same time, contributed to an increase in crime (Sotlar, 2008). Since the police, as a principal State body responsible for the provision of security, was no longer able to perform tasks aimed at protecting everyone everywhere from crime, private companies and sole traders, which often organised themselves as private security companies, seized the opportunity and entered this increasingly important sector. According to Johnston (1992), thus general increase in private security is considered as the re-birth of private security due to the remarkable growth in the number of newly registered private security companies and private security guards in this period.

Despite being a post-socialist state, Slovenia was no exception in this regard. In Slovenia, the predecessor of today's private security sector has already emerged in the period between 1976 and 1989, when the Associated Labour Act (Zakon o združenem delu, 1976) and the Companies Act (Zakon o podjetjih, 1988) were adopted. The very first private security company, i.e. the SOZD Varnost Ljubljana (*SOZD – Sestavljena organizacija združenega dela* (Composite Organisation of Associated Labour)), which consisted of 13 different TOZDs (*Temeljna organizacija združenega dela* (Basic Organisation of Associated Labour)) from across Slovenia (such as Varnost Moste, Varnost Maribor, etc.) began operating in that period. The SOZD Varnost Ljubljana ceased to exist after 1989 and individual TOZDs were transformed into independent public limited companies and limited liability companies, while the further development of the private security sector revolved around the establishment of new private security companies (Čas, 1999; Sotlar & Čas, 2011). After 1989, Slovenia observed an outstanding increase in the number of new private security companies, which were established rather quickly. Since the legal basis governing their functioning and operation was inadequate, the

State was forced to regulate the sector once again. The first systemic act, i.e. the Private Security and Obligatory Organisation of Security Services Act (Zakon o zasebnem varovanju in obveznem organiziranju službe varovanja, 1994), was adopted in 1994. The Act was in 2003 replaced by the Private Security Act (Zakon o zasebnem varovanju [ZZasV], 2003), and in 2011 by Private Security Act (Zakon o zasebnem varovanju [ZZasV-1], 2011).

Today, the private security sector in Slovenia is regarded as an array of services and activities which are available on the market and provided by private security companies or as in-house security, i.e. the provision of security services for the account and on behalf of an organisation by private security guards employed in the very same organisation they protect. This sector is governed by numerous rules and regulations prescribing the duties, rights and powers of companies providing private security services, which may use the aforementioned powers to legitimately interfere with human rights and fundamental freedoms when such an interference is considered to be in the public interest (Modic, Lobnikar, & Dvojmoč, 2014). This is also the point when citizens mostly come in touch with private security guards. Therefore, it is important to know how they perceive and understand the work of private security guards and the nature of private security – a form of policing that is not provided by the state.

The paper is based on a survey about Ljubljana residents' knowledge of and satisfaction with the work conducted by private security guards. In all previous studies dealing with the nature and work of private security guards in Slovenia, respondents were mainly students, while this time study was done among general population – residents of Ljubljana. Since this is the biggest urban area in Slovenia, and we can assume that contacts between citizens and private security guards are more common than in rural areas, results of the study can be more easily generalised.

2 PREVIOUS RESEARCH STUDIES ON THE KNOWLEDGE OF AND SATISFACTION WITH PRIVATE SECURITY GUARDS' WORK

A considerable number of studies aimed at assessing the knowledge of and satisfaction with the work performed by private security guards was conducted across the globe, initially in the Western world, then in Asia and recently in Russia. On a sample of 209 respondents, Shearing, Stenning, and Addario (1985) found that Canada's residents had mostly held a positive attitude towards security guards already in 1985. Similar results were obtained by Nalla and Heraux (2003) on a sample of 631 students in the USA. Respondents generally had a positive attitude towards security guards' work, however, students who had previously been in some type of contact with security personnel expressed a negative opinion regarding the nature of their work and their degree of professionalism. Nalla and Lim (2003) conducted a similar survey on a sample of 260 students in Singapore and their results were not substantially different from those obtained on the student population in the USA. When Nalla and Hwang (2004) carried out the study on a sample of 172 students in South Korea, they found that students expressed a

predominantly positive attitude towards security guards. The differences in terms of the degree of their satisfaction with the security guards' work were evident particularly in relation to the respondents' gender, their family income level and employment status. However, the results of research studies involving the general and not only student population are even more important for the purpose of this paper. The findings of Van Steden and Nalla (2010), who conducted a study on a sample of 428 residents in the Netherlands, show that they were mostly satisfied with the work performed by private security guards, however, residents who had a positive experience with security guards expressed a higher degree of satisfaction with their work. A similar conclusion may be drawn from the results of a study involving the residents of India (Nalla, Ommi, & Murthy, 2013). In addition, the findings of a study conducted by Moreira et al. (2015) on a sample of 163 residents in Portugal, which focused on the satisfaction with security guards' work, show that security guards' responsible and professional conduct was the most relevant factor influencing the degree of respondents' satisfaction with their work. Nalla, Gurinskaya, and Rafailova (2017) examined the knowledge of and satisfaction with security guards' work in Russia. They carried out the study on a sample of 364 students and found they had rather diverging views of the nature of security guards' work, their professionalism and effectiveness. Once again, positive contacts with security guards also proved to be a strong predictor of the students' satisfaction in Russia.

In Slovenia, the knowledge of and satisfaction with private security guards' work remains rather under-researched, since studies conducted thus far only involved the student population, while the opinion of the general public has yet to be explored. This is also confirmed in studies on plural policing in Slovenia, where Lobnikar, Sotlar, and Modic (2015) and Sotlar, Modic, and Lobnikar (2016) find out that public opinion on the police is well researched, while we now only little how citizens perceive other organisations of "plural police family" like municipal warden service, customs service, judicial police and especially private security.

However, the knowledge of and satisfaction with private security guards' work was the subject of two research projects carried out in Slovenia in the scope of two years. The first study was conducted in 2004 on a sample of 407 students (Nalla, Meško, Sotlar, & Bodiroža, 2004), while the second study was carried out in 2006 on a sample of 509 students (Nalla, Meško, Sotlar, & Johnson, 2006). The findings of both studies showed that students held a negative opinion of private security guards. Students believed that private security guards lacked education, were insufficiently trained and unprofessional in performing their work. On the other hand, both studies also revealed that students believed that the activities and services provided by private security companies in Slovenia were necessary and in the general interest.

3 RESEARCH PROBLEM

The need for further research in the field of private security motivated the authors of this paper to look into an issue that had not yet been explored in Slovenia. When studying the field of private security, the authors were faced with the fact that

researchers had yet to discover what the general public thinks and knows about the work of private security guards and how it perceived and accepted their work. Following a literature review, the authors found that numerous research studies were dealing with police activities and the knowledge of and satisfaction with police work, while the opinion of the general public on private security remained unknown. In order to remedy the situation, the authors decided to research the described issue among the residents of Ljubljana[1]. The aim of this research study was to determine whether residents were familiar with the work performed by private security guards and whether they were satisfied with their work. At the same time, the researchers wished to define the main factors influencing the degree of satisfaction. To that aim, they posed several research questions related to the way in which respondents perceived security guards or their work, which was the best predictor of their satisfaction with security guards' work and whether there were any links or mutual cooperation between police officers and security guards. In order to verify and validate their findings, the researchers had initially set the following six hypotheses:

H1: The satisfaction of residents of Ljubljana with the work performed by security guards primarily depends on respondents' confidence in their work, the help and assistance provided by security guards, security guards' attitude towards residents and residents' experience with security guards' work.

H2: Security guards are well trained; they are well educated and professional.

H3: The residents of Ljubljana believe that the work performed by security guards is demanding, stressful and dangerous.

H4: The residents of Ljubljana believe that security guards and police officers cooperate in providing security on the territory of Ljubljana.

H5: Ljubljana residents' age and gender influence their perception of security guards.

H6: Respondents' previous experience with security guards' work or the fact that their parents or relatives work in private security companies, civil service or the police has an impact on their perception of security guards' work.

4 METHODS

4.1 Survey Questionnaire and Data Collection

Data were collected with a survey questionnaire, which was a modified and adapted version of the questionnaire used by Nalla and his colleagues (Nalla, et. al, 2004, 2006; Van Steden & Nalla, 2010), who had already conducted similar research studies both in Slovenia and abroad by surveying different entities, students and the general population. For the purpose of this survey, the questionnaire used in previous studies was examined in order to identify and adapt those questions that corresponded to the aims of the present survey. The questionnaire was translated from English into Slovene and then back into English. The aim of such a re-translation was to verify whether the content of the questions was

1 *Ljubljana is the capital of Slovenia and has a total of 292.988 residents (City of Ljubljana, 2019).*

translated adequately. The questionnaire used in this research study consisted of 29 closed-ended questions, which were divided into the following 6 sections:

- satisfaction with the work performed by security guards,
- experience with the work performed by security guards,
- security guards' professionalism,
- nature of security guards' work,
- cooperation between police officers and security guards, and
- demographic data.

The responses were provided on a 5-point Likert scale, while one of the sub-questions required a *yes*/*no* answer.

The research study on the knowledge of and satisfaction with the work performed by private security guards (opinions on complexity, stressfulness and danger on one side and satisfaction with private security guards work) was conducted in Ljubljana. As the capital of Slovenia, Ljubljana is an urban area, which is why the researchers presumed that the scope of activities performed by private security guards was much broader than in other parts of the country. Data were collected by Valicon d.o.o., a company providing marketing consulting and research services. Data were collected by an online survey available on the company's website and a telephone survey. Such a combination of data collection methods was necessary in order to cover the age structure of respondents, which spanned from 18 to 75. The researchers presumed that the majority of respondents falling into the over 60 age group did not use the internet, which is why they were targeted by the telephone survey. However, data obtained both online as well as by telephone were weighted by using the combined weight method in order to guarantee the representativeness of the sample in terms of gender and age. The described weighing method also ensured the representativeness of data in terms of gender and age.

4.2 Sample Description

The sample consists of 332 randomly selected residents. The data they provided were weighted in order to obtain the most representative sample of the city of Ljubljana. Respondents participating in the survey were between 18 and 75 years of age. The sample was created by applying the probability sampling technique. Table 1 shows that the sample of 332 respondents consisted of 161 male and 171 female respondents. The share of female respondents is higher than the share of male respondents by three percent.

Table 1: Respondents by gender

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Male	161	48.6	48.6	48.6
	Female	171	51.4	51.4	100.0
	Total	332	100.0	100.0	

Table 2 shows that the average age of respondents was 44. Half of respondents were younger than 42 (median), while the majority of respondents were 42 years of age (modus). The youngest respondent was 19 and the oldest respondent was 75.

Table 2: Respondents by age

Number	**Valid**	**332**
	Missing	**0**
Average value		44.3
Median		42.0
Modus		42.0
Minimum value		19.0
Maximum value		75.0

Apart from respondents' gender and age, the demographic data section also included a question aimed at determining the number of respondents whose family members or relatives were employed in civil service/police or in the private security sector. It turned out that only 13 percent of respondents had at least one relative working in civil service or the police (Table 3).

Table 3: Do any of your parents/relatives work in the civil service/police?

		Frequency	**Percent**	**Valid percent**	**Cumulative percent**
Valid	Yes	44	13.3	13.3	13.3
	No	288	86.7	86.7	100.0
	Total	332	100.0	100.0	

A mere six percent of respondents stated that one of their parents or relatives worked in the private security sector (Table 4).

Table 4: Do any of your parents/relatives work in the private security sector?

		Frequency	**Percent**	**Valid percent**	**Cumulative percent**
Valid	Yes	19	5.9	5.9	5.9
	No	313	94.1	94.1	100.0
	Total	332	100.0	100.0	

5 RESULTS

5.1 Satisfaction with the Work Performed by Private Security Guards

The research results are presented according to the individual sections of the questionnaire in order to ensure the transparency of data analysis, since each of the six sections corresponds to a hypothesis presented above.

The first section deals with respondents' satisfaction with the work performed by private security guards. The researchers wished to determine whether respondents were generally satisfied with their work, establish which factors played the most significant role in defining respondents' degree of satisfaction and find whether these factors had been included in the survey. The researchers

set down the following hypothesis: H1 –*The satisfaction with the work performed by security guards primarily depends on respondents' confidence in their work, the help and assistance provided by security guards, security guards' attitude towards residents and residents' experience with security guards' work*. The validity of the hypothesis was verified by conducting the regression analysis.

Table 5: The assessment of regression coefficients and their statistical significance

Model		Unstandardized coefficient		Standardized coefficient	*t*	*p*-value	Correlation		
		B	*SE*	Beta				*SE*	*SE*
1	(constant)	1.137	.366		3.107	.002			
	The public generally trusts security guards with the protection of their lives and property.	.168	.062	.172	2.700	.008	.601	.199	.125
	The work performed by security guards contributes to the general safety and security.	.106	.071	.099	1.508	.133	.570	.113	.070
	Security guards generally help people.	.270	.066	.277	4.086	.000	.670	.294	.190
	Security guards understand the needs of the public.	.144	.067	.144	2.153	.033	.613	.160	.100
	Security guards abuse their powers.	–.162	.059	–.164	–2.735	.007	–.527	–.202	–.127
	Security guards are not aware of the needs of their clients.	–.012	.052	–.012	–.234	.815	–.288	–.018	–.011
	Security guards' attitude towards residents is marked by friendliness and correctness.	–.035	.067	–.035	–.517	.606	.539	–.039	–.024
	...your experience with security guards' work.	.152	.062	.177	2.444	.016	.647	.181	.113
a. Dependent variable: I am satisfied with the work performed by security guards.									

The results of regression analysis show that the variable *I am satisfied with the work performed by security guards* is mostly influenced by the following variables (Table 5): *The public generally trusts security guards with the protection of their lives and property* ($B = 0.168$; $p < 0.05$), *Security guards generally help people* ($B = 0.270$; $p < 0.05$), *Security guards understand the needs of the public* ($B = 0.144$; $p < 0.05$), *Security guards abuse their powers* ($B = 0.162$; $p < 0.05$) and...*your experience with security guards' work* ($B = 0.152$; $p < 0.05$). It is therefore reasonable to conclude that the variable *I am satisfied with the work performed by security guards* is most strongly correlated with the variable *Security guards generally help people*, while it exhibits a negative correlation with the predictive variable *Security guards abuse their powers*. In light of the results obtained by regression analysis, the first hypothesis (H1) can be confirmed in the part that "the satisfaction with the work performed by security guards primarily depends on respondents' confidence in their work, the help and assistance provided by security guards, and residents' experience with security guards' work" but not to the security guards' attitude towards residents ($p = 0.606 > 0.05$) and also not to the security guards' contribution to the general safety and security ($p = 0.133 > 0.05$).

5.2 Security Guards' Professionalism

In the section on security guards' professionalism, the researchers were interested in exploring how the residents of Ljubljana perceived security guards or, in other words, what was their general opinion of security guards as the entities responsible for the provision of security. Responses to the questionnaire were measured on a 5-point scale, where 1 meant *I fully disagree* and 5 stood for *I fully agree*. The researchers set the following hypothesis: H2 – *Security guards are well trained; they are well educated and professional*. The validity of this hypothesis was verified by the *t*-test and the test value, i.e. $\mu = 3$. Therefore, according to the null hypothesis, the average value equals 3 i.e. indeterminate, while the average value is different from 3 (i.e. agree or disagree) according to the opposite hypothesis.

Table 6 shows that the null hypothesis for the variable *Security guards are well trained* and variable *Security guards are well educated* can be rejected. The results of the *t*-test revealed that Ljubljana residents believed that security guards were well trained ($t = 2.495$; $p < 0.05$), however, they were also of the opinion that security guards lacked education ($t = –9.040$; $p < 0.05$). On the other hand, the null hypothesis in relation to the variable *Security guards are professionals* ($t = –1.112$; $p > 0.05$) cannot be rejected, which means that Ljubljana residents believed that security guards were relatively professional or did not know which answer to choose.

Table 6: *t*-test

	Tested value = 3					
					95% confidence interval for difference	
	T	Degree of freedom	*p*-value (2-tailed)	Difference from the median value	Lower	Upper
Security guards are well educated.	–9.040	331	.000	–.476	–.58	–.37
Security guards are well trained.	2.495	331	.013	.133	.03	.24
Security guards are professionals.	–1.112	331	.267	–.062	–.17	.05

* Answers on the scale from 1 - *I fully disagree to 5 - I fully agree.*

5.3 Nature of Security Guards' Work

This section was devoted to examining how the residents of Ljubljana perceived the work performed by security guards or, in other words, what was their opinion of the work performed by security guards. The researchers formulated the hollowing hypothesis: H3 – *The residents of Ljubljana believe that the work of security guards is demanding, stressful and dangerous*. This hypothesis was verified with the *t*-test, which confirmed the researchers' presumptions. Table 7 thus shows that the residents of Ljubljana believe that the work performed by private security guards is stressful ($t = 17.231$; $p < 0.05$), dangerous ($t = 23.294$; $p < 0.05$), and demanding ($t = 15.563$; $p < 0.05$).

Table 7: *t*-test

	Tested value = 3					
					95% confidence interval for difference	
	T	Degree of freedom	*p*-value (2-tailed)	Difference from the median value	Lower	Upper
Security guards' work is stressful.	17.231	331	.000	.863	.76	.96
Security guards' work is dangerous.	23.294	331	.000	.992	.91	1.08
Security guards' work is demanding.	15.563	331	.000	.812	.71	.91

* Answers on the scale from 1 - *I fully disagree* to 5 - *I fully agree*.

5.4 Cooperation between Police Officers and Private Security Guards

In the section focusing of mutual cooperation between police officers and private security guards, researchers wished to establish whether the residents of Ljubljana believed that police officers and private security guards cooperated in providing the safety and security of the city. The researchers presented the following hypothesis: H4 – *The residents of Ljubljana believe that security guards and police officers cooperate in providing security on the territory of Ljubljana*.

To check the validity of the aforementioned hypothesis H4 the *t*-test was applied to the data collected with the question *Do security guards and police officers collaborate providing the safety and security in the society?*. Answers were on the scale from 1 - *I fully disagree* to 5 - *I fully agree*. It was found that the residents of Ljubljana believed that police officers and security guards cooperated in providing the safety and security in the society (test value 3; $t = 10.125$; $p < 0.05$).

5.5 The Impact of Gender and Age on the Perception of Private Security Guards' Professionalism

The researchers also wished to establish whether the gender and age of Ljubljana residents had any impact on their opinion regarding private security guards. They formulated the following hypothesis: H5 – *Ljubljana residents' age and gender influence their perception of security guards*. This hypothesis was validated with the analysis of variance. First the factor analysis was conducted on a set of five questions measuring citizens' perceptions of security guards capability to manage complex situations, professionalism, education and training to obtain single factor solution presenting the security guards professionalism. This single factor was then used in the ANOVA to validate the H5 hypothesis.

The factor analysis of the five variables within the security guards' professionalism section ($\alpha = 0.82$; *KMO* = 0.86) served as the basis for establishing a single-factor model (Table 9), while the eliminated factor, which was entitled *Security guards' professionalism*, can be used to explain 68.32% of variance, which clearly shows a strong correlation between the analysed variables and the eliminated factor (Šifrer & Bren, 2011).

	Factor
	1
Security officers are trained to manage complex situations.	.854
Security guards are professionals.	.847
Security guards are well educated.	.841
Security guards are well trained.	.841
Security guards are honest.	.744
Elimination method: principal component analysis	
a. a single eliminated factor.	

Table 8: Factor weights matrix

The categorisation of age groups was subsequently performed with the view of conducting the analysis of variance. Six age groups, which included respondents from 18 years of age onwards, were thus formed (Table 10).

Age category		Frequency	Percent	Valid percent	Cumulative percent
Valid	18 to 25	46	13.9	13.9	13.9
	26 to 35	63	19.0	19.0	32.9
	36 to 45	75	22.7	22.7	55.6
	46 to 55	56	17.0	17.0	72.6
	56 to 65	49	14.8	14.8	87.4
	over 65	42	12.6	12.6	100.0
	Total	332	100.0	100.0	

Table 9: Respondents' age groups

The factor *Security guards' professionalism* was then subjected to the analysis of variance (Table 11), which led to the conclusion that the age of Ljubljana residents indeed influenced their perception of security guards ($F = 1.363$; $p = 0.032 < 0.05$). The results of this analysis therefore make it possible to conclude that respondents' age influences their perception of security guards (older respondents perceive security officers as more professional). In contrast, residents' gender proved to have little or no impact ($F = 0.930$; $p = 0.679 > 0.05$). Since the factor *Security guards' professionalism* is evaluated as standardised variable, its values cannot be interpreted, for example the female-male averages are 0.027, –0.007 respectively, and standard deviations 0.96 and 0.99 respectively.

		Sum of squares	Degree of freedom	Square of average value	*F*	*p*-value
Age	Between groups	57626.586	213	270.547	1.363	.032
	Within groups	23225.877	117	198.512		
	Total	80852.463	330			
Gen-der	Between groups	52.133	213	.245	.930	.679
	Within groups	30.805	117	.263		
	Total	82.938	330			

Table 10: Analysis of variance – ANOVA

5.6 The Impact of Respondents' Experience with Security Guards' Work and the Employment of Respondents' Relatives in Private Security, Civil Service or the Police

One of the presumptions of this research project was that respondents, who already had previous experience with security guards' work or whose family members work in the police or the private security sector, might have a different perception of security guards work than other respondents. Thus, the following hypothesis was devised: H6 – *Respondents' previous experience with security guards' work or the fact that their parents or relatives work in private security companies, civil service or in the police has an impact on their perception of security officers' work*. The hypothesis was validated by applying the discriminant analysis on the set of five questions regarding the perception of the nature of security guards work, i.e. that their work is stressful, dangerous, demanding etc.

The discriminant analysis was conducted with the aim of comparing the differences within four groups, which were divided on the basis of the following questions: *Did respondents already have any experience with security guards' work*? (*yes/no*); *What was the nature of that experience?* (*positive/negative*); *Are respondents' parents or relatives working in civil service or the police?* (*yes/no*); *Are respondents' parents or relatives working in the private security sector?* (*yes/no*). The results of the analysis show that there are no statistically significant differences between these four groups, which means that the opinions of the Ljubljana residents of the work performed by security guards are rather uniform. A statistically significant model could only be observed when comparing the group of residents, whose relatives work in civil service/police, and the group of residents, whose relatives do not work in these sectors.

Table 12 shows that the Wilks' lambda had a statistically significant value in this case, since the p-value was lower than 0.05. Therefore, the obtained model is statistically significant, which means that there are statistically significant differences between respondents, whose parents or relatives work in civil service or the police, and those respondents, whose parents or relatives do not work in the civil service or the police. Respondents, whose parents or relatives work in the civil service or the police, perceive the work performed by security guards as more dangerous, but less stressful and demanding. Furthermore, the results obtained with respect to the statement *Security guards should be well paid* show a difference, which is very close to the statistically significant value ($p = 0.057$), due to the fact that this group of respondents attributed less importance to it.

Table 12: Wilks' lambda

Function test	Wilks' lambda	chi-square	Degree of freedom	*p*-value
1	.964	11.966	5	.035

These findings clearly show that the perception of security guards' work is only influenced by the fact that respondents' parents or relatives worked in the civil service/police, while their previous experience with security guards' work, the nature of that experience or the fact that their parents or relatives worked in the private security sector had little or no impact.

6 DISCUSSION

In Slovenia, the knowledge of and satisfaction with private security guards' work remains rather under-researched, since studies conducted thus far only involved the student population, while the opinion of the general population had yet to be explored. The literature review reveals that surveys, which were predominantly conducted in other countries, show that the satisfaction with the work performed by private security guards is generally assessed as positive by both students and the general public. These studies also show that positive contacts or positive experience with security guards were a strong predictor of the respondents' satisfaction with their work. The knowledge of and satisfaction with private security guards' work was the subject of two research projects carried out in Slovenia. Both studies were conducted on a sample of the student population (Nalla et al., 2004, 2006). Students were generally dissatisfied with the work performed by security guards and they believed that security guards lacked professionalism and education.

Even though the results obtained from the student population had been rather negative, the findings of the present study are much more encouraging. The general population – residents of Ljubljana – appear to be satisfied with the work performed by security guards and believe their work to be stressful and dangerous. However, the residents of Ljubljana still hold a negative opinion regarding security guards' education and professionalism. This very finding may be of key importance for all companies providing private security services in Slovenia. They may consider using the results of this survey to plan their education and training, professional socialisation and public relations processes, thus improving the degree of professionalism among security guards. Research findings clearly indicate that a higher degree of professionalism would greatly contribute to a more positive assessment of security guards by members of the general public. In this context another result of our study must be stressed, i.e. that respondents' age influences their perception of security guards professionalism meaning that older respondents perceive security officers as more professional.

These findings also guarantee the comparability of data and results obtained by similar studies conducted abroad. In particular, they may be compared with the findings of studies that involved the general population in the Netherlands, Portugal and India. The findings of all of these studies depict a rather uniform picture, i.e. the overall satisfaction of the general population with the work performed by security guards. The findings of studies conducted abroad show that positive contacts with security guards are the strongest predictor of satisfaction with their work, while the findings of this particular study carried out in Slovenia show that residents' satisfaction mainly depends on their trust in security guards' work, the help and assistance provided by security guards, security guards' attitude towards residents and residents' experience with security guards' work but not to the security guards' attitude towards residents and also not to the security guards' contribution to the general safety and security.

This study also represents an important starting point for further research of residents' attitudes towards private security guards in other cities and/or across Slovenia, as well as towards members of other organisations of plural policing.

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Residents' Views on Cyclist Safety and Cycling Infrastructure in the City Municipality of Celje

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Purpose:

The paper presents the results of two research studies analysing the views of different target populations on cyclist safety and the adequacy of preventive measures in Slovenia. The purpose of both research studies was to identify the shortcomings of different approaches to ensuring cyclist safety, evaluate the adequacy of planned solutions and propose some improvements of preventive actions taken by various stakeholders.

Design/Methods/Approach:

A field survey was conducted among the residents of the City Municipality of Celje (n = 171) on their satisfaction with cyclist safety, while an online survey was carried out among internet users (n = 210) on the usefulness of an alternative approach to raise cyclists' awareness by digitising cycling routes and safety risks.

Findings:

Results show that respondents are generally not satisfied with cyclist safety, as most believe that municipal efforts are insufficient to ensure it. It was observed that cycling infrastructure needs to be properly regulated and that a positive traffic culture should be promoted at the municipal level, including through the promotion of preventive activities. Both internet users and local residents recognise a strong need to digitise cycle paths by indicating safety risks. Therefore, it would be reasonable to upgrade conventional approaches to raising public awareness by introducing solutions that are useful for cyclists.

Research Limitations/Implications:

The limitation of the research study arises from the fact that its results cannot be generalised to all municipalities, since they apply different approaches to ensuring cyclist safety due to their autonomy and are facing different safety risks. Moreover, due to the use of a non-random sample, caution is necessary when generalising research results.

Practical Implications:

The results of the presented studies are primarily useful to decision-makers and infrastructure managers at national and local level when planning changes and safety measures in the field of cyclist safety.

Originality/Value:

The paper encompasses two studies, the findings of which complement one another substantially and provide a deeper insight into the issues of cyclist safety and preventive actions taken by different stakeholders. They serve as a basis for further exploring this issue in different local environments with a view of obtaining a more comprehensive insight into the key challenges of traffic safety from a broader perspective.

UDC: 351.78:656.183

Keywords: safety, cyclists, cycling infrastructure, safety risks, resident's perceptions, City Municipality of Celje

Stališča prebivalcev o varnosti kolesarjev in kolesarski infrastrukturi v Mestni občini Celje

Namen prispevka:

V prispevku predstavljamo rezultate raziskav, s katerima smo analizirali stališča različnih ciljnih populacij o kolesarski varnosti in primernosti preventivnih ukrepov v Sloveniji. Namen raziskav je ugotoviti pomanjkljivosti v pristopih k zagotavljanju varnosti kolesarjev, oceniti primernost načrtovanih rešitev in predlagati izboljšave na področju preventivnega ukrepanja različnih deležnikov.

Metode:

V okviru prispevka smo izvedli terensko raziskavo med prebivalci Mestne občine Celje (n = 171) o zadovoljstvu z urejenostjo kolesarske varnosti in spletno anketo med uporabniki spleta (n = 210) o uporabnosti alternativnega pristopa k ozaveščanju kolesarjev skozi digitalizacijo kolesarskih poti in varnostnih tveganjih.

Ugotovitve:

Rezultati kažejo, da anketiranci na splošno niso zadovoljni z varnostjo kolesarjev, saj večina meni, da občina za varnost kolesarjev ne naredi dovolj. Ugotavljamo, da je na ravni občine treba zagotoviti ustrezno urejenost kolesarske infrastrukture in spodbujati kulturo udeležencev v cestnem prometu, tudi skozi spodbujanje preventivnega ukrepanja. Uporabniki spleta kot tudi prebivalci Mestne občine Celje prepoznavajo visoko potrebo po digitalizaciji kolesarskih poti z označbo varnostnih tveganj, zato je smiselno klasične pristope k ozaveščanju javnosti nadgraditi z rešitvami, ki so uporabne za kolesarje.

Omejitve/uporabnost raziskave:

Omejitev raziskave je v tem, da je ne gre posplošiti na vse občine, saj občine zaradi svoje suverenosti različno pristopajo k zagotavljanju varnosti kolesarjev, prav tako pa se v vsaki občini pojavljajo različna varnostna tveganja. Obenem je zaradi neslučajnostnega vzorca potrebna previdnost tudi pri posploševanju rezultatov raziskave.

Praktična uporabnost:

Rezultati prispevka so primarno uporabni za odločevalce in upravljavce na državni ravni ter lokalni ravni pri načrtovanju sprememb in varnostnih ukrepov na področju varnosti kolesarjev.

Izvirnost/pomembnost prispevka:

Prispevek vključuje raziskavi, katerih ugotovitve se pomembno dopolnjujejo in omogočajo globlji vpogled v problematiko varnosti kolesarjev ter preventivnega ukrepanja različnih deležnikov. Prispevek predstavlja podlago za nadaljnje raziskovanje tovrstne problematike v različnih lokalnih okoljih za pridobitev celovitejšega vpogleda v ključne izzive prometne varnosti na širši ravni.

UDK: 351.78:656.183

Ključne besede: varnost, kolesarji, kolesarska infrastruktura, varnostna tveganja, stališča prebivalcev, Mestna občina Celje

1 INTRODUCTION

Developed countries are increasingly focusing on the environmental protection, healthy lifestyles, better traffic management and, hence, alternative concepts of sustainable mobility when drafting their development priorities. Recent trends in Slovenia show that the share of physically active population has been increasing, which may also be observed in the growth of various types of cycling (Kolesarska zveza Slovenije [Slovenian Cycling Federation], n. d.), such as cycling as a form of recreational or sports activity, cycling for families or tourist groups and occasional cycling. Therefore, cycling infrastructure is increasingly congested and cyclists tend to be among the most vulnerable road users due to their defencelessness and exposure to numerous risks (Policija [Police], n. d. a). Traffic accidents involving cyclists often produce severe consequences, which is clearly demonstrated by numerous fatalities and injuries. In Slovenia, the number of such accidents is very high and exceeds the EU average (European Commission [EC], n. d.), which is why it is extremely important to ensure greater traffic safety and raise public awareness about cyclist safety and related issues.

A study conducted by researchers in the US and Canada on associations between cyclists' characteristics, availability of cycling infrastructure and the perceptions of cycling shows that the availability of cycling infrastructure is strongly correlated with the perception or, to put it differently, the feeling of safety. Therefore, increasing the availability of cycling infrastructure in cities would make it significantly more likely for respondents to perceive cycling as safer and enhance the frequency of cycling, even though personal characteristics also have an important role in such perceptions (Branion-Calles, Nelson, Fuller, Gauvin, & Winters, 2019). A study assessing the impacts of building a separate cycling infrastructure on drivers' behaviour shows, for instance, that separate cycling infrastructure would substantially reduce cyclists' exposure to risks and the likelihood of traffic accidents, however, researchers note that the construction of separate cycling infrastructure might also produce a negative impact. The greater

absence of cyclists from mixed traffic situations could impair proper behaviour and reduce tolerance to cyclists, particularly among drivers, which would in turn increase the risk for cyclists on the roads (Thompson, Wijnands, Savino, Lawrence, & Stevenson, 2017). Therefore, adequate road or cycling infrastructure combined with measures for maintaining the roadworthiness of vehicles and promoting proper behaviour of all road users seems to be the most important aspect for guaranteeing cyclist safety in road traffic (Javna agencija Republike Slovenije za varnost prometa [Slovenian Traffic Safety Agency, STSA], 2013c; Šumah, 2012).

The lack of cyclists' awareness of safety risks and the specific characteristics of cycle paths, as well as insufficient cycling infrastructure, particularly in urban environments and cities, represent the most prominent issues in the field of cyclist safety in Slovenia (Belca et al., 2018a, 2018b, 2018c; Brcar, 2017). Due to insufficient and poorly executed or maintained cycling infrastructure, municipalities in Slovenia are perceived to be rather unfavourable to cyclists (STSA, 2013b). According to the STSA, problems related to cyclist safety also arise from the fact that Slovenia currently has no institution that would deal with cyclist safety and cycling as a mode of transport in a comprehensive manner and that in practice, cycling is generally not considered as an integral part of road traffic (STSA, 2017b).

Better planning of cycling traffic and the construction of adequate cycling infrastructure would boost a more widespread use of bicycles, thus contributing to greater mobility and to tackling issues related to traffic flow capacity, while simultaneously improving cyclist safety (Šumah, 2012). Improving cycling infrastructure is the first step towards increasing the share of cycling in cities, however, it is currently hindered by a haphazard approach to the construction of adequate infrastructure and the lack of strategy, which may be observed in the implementation of individual, separate and unconnected projects (Ministrstvo za infrastrukturo [Ministry of Infrastructure, MI], 2017). This is also confirmed by the programme of activities for cyclists, which states that the reason for the (still) insufficient number of cyclists in road traffic is primarily related to the underdeveloped cycling infrastructure and extremely flawed legislative framework (MI, 2017). Accordingly, statistical data show that most traffic accidents involving cyclists occur in built-up areas, which clearly points to the need for adopting more efficient measures at the local level and for a greater interaction between national and local levels (STSA, 2017b). Apart from the provision of adequate infrastructure, other important measures contributing to greater cyclist safety also include raising the awareness of all road users about preventive behaviours and the promotion of appropriate road traffic culture. Currently, there is no comprehensive overview of the situation in the field of cycling infrastructure in Slovenia, which would provide cyclists with the necessary information about the condition and difficulty levels on individual cycle paths, thus enabling them to prepare for potential perils and risks. Moreover, the likelihood of traffic accidents is much higher due to road users' poor driving culture or, in other words, the inconsiderate attitude towards the safety of other users, which is often reflected in intolerance and violation of the highway code.

This paper presents the results of two quantitative research studies analysing the views of two different target groups on cyclist safety and the adequacy of

preventive measures. The two studies were aimed at establishing shortcomings in the provision of cyclist safety, evaluating the suitability of planned solutions and proposing improvements in the field of preventive action. Since traffic accidents involving cyclists in the Savinjska region (a region in the centre-east of Slovenia), which is currently witnessing a strong upward trend in cycling, are extremely frequent and well above Slovenia's average, the researchers decided to analyse the level of satisfaction with the current cycling infrastructure and cyclist safety among the residents of its largest municipality (i.e. Mestna občina Celje [The City Municipality of Celje, CMC]). In the second study, internet users were asked to share their views on the need to digitise cycle paths, their characteristics and safety risks in order to evaluate potential positive implications of such information and awareness raising activities.

2 SAFETY SITUATION AND THE REGULATORY FRAMEWORK GOVERNING CYCLE PATHS IN SLOVENIA

Discussions about the need to improve the traffic safety of cyclists by focusing on the protection of vulnerable road users have been widely promulgated in 2013 by the European Transport Safety Council (ETSC), while the European Parliament proposed its own initiatives for improving the situation and called upon the EC and Member States to consider pedestrians and cyclists as an integral part of the traffic system (STSA, 2013a). Calls for expanding and improving cycling infrastructure with a view to provide a higher level of cyclist safety are also evident from reports on cyclist safety in south-east European regions (ROSEE, 2013; STSA, 2013c). According to the EC (2017), roads in the EU are the safest in the world, however, the number of fatalities and injuries remain too high. In 2016, the average number of fatalities among cyclists in Europe amounted to four per million population, while the average in Slovenia reached 5.8, which means that Slovenia ranks 8th when it comes to the annual number of fatalities among cyclists per million population (EC, 2017). Therefore, Slovenia is one of the countries in which the share of fatalities among cyclists is higher than the EU average and is thus facing an important traffic safety issue which it needs to address accordingly.

Results of the STSA annual reports show that in the last five years, the average number of fatalities among cyclists in Slovenia has remained more or less the same, namely 11.8 (STSA, 2019). On the basis of statistical data regarding the number of fatalities among cyclists, these may be broken down into different categories, for instance, according to the cause and type of accident, cyclists' age or gender. In this respect, the STSA finds that a whopping 25% of all fatalities involve cyclists older than 55 years of age. Accordingly, the Slovenian Police (Policija [Police], n. d. b) also state that older cyclists represent the most vulnerable road users. In Slovenia, the largest share (66%) of accidents resulting in a grave injury or death of a cyclist is actually caused by cyclists themselves, who fail to comply with the highway code rules regarding priority, speeding or riding in the wrong direction (STSA, 2019). According to Gabršček (2015), the growing number of cyclists in road traffic often leads to conflicts between cyclists, drivers

and pedestrians. This means that cyclists themselves can contribute significantly to the reduction of accidents by engaging in self-protective behaviour, complying with the rules and acting according to their capabilities; at the same time, State and municipal bodies can also achieve great progress by adopting adequate infrastructure plans and preventive measures. The STSA (2013b) observes that it would also be necessary to improve statistical data management practices and the quality of analytical data on traffic accidents involving cyclists, particularly in terms of processing statistical data according to the type of cyclist. This could contribute to the development of more suitable and efficient preventive measures and promotional activities aimed at specific target groups.

To understand cyclist safety concerns and current challenges it is not only important to study the actual state-of-play, but to also consider the guidelines or directives adopted in international and national strategies. The EU decided to tackle these issues by adopting the Vision Zero and Safe System approach aimed at eliminating fatalities and serious injuries caused by road accidents on all European roads, which requires close cooperation with competent authorities of its Member States. This approach is implemented by adopting laws, supporting public education campaigns, helping Member States and other road safety actors in sharing relevant experience and providing co-funding to support similar campaigns and preventive measures (EC, n. d.).

Slovenia pursues similar goals, as its Resolucija o nacionalnem programu varnosti cestnega prometa za obdobje od 2013 do 2022 (Resolution on the National Programme on Road Traffic Safety for the 2013–2022 period, 2013; henceforth: Resolution) sets out the following long-term goal: "zero deaths and zero serious injuries cause by road accidents in Slovenia". The Resolution imposes an obligation on State authorities and organisations, authorities of local self-government communities, expert bodies, civil society organisations and individuals to dedicate any decisions and actions towards its implementation, as well as to adapt and plan the traffic system with a view of preventing further fatalities and injuries (Resolution, 2013). The STSA, whose mission is to reduce the worst consequences of traffic accidents (fatalities and injuries of road users), is particularly active in this field (STSA, 2010).

In Slovenia, the two most important legal acts regulating cyclist safety and defining the responsibilities of individual stakeholders are the Road Traffic Rules Act (Zakon o pravilih cestnega prometa, 2013) and the Roads Act (Zakon o cestah, 2010). The Road Traffic Rules Act (Zakon o pravilih cestnega prometa, 2013) stipulates rules applicable to riding a bicycle, regulates cycling areas, defines the principles of road (and cycling) traffic, and prescribes the conduct of road users in order to guarantee free-flowing, calm and safe traffic. The Act also imposes the obligation to obey the rules and prescribes detailed conditions for riding a bicycle and cycling in road traffic. It stipulates that cyclists are obliged to ride their bicycles on designated cycle paths, cycle lanes or cycle routes, observe traffic signalisation (traffic signs, illuminated signs and road markings), as well as maintain their bicycles and other equipment (lights, protective helmet and reflectors) in good condition (Zakon o pravilih cestnega prometa [Road Traffic Rules Act], 2013). The Roads Act (Zakon o cestah, 2010), which categorises cycling infrastructure

as public service infrastructure, defines, *inter alia*, basic terms related to cycling infrastructure and stipulates the manner of regulating and funding State and municipal cycle routes. Much like public roads, cycling infrastructure must also be properly maintained, which is why Article 62 of the Roads Act (Zakon o cestah, 2010) stipulates that the maintenance of traffic surfaces (including cycling routes) located in built-up areas falls into the remit of municipalities. In addition, municipalities are responsible for the routine maintenance of State cycling routes on municipal roads (Zakon o cestah [Roads Act], 2010). In terms of guaranteeing cyclist safety, the applicable legislation is rather unfavourable to cyclists, since the Roads Act confers a broad discretionary power on infrastructure managers, which means that they are able to invoke numerous reasons (economic, spatial, environmental, etc.) for not complying with the prescribed solutions, which would ensure greater safety for cyclists (STSA, 2013b).

2.1 Regulation of Cycling and Cycle Paths in the City Municipality of Celje

The rise of cycling is closely related to the development of tourism, since increasing numbers of people are engaging in tourist and recreational cycling, which is a particularly noticeable trend in the CMC. The tourism sector in Celje has been growing continuously and recent tourism statistical data show extremely positive and optimistic trends for the future of the CMC (Dorn, 2016). However, the growing flow of people and traffic also increases the likelihood for cyclists to be involved in traffic accidents. The fact that in 2015, a whopping 15% of all traffic accidents involving a cyclist occurred on the territory of the Celje Police Directorate (STSA, 2017a) and that at least one cyclist dies every year in this region is particularly alarming. In the past five year, 12.5% of all injuries among cyclists in Slovenia happened in the Savinjska region, which is why it ranks 3rd when it comes to the frequency of injuries among cyclists (STSA, 2017a). A total of 835 cyclists' injuries were reported between 2012 and 2016 in the Savinjska region (STSA, 2017a) and most accidents involving cyclists, i.e. approximately 85%, occurred in built-up areas (STSA, 2017b).

In the CMC, cycling surfaces are regulated by a specific municipal ordinance, which categorises municipal roads and cycle paths in Celje, however, it fails to specifically mark or separate cycle paths from all other types of paths or roads. This is particularly problematic, as many cycling routes in the CMC run along other road traffic routes, which is why cyclists are often using the roads together with motorised vehicle drivers and are thus more vulnerable (Odlok o kategorizaciji občinskih cest in kolesarskih poti Celje [Ordinance on the Categorisation of Municipal Roads and Cycle Paths in Celje], 2010). Therefore, additional measures, which are addressed below, have been implemented to improve cyclist safety.

The CMC is striving to reduce the negative impacts of traffic by gradually introducing changes to the mobility habits and behaviours of its residents in the scope of various projects aimed at improving cycling infrastructure at the local level. However, in order to change residents' commuting habits, it is vital to provide adequate infrastructure, which would enable the use of alternative

modes of commuting (Razvojni center Inženiringi Celje [Development Center Engineering Celje, DCEC], 2017). To achieve this objective, the CMC is currently implementing various projects aimed at improving the links between urban areas and the outskirts. According to the CMC City Council, this would reduce traffic jams, improve the quality of life in urban areas and increase traffic safety (CMC, n. d.).

Measures aimed at tackling cycling issues have been implemented at the regional and local level. The purpose of regional measures is to build cycling routes across the Savinjska region, thus promoting tourism development and increasing the quality of life for all residents of the region (Razvojna agencija Savinjske regije [Development Agency of the Savinjska Region], 2009). The objective of such measures is to site cycle paths so that they would run across and connect the entire region, thus promoting the use of different options for daily commute and enabling sustainable mobility. In cooperation with the municipalities of Štore, Šentjur, Žalec, Vojnik, Dobrna, and Laško, the CMC completed the preliminary design project for the siting of regional cycling routes. To tackle the issues identified in relation to traffic and workers' mobility, the CMC has also been adopting local measures. For instance, the CMC devised an Integrated Transport Strategy, which contains various measures in the field of sustainable mobility aimed at establishing a high-quality and integrated transport system, which would meet the needs of local residents, businesses and visitors alike (DCEC, 2017). With respect to improving cycling traffic, the CMC first introduced a public bicycle-sharing system. It then focused on providing an integrated cycling network at the local level and ensured the necessary conditions for improving cyclist's daily commute within the city of Celje by regulating the network of cycling routes in the CMC, which – by considering the expectations and habits of modern cyclists – provided access to the most important points of interest (CMC, 2018a). The objective of establishing a network of cycling routes is to create a safe and attractive cycling network on the territory of the CMC by 2022, improve and upgrade existing cycling infrastructure, increase the share of cyclists and simultaneously reduce the number of traffic accidents involving cyclists (CMC, 2018c). Experience from developed European cities shows that the possibility of affordable and convenient parking accompanied with a direct access to the public bicycle-sharing system can substantially reduce traffic-related problems. Therefore, the CMC decided to establish a P&R (park and ride) system, which contributes to the reduction of air and noise pollution, while increasing the attractiveness of urban areas (CMC, 2018b).

2.2 Projects and Measures for Improving Cyclist Safety

With a view of improving cyclist safety, the EU and Slovenia have been implementing numerous preventive activities and projects. For instance, the pan-European BIKE PAL project, which stresses the need to improve cycling safety, particularly in terms of protecting vulnerable road users through the implementation of measures defined in the EC Policy Orientations on Road Safety 2011-2020, is a prominent example of such projects (STSA, 2013a). Its aim is to

improve cycling safety through information and awareness raising of decision- and policy-makers. Researchers working on the BIKE PAL project also ranked EU Member States based on cycling safety, conducted a scientific review of existing policies on cycling safety and used it to devise a manual on safe cycling, which is suitable for all categories of cyclists (European Transport Safety Council, 2014).

In Slovenia, important preventive activities have been carried out by the Zavod Varna pot (Safe Journey Institute). These are based on the Vision Zero and Safe System approach, and include education activities for children, adolescents, their parents and other adults on appropriate conducts and behaviours to ensure road safety at various safe driving ranges and stations (Varna pot [Safe Journey], n. d.). Furthermore, the Federation of Drivers' and Auto Mechanics' Associations organises annual projects for safe cycling, which are carried out in the form of a nation-wide preventive action and entails media campaigns, training courses dedicated to cycling and obtaining a cyclist's licence, activities for the promotion of cycling and inspections of local cycling infrastructure (STSA, 2018b). Apart from awareness raising activities, other projects focusing on sustainable mobility have also been implemented in Slovenia. For instance, researchers working on the CYCLO – Cycling Cities project are striving to promote the use of bicycles as a daily means of transport and develop cycling tourism. They also produced a manual entitled Cycling in the Heart of Slovenia and carried out educational and promotional activities in municipalities across Slovenia (CYCLO, 2012). In addition, Slovenia's municipalities have recently been addressing the need for encouraging mobility by providing public bicycle-sharing systems, which are achieving the desired results. However, as previously mentioned, the growing number of cyclists in urban areas also increases the likelihood of accidents.

As part of the Creative Path to Knowledge Programme (2016–2020), the topic of cyclist safety was addressed in 2018 by the Faculty of Criminal Justice and Security of the University of Maribor [UM] in cooperation with the Faculty of Electrical Engineering and Computer Science of the UM and the SGB d.o.o. company in the framework of a project entitled Digitising and Analysing Safety Risks on Cycle Paths in Slovenia [Datkol:S]. The fundamental premise of the project relied on the fact that the information about the general condition of cycle paths in Slovenia was currently insufficient, while its objective was to improve the availability of information about the safety situation on cycle paths. To improve cyclists' awareness of potential risks identified along popular cycle paths in Slovenia, researchers digitised all safety risks and marked them on publicly available online maps (Belca et al., 2018a, 2018b, 2018c). The project relied on a creative approach to ensuring a higher degree of safety among cyclists by firstly devising a list of the most commonly identified risks on cycle paths and then developing a model, which allows a quantitative assessment of cycle paths' safety. The model was tested on five recreational cycle paths in Slovenia, including on the Teharje – Podčetrtek cycle path (which is part of the CMC). Subsequently, safety risks were analysed and digitised in publicly available online maps. The results are useful to all categories of cyclists, particularly to tourists, who are embarking on a given cycle path for the first time and wish to familiarise themselves about its safety profile. The idea for the project originates from the fact that the information

provided to cyclists about safety risks along certain cycle paths could be improved through digitisation and user-friendly presentation, thus encouraging cyclists to adopt preventive behaviours (Belca et al., 2018a, 2018b, 2018c).

To further analyse issues, challenges and potential solutions related to cyclist safety, a research study was first conducted in the CMC to establish whether its residents were satisfied with the situation regarding cycling infrastructure and cyclist safety. A second study was then carried out to explore internet users' views on the usefulness of digitising cycle paths and safety risks for raising cyclists' awareness and promoting preventive action.

3 METHODOLOGY

This section presents the results and findings of both research studies, which included (1) the analysis of the CMC residents' satisfaction with the situation regarding cycling infrastructure and cyclist safety on cycle paths in Celje [R1]; and (2) the evaluation of the usefulness or practicality of digitising cycle paths and safety risks on the basis of views expressed by internet users [R2]. Both research studies were conducted by applying a survey method, whereby information was gathered by two separate structured questionnaires. The two studies were carried out separately, since they involved different target populations, namely R1 focused on the CMC residents and R2 involved internet users.

R1 was conducted in July 2019; data were gathered by field survey (in shopping centres and the old town centre) in Celje. This method allowed researchers to involve residents of all age groups, thus providing a higher representativeness of results. The questionnaire consisted of five sets of questions and included a total of 45 variables. Researchers assessed residents' satisfaction with the current situation regarding cycling infrastructure and cyclist safety in the CMC; residents' views on the responsibility of individual stakeholders and the adequacy of preventive action; their attitude towards planned changes in the field of cycling and their experience with traffic accidents involving cyclists. Respondents were expressing their views on 5- and 3-point scales of agreement (where 1 stood for the lowest degree of agreement) and by answering dichotomous questions (yes/no). The questionnaire also comprised single- and multiple-choice questions.

R2, which was conducted in the form of an online survey (by using the 1ka online tool), was aimed at establishing respondents' views on the digitisation of cycle paths and safety risks on such paths. The survey encompassed internet users, since they are the primary users of online maps, which would be used to implement the proposed digitisation in the public domain. R2 was conducted between January and April 2019; data collection was organised by sharing the link to the questionnaire on various online cycling forums and in specific social media groups. The questionnaire consisted of two sets of questions and a total of 10 variables, which were used to assess whether internet users and cyclists recognised the need for the aforementioned digitisation and whether they identified any potential implications and usefulness of such information sharing. Respondents expressed their views by answering dichotomous questions (yes/no), as well as single- and multiple-choice questions.

Due to divergent approaches taken when conducting the two studies and the reliance on two different target populations, the samples used in R1 and R2 vary in terms of demographic characteristics. These are presented in tables 1 and 2 below.

Table 1: Demographic data in R1

	Responses	Frequency (n = 171)	%
Gender	Male	75	44
	Female	96	56
Age	Average	45	/
	Minimum age	20	/
	Maximum age	70	/
Education	Elementary or lower	12	7
	Secondary	58	34
	Third-level college or university education	89	52
	Specialisation, MA or PhD	12	7
Status	Student	12	7
	(Self-)employed	117	68
	Unemployed	8	5
	Retired	34	20

The sample in R1 consisted of 171 respondents residing in the territory of the CMC, while the gender ratio was relatively equal. Respondents' average age was 45 and slightly more than half of respondents completed third-level college or university education. Two thirds of respondents were employed (Table 1).

Table 2: Demographic data in R2

	Responses	Frequency (n = 210)	%
Gender	Male	107	51
	Female	103	49
Age	Less than 20	25	12
	21-40	132	63
	41-60	48	23
	61 or older	5	2
Education	Elementary	13	6
	Secondary	122	58
	Higher	75	36
Status	Student	90	43
	Employed	101	48
	Unemployed	9	4
	Retired	5	2
	Other	5	2

The sample in R2 comprised 210 respondents with an equal gender ratio. Two thirds of respondents were between 21 and 40 years of age, while more than half

of them completed secondary education and more than one third completed higher education. Slightly less than half of respondents were employed, while 43% of respondents were still studying (Table 2).

4 RESULTS

Results obtained in the scope of both research studies are summarised below by applying descriptive statistics. The results of R1 are presented in tables 3 to 9, while those of R2 are put forward in tables 10, 11 and 12.

n = 171	Satisfaction with the situation			Assessment of the current state-of-play		
	μ	*SD*	*Me*	μ	*SD*	*Me*
Cycling infrastructure in the CMC	2.8	0.91	3	2.9	0.83	3
Transport infrastructure for cyclists in the CMC	2.8	0.89	3	2.9	0.89	3
Cyclist safety in the CMC	2.7	0.92	3	2.9	0.92	3

Table 3: Respondents' satisfaction with the situation regarding infrastructure and cyclist safety

Table 3 shows the average values (μ) of respondents' satisfaction with the situation regarding cycling infrastructure and transport infrastructure used by cyclists, as well as with the general state-of-play pertaining to cyclist safety in the CMC. Respondents rated their level of satisfaction on a 5-point scale, where 1 stood for "extremely unsatisfied" and 5 meant "very satisfied". The largest share of respondents rated their satisfaction with all three segments (cycling infrastructure, transport infrastructure for cyclists and cyclist safety) by selecting the value of 3 (neither unsatisfied nor satisfied). The average level of satisfaction with cycling and transport infrastructure amounted to 2.8, while the average satisfaction with the general cyclist safety in the CMC reached 2.7. The second column in Table 3 contains data regarding the perceived situation in the aforementioned segments, which were also assessed by respondents on a 5-point scale (where 1 denoted extremely poor situation and 5 referred to an excellent situation). Again, most respondents evaluated all segments with the average score of 3 (neither good nor bad), while the average grade regarding the adequacy of the current situation amounted to 2.9 with respect to all three segments.

n = 171		*n*	%
Poorly maintained cycling infrastructure	(yes)	80	46.4
	(no)	91	53.6
Inexistence of cycling infrastructure	(yes)	78	45.6
	(no)	93	54.4
Inexistence of transport infrastructure for cyclists	(yes)	79	46
	(no)	92	54

Table 4: Perceived shortcomings in ensuring cyclist safety

Respondents believed that the above-listed risks or shortcomings (Table 4) were somewhat equally distributed, since 46.4% of respondents selected poorly maintained cycling infrastructure and inexistence of transport infrastructure for cyclists, while the inexistence of cycling infrastructure was chosen by 45.6% of respondents. Since not all residents are, in fact, cyclists, the perception of shortcomings among the general public in the CMC is relatively high.

Table 5: Respondents' views on CMC's endeavours in the field of cyclist safety

n = 171	1	2	3	μ	*SD*
Cycling infrastructure in the CMC	41%	46%	13%	1.7	0.97
Transport infrastructure for cyclists in the CMC	43%	40%	17%	1.7	1.01
Cyclist safety in the CMC	37%	47%	16%	1.8	0.93

As presented in Table 5, respondents were asked to express their views on whether the municipality's endeavours had been sufficient to improve cyclist safety on a 3-point scale (where 1 meant "Insufficient", 2 stood for "Neither/Nor" and 3 denoted "Sufficient"). Less than half of all respondents (between 40% and 47%) believed that the CMC's efforts had been neither insufficient nor sufficient. This is followed by the share of respondents ranging from 37% to 43%, who believed that its endeavours had been insufficient. Only 13% to 17% of all respondents were of the view that the CMC has done enough.

Table 6: Respondents' views on who is responsible for traffic accidents involving cyclists

n = 171		*n*	%
Cyclists themselves (by disobeying the highway code)	(yes)	142	83
	(no)	29	17
Car drivers (aggressive driving, speeding)	(yes)	113	66
	(no)	58	34
Non-governmental organisations in the field of road safety	(yes)	29	17
	(no)	142	83
Police	(yes)	19	11
	(no)	152	89
Municipality	(yes)	43	25
	(no)	128	75
State	(yes)	29	17
	(no)	142	83

Respondents were also given a multiple-choice question aimed at establishing who was, in their opinion, responsible for traffic accidents involving cyclists. Table 6 clearly shows that most respondents (83%) believed that cyclists themselves were responsible because they failed to comply with the highway code. Furthermore, 66% of respondents thought that accidents were caused by car drivers due to aggressive driving behaviours and/or speeding, while 25% of respondents blamed the municipality. 17% of respondents attributed such a responsibility to the State and an equal share of respondents believed the responsibility for traffic accidents involving cyclists was borne by NGOs in the field of road safety. Only 11% of respondents were of the opinion that such a responsibility also lay with the police.

n = 171		*n*	%
Maintaining sound cycling infrastructure and transport infrastructure for cyclists	(yes)	123	72
	(no)	48	28
Building cycling infrastructure that is separate from other types of road traffic	(yes)	130	76
	(no)	41	24
Tighter control of motor vehicle drivers by the police	(yes)	72	42
	(no)	99	58
Tighter control of cyclists by the police	(yes)	70	41
	(no)	101	59
Digitisation of safety risks on all cycle paths and their marking on publicly available online maps	(yes)	108	63
	(no)	163	37
Organisation of other preventive actions and measures	(yes)	96	56
	(no)	75	44

Table 7: Respondents' views on the efficiency of approaches to cyclist safety

Respondents were then given a multiple-choice question asking them which were, in their opinion, the most efficient approaches to ensuring cyclist safety. As evident from Table 7, respondents believed that the building of separate cycling infrastructure was the most efficient approach (76%), followed by the maintenance of sound cycling infrastructure and transport infrastructure for cyclists (72%). Another very efficient approach includes the digitisation of safety risks on cycle paths in the CMC (63%), while more than half of all respondents (52%) also believed that a higher degree of safety could be guaranteed by other preventive actions and measures. A relatively large share of respondents was of the view that tighter police control of drivers (42%) and cyclists (41%) could also prove efficient.

	Familiarity with changes			Usefulness		
n = 171	*μ*	*SD*	*Me*	*μ*	*SD*	*Me*
Introduction of the public bicycle-sharing system	2.6	0.94	3	2.5	0.94	3
Introduction of the P&B system	1.9	0.86	2	2.5	1.08	3
Constructing the northern connecting road together with the necessary infrastructure for cyclists and pedestrians	1.7	0.82	2	2.7	1.10	3
Improving and upgrading the network of cycling routes	1.9	0.87	2	2.7	0.97	3
Constructing regional cycling routes	2.1	093	3	2.7	0.95	3

Table 8: Respondents' familiarity with and views on the need to improve cyclist safety

As can be observed from Table 8, researchers used a 3-point scale (where 1 meant "I am not familiar with the measure at all."; 2 stood for "I am partly familiar with the measure."; and 3 meant "I am fully familiar with the measure.") to establish the extent to which respondents were familiar with individual measures, which have been recently implemented by the CMC with a view to improve cyclist safety. Respondents were most familiar with the functioning of the public bicycle-sharing system and with the construction of regional cycling routes, which are completely separated from other modes of transport. They were slightly less familiar with the introduction of the P&B (park and bike) system and with the improvements and planned upgrades of the 30-kilometre network of cycling routes in the CMC.

Respondents were the least familiar (average value of 1.7) with the construction of the northern connecting road together with the necessary infrastructure for cyclists and pedestrians. Respondents were then asked to share their views on whether these measures, which are aimed at improving cyclist safety, were at all necessary. They did so by using a 3-point scale (where 1 stood for "Unnecessary"; 2 denoted a "Neither/Nor" response; and 3 meant "Necessary"). Regardless of their familiarity with individual measures, respondents believed that all measures were necessary, since most respondents marked them with the score of 3.

Table 9: Respondents' use of measures aimed at improving sustainable mobility

n = 171	*M*	*SD*	*Me*
Introduction of the public bicycle-sharing system	2.0	0.94	2
Introduction of the P&B system	2.0	0.86	2

Respondents used a 3-point scale (where 1 meant "Never", 2 stood for "Occasionally" and 3 meant "Frequently") to express their intention of using activities/measures aimed at improving sustainable mobility. Only half of all respondents are (or intend to) use these measures, which clearly points to a certain degree of reservedness towards the planned changes (Table 9).

Since both the results of R1 as well as various road safety reports show that road users and municipalities are most often perceived as those responsible for ensuring road safety, preventive measures and projects must target these two areas. Respondents believe that cyclists' awareness and information or, in other words, their level of preparedness, could be enhanced through the digitisation of cycling infrastructure, cycle paths and their characteristics, which is a rather creative and modern approach to awareness raising. The following paragraphs thus present the results obtained in the scope of R2, which reflect the views of internet users on the usefulness of such a solution. Respondents' experience with traffic accidents involving cyclists were the subject of the first question.

Table 10: Internet users' experience with traffic accidents involving cyclists

n = 210		*n*	%
Involvement in an accident involving a cyclist	(yes)	53	25
	(no)	157	75
Involvement of a family member-cyclist in an accident involving a cyclist	(yes)	74	35
	(no)	136	65
Witnessing an accident involving a cyclist	(yes)	101	48
	(no)	109	52

As may be inferred from Table 10, one in four respondents has already been involved in a traffic accident involving a cyclist, while one in three has a family member, who has already been involved in such an accident. The fact that almost half of all respondents has already witnessed such an accident is also rather alarming.

n = 210		*n*	%
Recreational cyclist (*n* = 78)	(yes)	64	82
	(no)	14	18
Family cyclist (*n* = 11)	(yes)	9	80
	(no)	2	20
Occasional cyclist (*n* = 83)	(yes)	71	85
	(no)	12	15
Non-cyclist (*n* = 38)	(yes)	35	92
	(no)	3	8
Total (*n* = 210)	(yes)	179	85
	(no)	31	15

Table 11: Respondents' view on the usefulness of digitising cycle paths and safety risks

Table 11 shows respondents' views on the need for digitising cycle paths and safety risks broken down according to the category of cyclist. The usefulness of such a measure was mostly recognised by non-cyclists (92%), followed by occasional cyclists (85%) and recreational cyclists (82%). Family cyclists believed this measure to be slightly less useful (80%), however, their share was still relatively high

n = 210		*n*	%
Cyclists setting out for their ride would be better prepared for potential safety risks along their path.	(yes)	174	83
	(no)	36	17
This is an innovative and user-friendly approach to prevention and awareness raising among cyclists.	(yes)	120	57
	(no)	90	43
The number of fatalities among cyclists would decrease.	(yes)	132	37
	(no)	78	63
None of the above.	(yes)	17	8
	(no)	193	92

Table 12: Respondents' view on the positive implications of digitising cycle paths and safety risks

Table 12 shows that most respondents believed that the most positive implication of digitising safety risks on cycle paths was related to the fact that the provision of such information would allow cyclists to be better prepared for potential safety risks along their path (83%). This was followed by the opinion that digitisation was an innovative and user-friendly approach to increasing cyclists' preventive behaviours and awareness (57%), and that the use of such a preventive measure would result in fewer fatalities (37%).

5 DISCUSSION

Residents perceive traffic safety as an extremely important aspect, as has also been confirmed by a research study on the perception of safety conducted by Virtič and Gorenak (2008), which shows that Slovenia's residents feel most threatened by public law and order violations, crime and the situation related to traffic safety. A study on the perception of threats and the provision of safety and security in local communities, which was carried out by Sotlar and Tominc (2012), also demonstrates that road safety is one of the priorities identified by residents. With the growing

popularity of cycling and the adoption of measures aimed at sustainable mobility (Poljak Istenič, 2015), issues related to cyclist safety are becoming increasingly pertinent. Indeed, a research study analysing traffic accidents shows that built-up areas and cities are witnessing growing numbers of pedestrians and cyclists, which in turn increase the likelihood of accidents involving cyclists (Brcar, 2017). Therefore, the purpose of this paper was to analyse residents' satisfaction with the situation and regulation of cycling infrastructure and cyclist safety on the basis of a specific example of a city municipality in Slovenia (i.e. the CMC), which has been facing with a large share of accidents involving cyclists. The obtained results were then complemented with the results of the second study, which was conducted among internet users and aimed at establishing the usefulness of informing the public about safety risks by means of digitising cycle paths and their characteristics, thus promoting cyclists' preventive behaviours. Both studies demonstrate which shortcomings and risks are most frequently perceived by residents and help researchers to identify required solutions. Research results show that respondents are of the view that the situation regarding cyclist safety in the CMC is generally neither good nor bad, which is why their satisfaction with cycling and transport infrastructure, and with cyclist safety as a whole is also somewhat average. Respondents are overall quite dissatisfied with measures addressing cyclist safety and believe that it could be improved not only by measures adopted at municipal level but also by providing better information to cyclists about risks and threats along cycle paths.

Approximately 50% of respondents believe that poorly maintained cycling infrastructure and the absence of cycling infrastructure and transport infrastructure for cyclists in Celje are the most prominent shortcomings. These findings are in line with the results obtained within the Datkol:S project (Belca et al., 2018a, 2018b, 2018c), where the analysis of the Teharje – Podčetrtek cycle path revealed that inadequately maintained cycling infrastructure on certain sections and the inexistence on cycling and transport infrastructure were identified as the most problematic aspects. The research also shows that 80–90% of respondents believe municipal efforts in the field of cyclist safety to be insufficient. Accordingly, 25% of respondents are convinced that the municipality is responsible for addressing traffic accidents involving cyclists that occur on its territory. Since respondents are relatively dissatisfied with municipal measures, it is worth noting that the responsibility for ensuring road safety at the local level also lies with municipal traffic wardens, whose role has recently been significantly strengthened, as they have been conferred more powers both in the field of road traffic and in the provision of law and order (Modic, 2015; Modic, Lobnikar, & Dvojmoč, 2014). Therefore, municipalities have an enormously important role not only in regulating and maintaining infrastructure, but also in terms of enforcing rules and exercising control over their application, which is implemented through various practical approaches to minor offences and other violations (Tičar, 2015).

The first part of the research also focused on the degree of residents' familiarity with measures and projects dedicated to improving cyclist safety, which have been implemented in Celje. It established that respondents were most familiar with the introduction of the public bicycle-sharing system and the construction

of regional cycling routes. Regardless of the degree of their familiarity, most respondents were convinced that all measures were necessary. However, most respondents claim that they would only occasionally make use of measures focusing on sustainable mobility (bicycle-sharing system and the P&R system). Therefore, research findings suggest that it would be necessary to better inform local residents and encourage them to use alternative measures for achieving sustainable mobility in order to bring such planned changes to life and genuinely contribute to improvements.

In the second part of the research, users of online social networks and cycling forums were asked whether there was a need to digitise cycle paths and safety risks in Slovenia. Results show that a whopping 85% of respondents recognise the need for such a solution. It was also established that one in four respondents has already been involved in a traffic accident involving a cyclist, one in three respondents has a family member, who was involved in such an accident, while almost half of all respondents have already witnessed such an accident. This finding is most likely conducive to the fact that respondents recognise various positive implications of the proposed digitisation, since 83% of them believe that by using such preventive measures, cyclists would be better prepared to face safety risks along their path. Furthermore, more than half (57%) of all respondents believe this to be an innovative and user-friendly approach to promote cyclists' preventive behaviours and awareness. Considering the frequency of respondents' experience with traffic accidents involving cyclists and their acknowledgment of the need for digitising safety risks on cycle paths, the researchers believe that such digitisation measures should be gradually introduced on the most accident-prone cycling paths in Slovenia. This could improve information and awareness raising of cyclists and draw the attention of decision-makers and infrastructure managers to some of the most pertinent safety risks, which must be eliminated as a matter of priority.

6 CONCLUSION

The paper presented the results of two research studies, which analysed the views of different target populations on cyclist safety and the adequacy of preventive measures implemented in Slovenia. The purpose of these two studies was to identify the challenges and shortcomings of different approaches to ensuring cyclist safety, assess the adequacy of planned solutions and propose improvements in the field of preventive measures adopted by various stakeholders.

The findings presented in this paper could be used to devise the following proposals and recommendations for improving the situation both at the local and at national level: (1) Digitisation of safety risks on all cycle paths in the CMC and across Slovenia with a view to raise awareness of safety risks and provide a broader overview of priority measures for all key stakeholders; (2) Greater promotion of sustainable mobility and adoption of programmes for ensuring a higher degree of knowledge regarding measures aimed at sustainable mobility with a view to increase the use of such measures; and (3) Regular maintenance of cycling infrastructure, as well as the improvement and regulation of transport

infrastructure used by cyclists with a view of adopting a comprehensive approach to prevention and improving cyclist safety.

The value and originality of the research work presented in this paper stems from the fact that it involves the very first study of its kind conducted in a local environment, which provides both the findings regarding residents' views on the safety of cycling infrastructure on the territory of a specific municipality, as well as the usefulness of the applied methodology for analysing the safety of cycle paths in Slovenia. Since the research work combines the results of two studies, the findings of which substantially complement one another, it provides a deeper insight into the issue of cyclist safety and reveals respondents' views on tackling this issue. Therefore, research results may be of great use to decision-makers and cycling infrastructure managers at the State level when planning priority measures. Furthermore, they are particularly useful to the key stakeholders at the level of the CMC (Celje Police Directorate and the CMC City Council), since they might contribute significantly to the planning of future priorities, safety measures and preventive activities in the field of cyclist safety.

In Slovenia, the issue of cyclist safety at the local level is currently under-researched, which is why the results presented herein may also prove useful to other researchers focusing on safety and security issues in local communities. The limitations of research studies stem from the use of non-random samples, which is why their findings may not be generalised to all municipalities and residents. Moreover, municipalities apply different approaches to ensuring cyclist safety due to their autonomy, which may be more or less efficient, and are faced with different safety risks. However, given the fact that the vast majority of traffic accidents occurs in built-up areas, it would be extremely important to conduct any further research of this phenomenon and tackle the identified issues at the local level. With a view of comparing the efficiency of different approaches and promote the exchange of best practices, it would also be reasonable to conduct a comprehensive research study encompassing all municipalities in Slovenia.

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Students' Violence Against Teachers in Relation to School Climate

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Purpose:

The aim of this paper was to analyse the connection between experiencing violent behaviour of students directed at teachers and school climate.

Design/Methods/Approach:

The school climate is expressed through four dimensions: nature of the teacher-student relationship; nature of the relationship among students; extent to which students have decision-making autonomy; clarity, consistency and fairness in school rules. The research was based on four hypotheses, which negate the relationship between violent behaviour of students directed at teachers and various dimensions of school climate. It was conducted on a sample of 451 students in their final years of secondary schools in Zagreb.

Findings:

The results indicate that there is a statistically significant difference in the perception of three out of four dimensions of school climate between the students who have experience with violent behaviour of students directed at teachers and those students who do not have such experience. The results show that the students who have experience with violent behaviour of students directed at teachers assess students' autonomy more negatively.

Research Limitations/Implications:

Future research should include a larger sample of respondents, both secondary school students and teachers.

Practical Implications:

This research has significant practical implications for safety in schools since it indicates the need to design quality school climate in secondary schools in Zagreb.

Originality/Value:

The results of this research could be used to present the importance of school climate in schools in order to prevent violent behaviour of students directed at teachers.

UDC: 343.62+373.5

Keywords: school climate, violent behaviour of students directed at teachers, secondary school

Nasilje učencev nad učitelji v povezavi s šolsko klimo

Namen prispevka:

Namen prispevka je analizirati povezavo med doživljanjem nasilnega vedenja učencev nad učitelji in šolsko klimo.

Metode:

Šolska klima se izraža skozi štiri dimenzije: odnos učitelj-učenec, odnosi med učenci, obseg avtonomije odločanja učencev in jasnost, doslednost ter poštenost šolskih pravil. Raziskava je temeljila na štirih hipotezah, ki negirajo povezavo med nasilnim vedenjem učencev nad učitelji in različnimi dimenzijami šolske klime. Raziskava je bila izvedena na vzorcu 451 učencev zaključnih letnikov srednjih šol v Zagrebu.

Ugotovitve:

Rezultati analize kažejo, da obstajajo statistično pomembne razlike v dojemanju treh od štirih dimenzij šolske klime med učenci, ki imajo izkušnje z nasilnim vedenjem učencev nad učitelji, in učenci, ki takšnih izkušenj nimajo. Rezultati kažejo tudi, da učenci, ki imajo izkušnje z nasilnim vedenjem učencev nad učitelji, bolj negativno ocenjujejo avtonomijo učencev.

Omejitve/uporabnost raziskave:

Prihodnje raziskave bi morale vključevati večji vzorec anketirancev, tako srednješolcev kot tudi učiteljev.

Praktična uporabnost:

Raziskava ima lahko praktično vrednost za zagotavljanje varnosti v šolah, saj kaže na potrebo po oblikovanju kakovostne šolske klime v srednjih šolah v Zagrebu.

Izvirnost/pomembnost prispevka:

Rezultate raziskave bi lahko uporabili za predstavitev pomena šolske klime, z namenom preprečevanja nasilnega vedenja učencev nad učitelji.

UDK: 343.62+373.5

Ključne besede: šolska klima, učenci, nasilno vedenje, nasilje nad učitelji, srednja šola

1 INTRODUCTION

Similar to any manifestation of violence, school violence represents a serious social problem. School violence includes any form of violence that interrupts educational and teaching processes and, at the same time, involves aggression (Espelage et al., 2013).

An extensive body of research on school violence (for instance Bilić, Buljan-Flander, & Hrpka, 2012; Espelage et al., 2013; Olweus, 1998; Rigby, 2002) has so far been focused on victimisation of students by students, i.e. on violence among students in schools. Through the change in the paradigm that peer

violence, including violence among students in schools, is not a characteristic of the process of growing up of children and students, the focus of research was directed at children. Given that children spend a larger part of their childhood in educational institutions, i.e. schools, the research was focused on violence among students in schools.

This paper provides research on the experience of violent behaviour of students directed at teachers in relation to school climate on a sample of students from several secondary schools in Zagreb.

1.1 Victimisation of Teachers

Terry (in Garrett, 2014, p. 21) defines violent behaviour directed at teachers as "a situation from which a victim cannot escape". It is a situation of abuse of the unequal distribution of power with characteristic persistent and repetitive aggression (Terry in Garrett, 2014). Terry (in Garrett, 2014, p. 21) stresses that teachers finds themselves in "a powerful social limitation that excludes the opportunity to escape as a means for terminating the offensive interaction."

In the definition by De Wet (2010, p. 190), stressed is the intention of violent behaviour and the characteristic of repetition "with the aim of inflicting damage to a victim at a physical, emotional, social and/or professional level." Teachers cannot avoid such situations because they are obliged to remain at the workplace and at the same time are legally unprotected at their workplace.

Garrett (2014) adds to the definition factors invisible to an observer that are in opposition to the perceived superior authority of a teacher. Garrett (2014) emphasises that both serious as well as isolated negative incidents are considered violent behaviour.

Academic and behavioural outcomes of students are directly influenced by professional functioning of teachers (McMahon et al., 2014; Reddy, Fabiano, & Jimerson, 2013; Reddy et al., 2014). Challenging working conditions that include school violence, negative school climate and problems with discipline are directly related to the satisfaction of teachers (Cohen, Pickeral, & McCloskey, 2009; Ingersoll, 2001; Kersaint, Lewis, Potter, & Meisels, 2007; McMahon et al., 2014).

In schools, teachers are mostly exposed to traditional forms of violence, for example to physical, verbal or social forms of violence (Lokmić, Opić, & Bilić, 2013). They are, at the same time, unprotected victims of school violence due to the lack of education and lack of upbringing in families, unacceptance of authority by children, significant influence of peers and media, through which children, as a result of lack of control, obtain information inappropriate for their age that is later reproduced through their behaviour (Lokmić et al., 2013).

The variables regarding school, such as school climate and discipline standards, are strong predictors of the victimisation of teachers (Gottfredson & Gottfredson, 1985; Gottfredson, Gottfredson, Payne, & Gottfredson, 2005; McMahon et al., 2014). Identifying the nature and extent of violence directed at teachers can help in understanding school climate and in developing effective interventions (McMahon et al., 2014).

The context of every-day school situations is frequently considered the third reason for violent behaviour, particularly due to the stress that students face in such situations (Lokmić et al., 2013). Stress related to school can be caused by teachers, classmates and, frequently, parents (Lokmić et al., 2013). Children, i.e. students are used to being important to their parents and expect, therefore, the same treatment at school (Lokmić et al., 2013). Problems occur when such expectations are not met and when they cannot accept it and start seeking manners to stand out and draw attention, which, depending on the temperament of individual students can also be violent (Lokmić et al., 2013).

Teachers can also induce violence by their acts. To put it more precisely, students can feel hurt and less valuable if they are constantly exposed to teachers' criticism, which can lead to students' violent behaviour (Lokmić et al., 2013). Teachers that set clear rules and explain them clearly and in detail face the problem of violence less frequently compared to teachers who are more lenient and who never clearly define what is tolerated and what is not (Lokmić et al., 2013; Seiberer-Nagler, 2016).

Students in school usually form peer groups in which an individual, a leader, stands out and determines, to a large extent, the behaviour of the entire group (Lokmić et al., 2013; Staff & Kreager, 2008). A leader who behaves violently towards teachers will gather a peer group with similar characteristics and they will mutually encourage themselves in provoking teachers, disrupting classes and ignoring teacher's authority (Lokmić et al., 2013; Staff & Kreager, 2008). Individuals belonging to such groups might not be violent; however, to be accepted by their peers is important to them and, in order to avoid being mocked, they will try to fit in by behaving violently towards teachers (Lokmić et al., 2013; Wang & Dishion, 2012).

1.2 School Climate

Cohen, McCabe, Michelli, and Pickeral (2009) claim that school climate affects the quality and nature of school life. Everyday experiences of school life, as well as norms, goals and values along with interpersonal relations represent the basis of the concept of school climate that is publicly determined by four areas: safety, relations, teaching and learning, as well as (external) surroundings (Cohen, McCabe et al., 2009; Freiberg, 1999; Homanna, Barber, Torney-Purta, 2006; Perry, 1908).

School climate significantly affects individual experiences (Comer in Cohen, McCabe et al., 2009). Two aspects of school climate – attachment to school and positive feedback from teachers - have been proven to affect students' self-esteem (Hoge, Smit, & Hanson, 1990). Research on school climate contributes to revealing relations between the school climate and students' self-understanding (Cairns; Heal; Reynolds, Jones, St. Leger, & Murgatroyd; Rutter, Maughan, Mortimore, & Ouston all in Cohen, McCabe et al., 2009). A range of studies has shown that a positive school climate is related to lower students' absence rates (Cohen, McCabe et al., 2009; DeJung & Duckworth, 1986; Purkey & Smith, 1983; Reid, 1983; Rumberger, 1987; Sommer, 1985), moreover, it is a successful predictor of the rate

of disciplinary measures (Cohen, McCabe et al., 2009; Wu, Pink, Crain, & Moles, 1982). Recent research indicates that an effective risk prevention is related to a safe, caring, participatory and responsible school climate (Berkowitz & Bier, 2005; Catalano, Berglund, Ryan, Lonczak, & Hawkins, 2002; Greenberg et al., 2003).

One of fundamentally important dimensions of school climate are relations that include how "related" people within a school feel about each other (Blum, McNeely, & Rinehart, 2002; Cohen, McCabe et al., 2009; Osterman, 2000). It is a fact that school attachment, i.e. the extent to which students feel attached to at least one caring and responsible adult in a school, is becoming a research area of significant interest (Cohen, McCabe et al., 2009). School attachment and interconnection within the school are a strong predictor of school success for adolescents, as concluded by Blum et al. (2002), as well as, by Shochet, Dadds, Ham, and Montague (2006). In addition, Karcher (2002a, 2002b) concludes that the same predictor can be applied to the prevention of violence and as a protective factor for risky sexual relations, violence and drug abuse (Catalano, Haggerty, Oesterie, Fleming, & Hawkins, 2004; Kirby, 2001).

School climate has a tendency to promote or to complicate purposeful behaviour of students and it strongly affects students' motivation for learning (Cohen, McCabe et al., 2009). School climate is based on the samples of personal experiences of parents, students and school staff, and it reflects norms, values, interpersonal relations, teaching and methodological procedures, as well as organisational structures, while the creation of school climate is an annual goal that is being achieved on a daily basis (DeWitt & Slade, 2014).

Creating a positive school climate is an annual goal that is achieved on a daily basis, and it is the entire process that includes trust at the level of the institution, positive shifts in thinking and the feeling of autonomy among students, employees and teachers (DeWitt & Slade, 2014).

Way, Reedy, and Rhodes (2007) stress the importance of school climate for secondary school students through four dimensions: (1) the nature of relations between students and teachers; (2) the nature of relations among students; (3) the extent to which students have decision-making autonomy; and (4) the extent to which a school provides clear, consistent and fair rules. These four concepts have been used as the basis for the research presented in this paper.

Researchers have noticed that lack of harmony between a person and the environment, as well as the extent to which students perceive that their schools do not support their need for attachment, autonomy and consistency can represent a risk for the psychological and behavioural health of students (Way et al., 2007).

Given that school climate is based on samples of personal experience of school life of children and school staff, and given that it reflects norms, values and interpersonal relations, teaching and methodological procedures, as well as organisational structure (DeWitt & Slade, 2014), this paper provides a review of differences in the perception of four dimensions of school climate (Way et al., 2007) by the students who have experience with violent behaviour of students directed at teachers and those students who do not have that experience.

2 METHODOLOGY

2.1 Research Aim

The main aim of the paper is to analyse the frequency of violent behaviour of students directed at teachers in the City of Zagreb and to determine whether there is a connection between school climate consisting of four dimension and the occurrence of violence of students directed at teachers.

Given that researched are the occurrence of violent behaviour of students directed at teachers, as well as the relation of such violence to the basic aspects of school climate based on whether students witnessed or heard of cases of such behaviour in their schools, the following research questions are asked:

1. Is there a difference in the perception of the teacher-student relationship between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience?
2. Is there a difference in the perception of the relationship among students between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience?
3. Is there a difference in the perception of the decision-making autonomy allowed to students between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience?
4. Is there a difference in the perception of clear, consistent and fair school rules between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience?

2.2 Hypotheses

Taking into account the previously defined research aim and the specific research questions, the following hypotheses have been formulated:

H1: There is no statistically significant difference in the perception of the claims that measure the nature of the teacher-student relationship between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience.

H2: There is no statistically significant difference in the perception of the claims that measure the nature of the relationship among students between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience.

H3: There is no statistically significant difference in the perception of the claims that measure the decision-making autonomy allowed to students between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience.

H4: There is no statistically significant difference in the perception of the claims that measure the clarity, consistency and fairness of school rules between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience.

2.3 Sample of Variables

The data were collected based on a questionnaire that contains 17 sets of questions, among which there is a relevant set of indicators of school climate measured with the help of 24 claims that are organised in four subscales: (1) nature of the teacher-student relationship, (2) nature of the relationship among students, (3) decision-making autonomy allowed to students, (4) available clear, consistent and fair school rules.

For all the questions that measure school climate offered are answers in the form of a Likert scale from 1 (I completely agree) to 6 (I completely disagree). The Cronbach's alpha coefficient of reliability for the entire set of school climate amounts to 0.885, whereas divided by subscale as follows: nature of the teacher-student relationship 0.675; nature of the relationship among students 0.760; decision-making autonomy allowed to students 0.823; available clear, consistent and fair school rules 0.859. The set of variables related to the school climate was authored by Professor Niobe Way from the University in New York and the author provided written permission for the use of the questionnaire in May 2017. When translating the questionnaire, cultural differences were taken into account and the questionnaire was adapted to the Croatian educational context.

The experience of violent behaviour of students directed at teachers was measured by a claim that examined whether students witnessed or heard of cases of violent behaviour of students directed at teachers. If students did not have the stated experience, they marked the statement with "X".

2.4 Sample of Respondents

The analysis included a sample of 451 students in their final years of secondary schools in Zagreb. 174 students from two grammar schools and 277 students from three secondary vocational four-year and three-year schools participated in the research. Vocational four-year and three-year schools where educating students in field of electro mechanics, industrial engineering and computer technology, which are schools that are mostly attended by male students. Access to students, i.e. the permission to conduct research was obtained from the Department of Education of the City of Zagreb. In addition, the consent was also obtained from school principals. The schools were selected by the Department of Education based on their previous positive experiences and cooperation. The sample of 451 students is a convenience, non-probabilistic sample formed by the arrival of persons conducting research to classes. To put in more clearly, included in the sample were all students who were attending classes when a person conducting research arrived.

2.5 Data Collection Methods

The data were collected by an anonymous and voluntarily survey of students in their final years of secondary schools in Zagreb in the first term of the school year 2017/2018 in accordance with the ethical rules of conducting scientific research. Surveyed were all students in randomly selected classes who were attending classes when a person conducting research arrived.

2.6 Data Processing Methods

The statistical package SPSS was used in processing data for the purpose of this paper. In order to answer the research questions, conducted was the non-parametric Mann-Whitney *U* test to determine differences between the group of students who have experience with violent behaviour of students directed at teachers and those who do not have that experience. Moreover, presented are percentage shares of students regarding their level of agreement with the measured claims of school climate.

3 RESULTS AND DISCUSSION

3.1 Descriptive Analysis

In the first part, presented are percentage shares of the students who have experience with violent behaviour of students directed at teachers and of those who do not have it regarding their level of agreement with the measured claims of school climate.

Table 1: Percentage share of the students*

	Experience with violence of students directed at teachers	I completely agree	I mostly agree	I agree	I disagree	I mostly disagree	I completely disagree
Students respect teachers	Yes	11.3%	24.8%	22.0%	22.7%	9.9%	9.3%
	No	17.8%	37.8%	26.9%	9.1%	5.2%	3.1%
Teachers take care of students	Yes	9.2%	17.0%	29.8%	21.3%	8.5%	14.2%
	No	12.3%	31.6%	36.1%	9.1%	4.6%	6.3%
Teachers contribute to students' self-esteem	Yes	9.2%	17.0%	29.8%	21.3%	8.5%	14.2%
	No	6.0%	20.4%	33.7%	22.5%	8.8%	8.8%

*Percentage share of the students who have experience with violent behaviour of students directed at teachers and those who do not have it regarding the level of agreement with the claims that measure the teacher-student relationship

It is visible from the results presented in Table 1 that students are more prone to express agreement with the statements that measure the teacher-student relationship, i.e. that their answers are more frequently located on the left distribution side that indicates a certain level of agreement with the statements that students respect teachers, that teachers take care of students and that teachers contribute to students' self-esteem. The stated refers both to those students who have experience with violent behaviour of students directed at teachers and to those who do not have that experience.

Table 2: Percentage share of the students*

	Experience with violence of students directed at teachers	I completely agree	I mostly agree	I agree	I disagree	I mostly disagree	I completely disagree
Students help each other	Yes	9.9%	26.1%	26.1%	16.2%	10.6%	11.3%
	No	17.5%	37.4%	32.9%	6.3%	3.4%	2.4%
Students apply themselves to earn the best grades	Yes	7.7%	19.7%	20.4%	21.8%	12.0%	18.3%
	No	21.0%	22.4%	26.9%	18.5%	7.0%	4.2%
Students put a lot of effort into their work	Yes	9.9%	8.5%	18.3%	31.0%	15.5%	16.9%
	No	16.8%	21.8%	24.5%	21.3%	10.1%	5.2%
Students hardly get along	Yes	6.3%	13.4%	23.9%	28.9%	16.9%	10.6%
	No	3.9%	5.6%	13.0%	36.5%	29.1%	11.2%
Students trust each other	Yes	6.4%	16.3%	24.8%	24.1%	9.2%	19.1%
	No	7.0%	27.7%	36.1%	16.1%	9.5%	3.5%

*Percentage share of the students who have experience with violent behaviour of students directed at teachers and those who do not have it regarding the level of agreement with the claims that measure the relationship among students

Similar to the claims that measure the teacher-student relationship, students are more prone to agree that students help each other and to disagree that students hardly get along, regardless of the experience with violence of students directed at teachers. However, for other claims, there are visible differences in the answer trends depending on the experience of violence. More than a half of students who have experience with violent behaviour of students directed at teachers are more prone to disagree that students apply themselves to earn the best grades, that students put a lot of effort into their work and that students trust each other.

Table 3: Percentage share of the students*

	Experience with violence of students directed at teachers	I completely agree	I mostly agree	I agree	I disagree	I mostly disagree	I completely disagree
Students have the opportunity to propose activities in class	Yes	9.2%	12.1%	30.5%	18.4%	12.1%	17.7%
	No	7.0%	27.7%	36.1%	16.1%	9.5%	3.5%
Students have the opportunity to participate in determining the rules	Yes	3.5%	5.7%	19.9%	24.8%	12.1%	34.0%
	No	7.7%	13.3%	31.2%	21.1%	16.1%	10.5%
Students have the opportunity to participate in decision-making	Yes	2.9%	12.9%	20.0%	25.7%	14.3%	24.3%
	No	2.5%	14.4%	22.9%	21.1%	18.3%	20.8%

*Percentage share of the students who have experience with violent behaviour of students directed at teachers and those who do not have it regarding the level of agreement with the claims that measure the decision-making autonomy allowed to students

More than a half of students who have experience with violent behaviour of students directed at teachers and those who do not have that experience express a certain level of agreement with the statement that students have the opportunity to propose activities in class, whereas more than a half of both groups expresses a certain level of disagreement with the statement that students have the opportunity to participate in decision-making. As for the opportunity of students to participate in determining the rules, over 70% of the students who have experience with violent behaviour of students directed at teachers disagree with that statement, whereas that only applies to less than half of the students who do not have that experience.

Table 4: Percentage share of the students who have experience with violent behaviour of students directed at teachers and those who do not have it regarding the level of agreement with the claims that measure the clarity, consistency and fairness of school rules

Table 4: Percentage share of the students*

	Experience with violence of students directed at teachers	I completely agree	I mostly agree	I agree	I disagree	I mostly disagree	I completely disagree
The rules are fair	Yes	12.9%	25.0%	24.3%	16.4%	6.4%	15.0%
	No	12.1%	31.8%	34.6%	12.5%	3.9%	5.0%
Sanctions for disobeying the rules are equal for all	Yes	17.1%	19.3%	27.9%	10.0%	5.0%	20.7%
	No	22.5%	17.9%	29.8%	13.3%	7.4%	9.1%
Teachers explain to students what is expected from them	Yes	11.3%	28.4%	36.2%	9.2%	7.1%	7.8%
	No	17.9%	31.6%	36.1%	9.8%	2.1%	2.5%
The procedures regarding the application of the rules are clear	Yes	10.1%	21.0%	39.9%	15.2%	5.8%	8.0%
	No	12.0%	27.1%	44.0%	11.3%	2.5%	3.2%
The procedures regarding the application of the rules are often ignored	Yes	13.8%	19.6%	30.4%	19.6%	8.0%	8,7%
	No	3.5%	13.0%	20.7%	36.1%	17.2%	9.5%

*Percentage share of the students who have experience with violent behaviour of students directed at teachers and those who do not have it regarding the level of agreement with the claims that measure the clarity, consistency and fairness of school rules

Over 60% of the students from both groups express a certain level of agreement with all the claims that measure the clarity, consistency and fairness of school rules, with the exception of the claim stating that the procedures regarding the application of the rules are often ignored. To put it more precisely, less than half of the students who do not have experience with violence of students directed at teachers express a certain level of agreement with that statement.

It can be concluded that students mostly positively assess the teacher-student relationship and school rules, whereas they mostly do not recognise the autonomy allowed to students in their schools. Similarly, the results of the subscale on the relationship among students indicate the existence of certain problems in the relationship among students.

3.2 Differences in Assessing the School Climate

In order to test the research hypotheses, conducted was a non-parametric Mann-Whitney *U* test to determine the differences between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience. The stated test was used because the preconditions for using the *t*-test to test differences between two independent groups were not met, i.e. because there is a deviation regarding the presumption of the normal distribution and homogeneity of variances for the used variables.

Table 5: Mann-Whitney *U* test difference*

Teacher-student relationship	Experience with violence of students directed at teachers	*n*	*M*	Central rank	Mann-Whitney *U* test
Students respect teachers	No	286	2.56	194.97	
	Yes	141	3.23	252.60	
	Total	427			14720.000**
Teachers take care of students	No	285	2.81	194.75	
	Yes	141	3.45	251.40	
	Total	426			14748.500**
Teachers contribute to students' self-esteem	No	285	3.34	205.10	
	Yes	141	3.65	230.48	
	Total	426			17698.000*

Note: p < .05; p < .01***

*Mann-Whitney *U* test difference in the perception of the teacher-student relationship between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience

The results presented in Table 5 indicate that students who do not have experience with violent behaviour of students directed at teachers consider, to a greater extent, that students respect teachers ($U = 14720.000$, $p < .01$), that teachers take care of students ($U = 14748.500$, $p < .01$), and that teachers contribute to students' self-esteem ($U = 17698.000$, $p < .05$).

The above results are in accordance with the research results obtained by the authors of the concept of school climate (Way at al., 2007), who claim that the decrease in trust in teachers, in this case in respect for teachers, will lead to an increase in violent and other problematic types of behaviour (O'Grady, Hinchion, & McNamara, 2011). In addition, average assessments of students who witnessed or heard of violent behaviour of students directed at teachers ($M = 3.23$) mostly indicate that students do not agree with the statement that students in their school respect teachers. This should be taken seriously because it indicates the existence of disrespect for teachers, whereby late and inappropriate reactions present a risk for worsening the teacher-student relationship.

Similarly, average assessments of students indicate that students are prone to disagree with the statement that teachers in their school take care of students ($M = 3.45$). Such results require a further analysis of school climate, i.e. it is necessary that students' and teachers' councils, in collaboration with school psychologists

and pedagogues, devise manners of how best to approach students at the school level, as well as at the level of each individual class, i.e. classroom (Košir & Tement, 2013). The founders of the concept of school climate Way et al. (2007) claim that the teacher-student relationship is related to a decrease in self-esteem, as well as to the occurrence of symptoms of depression and problematic behaviour in students.

The reason for concern is that students, both those who have experience with violence of students directed at teachers and those who do not have that experience, mostly do not agree with the statement about a possible contribution of teachers to students' self-esteem. The above stated has to be taken into account and the teacher-student relationship as part of school climate should be further examined as the research results suggest there is a need for teachers be devote themselves to their students more intensively.

This part of the research conducted in Croatia is in accordance with the results that Way et al. (2007), the founders of the concept of school climate, obtained after having tested the dimensions of school climate in the USA. To put it more precisely, a worse assessment of the teacher-student relationship by students leads to violent and other problematic forms of student behaviour (Lee, 2012; Way et al., 2007).

Table 6: Mann-Whitney *U* test difference*

Relationship among students	Experience with violence of students directed at teachers	*n*	*M*	Central rank	Mann-Whitney *U* test
Students apply themselves to earn the best grades	No	286	2.81	193.06	
	Yes	142	3.65	257.69	
	Total	428			14173.000**
Students put a lot of effort into their work	No	285	3.02	191.68	
	Yes	142	3.85	257.69	
	Total	427			13873.000**
Students hardly get along	No	285	4.40	229.75	
	Yes	141	3.68	182.39	
	Total	426			15746.500**
Students trust each other	No	285	3.04	195.10	
	Yes	141	3.71	250.68	
	Total	426			14849.500**

Note: p <. 05; p < .01***

*Mann-Whitney *U* test difference in the perception of the relationship among students between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience

Students who do not have experience with violent behaviour of students directed at teachers consider, to a greater extent, that students apply themselves to earn the best grades (U = 14173,000, p < .01), that students put a lot of effort into their work (U = 13873.000, p < .01) and that students trust each other (U = 14849.500, p < .01), whereas they believe, to a smaller extent, that students hardly get along.

Average assessments of students who witnessed or heard of cases of violent behaviour of students directed at teachers indicate that they mostly disagree with the statement that students in their school apply themselves to earn the best

grades (M = 3.65). Having in mind the concept of school climate, it is visible that violence of students directed at teachers, regardless of whether it was witnessed or just heard of, is related to the perception of the relationship among students, i.e. to the perception their fellow students' effort.

Similarly, the students who witnessed or heard of violence of students directed at teachers mostly disagree with the statement that students in their school put a lot of effort into their work (M = 3.85). Taking into account the obtained results, it is likely that students, based on the information on violence of students directed at teachers that they witnessed or heard of, lose motivation to put additional effort. Furthermore, the presence of violence of students directed at teachers disrupts the school climate and working atmosphere, which can also lead to demotivating students to put effort and energy into their work.

Average assessments for both groups of students lie below the scale average, which indicates that both students who do not have experience with violence of students directed at teachers and those who have that experience are more prone to disagree that students hardly get along, whereby students with experience with violence of students directed at teachers agree more compared to those who do not have that experience. It can be concluded that the possibly disturbed school climate and friendly environment are related to cases of violent behaviour of students directed at teachers.

In accordance with the previous claims that measure the relationship among students, the students who have experience with violent behaviour of students directed at teachers are more prone to disagree with the statement that students trust each other, which indicates that they have a more negative view of the relationship among students. The described situation is the results of witnessing, i.e. possessing information on violent behaviour of students directed at teachers, whereby students lose confidence in their fellow students who are ready to be violent towards teachers, i.e. have already been violent towards teachers. The described situation probably causes concerns in other students.

Way et al. (2007), in the results of their research conducted in some 30 schools in the USA, state that the loss of trust in fellow students leads to corresponding occurrence of violent and other problematic forms of behaviour, as well as depression symptoms and loss of self-confidence. For that reason, it is necessary to empower relationships among students (Sungur, 2007; Way et al., 2007).

Table 7: Mann-Whitney *U* test difference*

Decision-making autonomy allowed to students	Experience with violence of students directed at teachers	*n*	*M*	Central rank	Mann-Whitney *U* test
Students have the opportunity to suggest activities in the classroom	No	285	3.56	211.43	
	Yes	141	3.65	217.68	
	Total	426			19503.500
Students have the opportunity to participate in determining the rules	No	284	4.48	215.11	
	Yes	140	4.38	208.76	
	Total	424			19424.000
Students have the opportunity to participate in decision-making	No	284	4.01	210.16	
	Yes	140	4.09	217.24	
	Total	424			19216.000

Note: p < .05; p < .01***

*Mann-Whitney *U* test difference in the perception of the autonomy allowed to students between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience

As for the assessment of the extent to which autonomy is allowed to students, it is visible that students do not differ depending on the experience with violent behaviour of students directed at teachers. It can be concluded that students who have experience with violent behaviour of students directed at teachers and those who do not have that experience disagree, to the same extent, with the statement that students have the opportunity to propose activities in class and to participate in determining rules and making decisions in school. It should be stated that students from both groups disagree more than agree with the statement that students have the opportunity to propose activities in class and to participate in determining rules and making decisions in school.

The obtained results have to be viewed in the context of the Croatian educational system, i.e. in accordance with the legislation and regulations that do not include students as decision-makers or as participants in decision-making, which, to a certain extent, disturbs the positive school climate in the secondary schools in Zagreb (Zakon o odgoju i obrazovanju u osnovnoj i srednjoj školi, 2008).

While the Croatian education system does not offer students the opportunity for active participation in decision-making, the authors Way et al. (2007), in their American research, prove that students' autonomy in decision-making, that exists in the system, is related to violent and other problematic forms of behaviour, students' mental health and self-confidence.

Table 8: Mann-Whitney *U* test difference*

Clarity, consistency and fairness of school rules	Experience with violence of students directed at teachers	*n*	*M*	Central rank	Mann-Whitney *U* test
The rules are fair	No	280	2.79	200.41	
	Yes	140	3.24	230.68	
	Total	420			16775.500*
Sanctions for disobeying the rules are equal for all	No	285	2.93	205.74	
	Yes	140	3.29	227.79	
	Total	425			17879.500
Teachers explain to students what is expected from them	No	285	2.54	202.36	
	Yes	141	2.96	236.01	
	Total	426			18842.500
The procedures regarding the application of the rules are clear	No	284	2.75	201.55	
	Yes	138	3.09	231.97	
	Total	422			16770.500
The procedures regarding the application of the rules are often ignored	No	285	3.79	231.33	
	Yes	138	3.14	172.08	
	Total	423			14156.500**

Note: $p < .05$; $p < .01$***

*Mann-Whitney *U* test difference in the perception of school rules between the students who have experience with violent behaviour of students directed at teachers and those who do not have that experience

The students who do not have experience with violence of students directed at teachers consider, to a greater extent, that school rules are fair ($U = 16775.500$, $p < .05$) and, to a lesser extent, that procedures regarding the application of the rules are often ignored ($U = 14156.500$, $p < .01$).

Students who witnessed or heard of cases of violent behaviour of students directed at teachers mostly, on average, do not agree that rules in their school are fair ($M = 3.24$), which indicates that allowing violent events and inadequate reactions to them can cause suspicion in students regarding the fairness of school rules.

Students who have experience with violence of students directed at teachers agree to a greater extent with the statement on ignoring the procedures for the application of rules ($M = 3.14$). The above stated should encourage schools to additionally and more clearly explain the procedures of the application of rules to their students, whereby it is important to avoid situations in which, due to uncertainties, a large number of students will witness the violence of students directed at teachers. To put it more precisely, clarifying the procedures for the application of rules in schools as part of the positive school climate contributes to preventing or reducing violence (Gottfredson & Gottfredson, 1985).

4 CONCLUSION

The analysis and determination of the relation between school climate and the occurrence of violence of students directed at teachers has been conducted on a sample of 451 students in their final years of secondary schools in Zagreb.

In this paper, three hypotheses were refuted due to the existence of a statistically significant difference in the perception of claims that measure three dimensions of school climate (nature of the teacher-student relationship, nature of the relationship among students and clarity, consistency and fairness of school rules) between the students who have experience with violent behaviour of students directed at teachers and the students who do not have that experience.

The accepted hypothesis (no statistically significant difference in the perception of claims that measure clarity, consistency and fairness of school rules between the students who have experience with violent behaviour of students directed at teachers and the students who do not have that experience) is the consequence of the inflexibility of the Croatian education system that does not foresee active roles of students in determining the rules, which means that we cannot expect that the autonomy of students in decision-making and determining the rules will make a difference.

The results of the research indicate the difference in the perception of three out of four dimensions of school climate depending on whether or not students witnessed or heard of violent behaviour of students directed at teachers.

When asking question about when students last witnessed student violence against teachers, we wanted to find out the prevalence of such events. In doing so, we have decided to take into account the experiences of students who have heard of such events, considering that news of such events among peers is spreading extremely fast. This was done so as not to lose valuable information, which has rarely been collected in Croatia. The question of whether students have witnessed or heard about students' violent behaviour towards teachers is one of the last questions in the questionnaire before sociodemographic questions. In this way, answering this question did not affect answering other questions in the questionnaire.

The results presented in this paper can have practical implications because, based on the obtained data, it is possible to view the extent to which the experience with violent behaviour of students directed at teachers affects the perception of the concept of school climate. In addition to the information on the number of students who witnessed or heard of violent behaviour of students directed at teachers, the paper provides an assessment of school climate by students on a subsample of the students who witnessed or heard of violent behaviour of students directed at teachers. Based on the research results, schools have the opportunity to more effectively prevent violence of students directed at teachers and to strengthen the elements of school climate on the basis of insight into decomposed dimensions of the concept. Accordingly, with the help of pedagogical designing and strong implementation of the concepts of school climate, schools can raise the level of safety of teachers, as well as strengthen positive foundations of school climate, i.e. school atmosphere. Furthermore, the research results are, especially after changes have been implemented in schools in accordance with the research results, of great

significant for the safety of students because students will feel more comfortable in school, put more effort into their obligations, establish better relationships with each other and with their teachers, thus allowing little or no room for violent behaviour directed at teachers.

The authors of the concept of school climate (Way et al., 2007) presented in their research that all four dimensions of school climate, when positively perceived by students, contribute to the reduction of problematic behaviour and depression symptoms in students. All dimensions of school climate contribute to greater self-confidence in students (Berkowitz & Bier, 2005; Cohen, McCabe et al., 2009; Way et al., 2007).

As mentioned before, as part of primary preventive efforts of school, it is advisable that schools themselves design all-encompassing, integrated, multi-directional prevention models that will promote educational and social success through clearly communicated expected behaviours (Lane et al. in Espelage et al., 2013; Greenberg et al., 2003; McMahon et al., 2014).

Establishing a positive and supportive school climate, transparent and consistent school rules, participation of students and their parents in decision-making and encouraging students to participate in extra-curricular activities can greatly contribute to the prevention of school violence (Ozdemir, 2012), including violence of students directed at teachers.

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Ensuring Nuclear and Radiation Safety in the Republic of Slovenia

Saša Kuhar, Igor Sirc, Metka Tomažič

Purpose:

The purpose of the article is to present nuclear and radiation safety in Slovenia, operations of the Slovenian regulatory body, the Slovenian Nuclear Safety Administration (SNSA), and its Emergency Response Team.

Design/Methods/Approach:

We used the descriptive method and the method of document analysis. By analysing statistical data, we presented how the competence of the SNSA Emergency Response Team is ensured. The participatory observation will be used to analyse the exercises participated by the SNSA Emergency Response Team in year 2019.

Findings:

Ensuring nuclear and radiation safety is one of the core tasks of the SNSA. SNSA employees conduct expert, administrative, control and development tasks in the field of nuclear and radiation safety. An essential part of ensuring nuclear and radiation safety is emergency preparedness. Regular trainings of SNSA Emergency Response Team members, monthly checks of communication channels and equipment, preparation of procedures that precisely define the activities and work of SNSA and members of the Emergency Response Team, development of tools and exercise participation are necessary to ensure the highest level of preparedness. The Republic of Slovenia has developed comprehensive arrangements for ensuring preparedness and response in the event of a nuclear or radiological emergency, as confirmed by International Atomic Energy Agency (IAEA) in the Emergency Preparedness Review (EPREV) in 2017. Many national and international exercises are carried out annually. Analyses of the exercises carried out in 2019 revealed some challenges that are being addressed immediately or with a trainings and exercise plan for 2020.

Originality/Value:

The article presents activities undertaken in Slovenia in the area of emergency preparedness to ensure nuclear and radiation safety. Due to the possible devastating consequences of over-exposure to ionising radiation on human health and the environment, this topic is important for every citizen of the Republic of Slovenia and also in broader region, as nuclear accidents can have cross-border effects. People living in the vicinity of the nuclear power plant have higher interest in the topic and are treated in a special way.

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Keywords: ensuring safety, preparedness, response, emergencies, nuclear accident, radiological accident, regulatory body

Zagotavljanje varnosti na jedrskem in radiološkem področju v Republiki Sloveniji

Namen prispevka:

Namen prispevka je predstaviti zagotavljanje varnosti na jedrskem in radiološkem področju v Sloveniji, delovanje slovenskega upravnega organa Uprave Republike Slovenije za jedrsko varnost (URSJV) ter njene Skupine za obvladovanje izrednega dogodka.

Metode:

Za pripravo prispevka smo uporabili deskriptivno metodo in metodo analize dokumentov. Z analizo statističnih podatkov smo predstavili, kako zagotavljajo usposobljenost Skupine za obvladovanje izrednega dogodka URSJV. Za analizo vaj, v katerih je v letu 2019 sodelovala Skupina za obvladovanje izrednega dogodka URSJV, smo uporabili metodo opazovanja z udeležbo.

Ugotovitve:

Varnost je dobrina, na kateri temelji dobrobit vsake družbe, države in posameznika. Zagotavljanje varnosti na jedrskem in radiološkem področju je ena od nalog URSJV. Zaposleni na URSJV opravljajo strokovne, upravne, nadzorne in razvojne naloge na področjih sevalne in jedrske varnosti. Bistven del zagotavljanja jedrske in radiološke varnosti je pripravljenost na izredne dogodke. Da se zagotovi najvišja možna stopnja pripravljenosti, je nujno potrebno redno usposabljanje članov Skupine za obvladovanje izrednega dogodka URSJV, mesečno preverjanje zvez in opreme, priprava postopkov, ki natančno opredeljujejo delovanje in delo URSJV ter članov Skupine za obvladovanje izrednega dogodka, razvoj orodij in sodelovanje na vajah. V Republiki Sloveniji je dobro poskrbljeno za zagotavljanje pripravljenosti in odziva ob morebitnem jedrskem ali radiološkem izrednem dogodku, kar je leta 2017 potrdila tudi mednarodna pregledovalna misija za to področje EPREV. Na letni ravni izvajajo veliko vaj na državni in mednarodni ravni. Analize vaj, ki so se izvedle v letu 2019, so pokazale nekatere pomanjkljivosti, ki se jih bo poizkušalo takoj odpraviti oziroma z načrtom usposabljanj in vaj za leto 2020.

Izvirnost/pomembnost prispevka:

Prispevek predstavi dejavnosti, ki potekajo v Sloveniji na področju pripravljenosti na izredne dogodke in s tem zagotavljanja varnosti na jedrskem in radiološkem področju. Tematika je zaradi neželenih posledic v primeru prekomerne izpostavljenosti ionizirajočemu sevanju na zdravje ljudi in okolje pomembna tako za vsakega državljana Republike Slovenije kot tudi za širšo javnost, saj so vplivi jedrskih nesreč lahko tudi čezmejni.

UDK: 614.87:[621.039+621.311.25](497.4)

Ključne besede: zagotavljanje varnosti, pripravljenost, odziv, izredni dogodki, jedrska nesreča, radiološka nesreča, upravni organ

1 INTRODUCTION

According to the past experience nuclear and radiation safety is particularly important, because of the impact of ionizing radiation on human health and the environment. Even though 33 years has passed since the nuclear accident in Chernobyl and 8 years since the nuclear accident in Fukushima, the consequences of these accidents are still present in the environment today (Drobyshevskaya, 2018). It is therefore essential to primarily act in a preventive manner, to ensure the highest level of nuclear safety, including defence in depth in all phases of projecting, siting, constructing and operating of nuclear facility, competence of personnel working in nuclear facility, safety culture, operating and other procedures, control over installed equipment and outside support organisations, safe treatment of spent fuel and radioactive waste, etc. on operator's side and comprehensive regulatory and inspection control on regulatory body's side. As a final stage of nuclear safety both operator and regulatory body (as well as the whole state incident response system) have to be well prepared for all emergency situations, having well defined and tested all essential parts of an effective response system for nuclear emergencies.

As nuclear and radiological accidents are extremely rare, and because most people are not familiar with this field (Tzika, 2019), we discuss the potential nuclear and radiological scenarios that could occur in the territory of the Republic of Slovenia. *Hazard assessment for nuclear and radiological emergencies* (Uprava RS za jedersko varnost [Slovenian Nuclear Safety Administration, SNSA], 2017) presents the potential scenarios that could occur in the event of a nuclear or radiological accident. It includes accidents in nuclear facilities (Krško Nuclear Power Plant, TRIGA research reactor, Central storage for low- and intermediate-level waste in Brinje, and nuclear-powered ships entering Slovenian territorial waters). In addition to nuclear accidents, there is potential for a radiological accident in Slovenia, with involved radioactive sources. Radioactive sources can be mobile (sources in radiography, probes for measuring moisture and density of road surfaces, calibration sources) or used in stationary facilities (hospitals and research institutes, industrial radiography).

Risk assessment for nuclear or radiological accidents (SNSA, 2015) presents the following scenarios: accident at the Krško Nuclear Power Plant, accident at the TRIGA research reactor, accident at the radioactive waste storage in Brinje, accident in use of radioactive sources, accident due to uncontrolled radiation sources, accident during transport of radioactive and nuclear material, satellite crash with radioactive substances, accident abroad, and accident due to a criminal act. Nowadays, cyberattacks on the nuclear industry are also becoming real threats, as stressed by Tomažič and Bernik (2019). Cyberattacks are becoming more frequent and sophisticated, and their perpetrators extremely motivated. Scenarios differ a lot taking into consideration possible consequences (only nuclear accident at a nuclear power plant can cause large cross-border effects) and some unique challenges deriving from the nature of ionizing radiation. Ionizing radiation cannot be felt by any of human senses, which is in particular dangerous in case of so-called orphan sources (lost, abandoned, stolen, etc.) or in case of criminal acts involving radioactive sources.

As explained a nuclear accident at a nuclear power plant presents the highest risk scenario due to its possible consequences. In the event of a nuclear accident at a nuclear power plant with a containment structure, the structure should restrain the majority of radioactive substances, so that protective actions for the general population are not necessary, or can be minimal. However, in the event of a containment structure failure, a significant amount of radioactive substances can be released into the environment. As exposure to ionising radiation affects human life, protective actions are necessary to protect the population and the environment. As stated in the *Hazard assessment for nuclear and radiological emergencies* (SNSA, 2017), it is important that urgent protective actions are pre-prepared in advance, as there is not much time for their implementation during an accident. A protection and rescue plan must be prepared for every nuclear facility, and it has to be regularly rehearsed. At the SNSA, the responsibility for emergency preparedness and response falls under the Emergency Preparedness Division, whose basic tasks are providing all necessary competences and means of the SNSA Emergency Response Team, ensuring that Emergency Response Team's procedures are current and comprehensive, that the equipment, premises and documentation for the team's needs are adequate and operational and that all members of the team are properly trained for all their envisaged tasks in emergency. In implementation of the *National emergency response plan for nuclear and radiological accidents* (Vlada Republike Slovenije [Government of the Republic of Slovenia], 2010), the SNSA Emergency Response Team assess the situation to provide advice and give recommendations and proposal of protective actions to the Civil Protection Commander of the Republic of Slovenia, who takes decisions in all major emergencies in Slovenia. SNSA is his most important advisory body in taking pre-defined protective actions such as evacuation, sheltering, iodine prophylaxis – ingestion of potassium iodide tablets, food protective actions, etc.

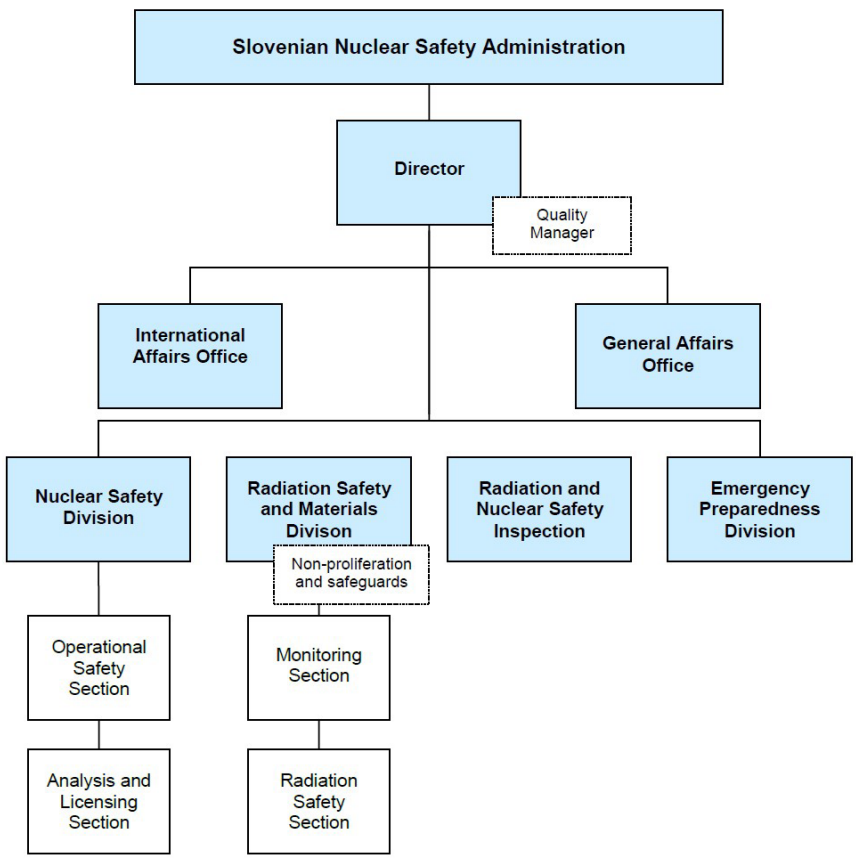
The article presents the work of the SNSA, the methods for ensuring nuclear and radiation safety, preparedness for nuclear and radiological emergencies in the Republic of Slovenia, overview of the Emergency Preparedness Division of the SNSA, SNSA Emergency Response Team and its trainings, as well as exercises carried out to test and evaluate its preparedness for such situations and analysis of the exercises in which the SNSA Emergency Response Team participated in 2019.

2 SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

SNSA is a body within the Ministry of the Environment and Spatial Planning. Employees of the regulatory body conduct expert, administrative, control and development tasks in the field of radiation and nuclear safety, radiation practices and activities of using sources of ionising radiation (except in healthcare and veterinary medicine), protection of the environment against ionising radiation, physical protection of nuclear materials and facilities, non-proliferation of nuclear weapons, and security of nuclear goods. Employees at the Radiation and Nuclear Safety Inspection Service conduct inspection and enforcement tasks in the areas mentioned above. The Nuclear Safety Division supervises and monitors the safety in nuclear facilities and issues licences and authorisations to nuclear

facilities in the Republic of Slovenia, and reviews and approves safety analyses and assessments. The task of the Radiation Safety and Materials Division is to supervise and monitor radiation safety in nuclear and radiation facilities, issuing authorisations, approving changes, confirming programmes and approving construction in areas of limited use of space due to nuclear facilities (Figure 1). It also conducts supervision of nuclear non-proliferation, security measures for nuclear goods, physical protection of facilities, including cybersecurity in the nuclear sector, and monitors nuclear security (SNSA, 2019a).

Figure 1: SNSA organigram (SNSA, 2019a)



SNSA prepares drafts of legislation and regulation related to its work, oversees the legislative framework for its field of work, fulfils international obligations in all fields of work, prepares reports, analyses and assessments (e.g. threat assessment, risk assessment), and participates in the preparation of other documents in cooperation with other stakeholders. The General Affairs Services provides legal assistance in procedures for issuing administrative act and participates in the implementation of international treaties. SNSA has implemented a system of management, which allows uninterrupted and effective operation of the organisation, combining all requirements on safety, health, the environment, physical security, quality and economy (SNSA, 2019a).

The work of the entire administration is to ensure nuclear and radiation safety in the Republic of Slovenia (SNSA, 2019a). The key task of SNSA in ensuring nuclear safety is to carefully monitor operations of the Krško Nuclear Power Plant and the TRIGA research reactor in Brinje. In accordance with the provisions of the Ionising Radiation Protection and Nuclear Safety Act (Zakon o varstvu pred ionizirajočimi sevanji in jedrski varnosti [ZVISJV-1], 2017), SNSA maintains the Central register of radioactive waste and spent fuel. Transportation of radioactive and nuclear material in the Republic of Slovenia is governed by the Transport of Dangerous Goods Act (Zakon o prevozu nevarnega blaga [ZPNB], 2006). Transport authorisations for radioactive materials under ZPNB (2006) are issued by SNSA, which also issues import/entry authorisations for radioactive and nuclear material, except for import/entry and export/departure of radioactive material used in healthcare of veterinary medicine.

An essential part of ensuring nuclear and radiation safety is emergency preparedness, which is one of the key processes of SNSA, managed by the Emergency Preparedness Division. The Emergency Preparedness Division ensures the preparedness of SNSA for responding to nuclear or radiological emergencies, works with many organisations and bodies in planning and responding to emergencies on the national level, and also cooperates in this field on the international level. SNSA must ensure preparedness for responding to emergencies, which could represent a radiological threat to the territory of the Republic of Slovenia. In other words, in the event of a nuclear or radiological emergency, SNSA personnel is activated to perform SNSA's envisaged tasks within the state's response system. In the event of a nuclear or radiological emergency, one of the key tasks of SNSA is to provide immediate data on the radioactivity in the environment, and to propose protective actions to the Civil Protection Commander of the Republic of Slovenia. Main tasks of SNSA in the event of nuclear or radiological emergency are defined by the *National emergency response plan for nuclear and radiological accidents* (Vlada Republike Slovenije [Government of the Republic of Slovenia], 2010).

Pursuant to ZVISJV-1 (2017), SNSA each year coordinates the preparation of the Annual Report on Radiation and Nuclear Safety in the Republic of Slovenia, which is approved by the Government of the Republic of Slovenia. The Report summarises all previous year's findings related to ionising radiation and nuclear safety, thus representing the main method of informing the general public of the annual findings on nuclear and radiation safety in the Republic of Slovenia.

3 PREPAREDNESS OF THE REPUBLIC OF SLOVENIA FOR NUCLEAR AND RADIOLOGICAL EMERGENCIES

Because an essential part of ensuring nuclear and radiation safety (last barrier of protection of people against harmful effects of ionizing radiation) is emergency preparedness, all authorities and organisation in the country, composing an overall incident response system, must have and maintain all the competences needed to implement their roles and responsibilities in accordance with pre-prepared action plans, in the event of a nuclear or radiological emergency. Nuclear and

radiological accidents are emergencies that directly impact the population and the environment, and therefore require protective actions. Every emergency does not result in an accident. An emergency might involve only a reduction of nuclear and radiation safety, which also requires an appropriate response of especially operator of a facility, but as well as also other competent organisations, in first place regulatory authority (SNSA, 2019a).

If the nuclear or radiological emergency occurs, tasks within the national competence are performed according to the National emergency response plan for nuclear and radiological accidents (Vlada Republike Slovenije [Government of the Republic of Sloveniag, 2010) by:

- Government of the Republic of Slovenia,
- Ministry of Defence, Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, Slovenian Armed Forces,
- Ministry of the Environment and Spatial Planning, Slovenian Nuclear Safety Administration, Environmental Agency of the Republic of Slovenia,
- Ministry of Health, Slovenian Radiation Protection Administration, Health Inspectorate of the Republic of Slovenia,
- Ministry of Agriculture, Forestry and Food, Veterinary Administration of the Republic of Slovenia, Inspectorate of the Republic of Slovenia for Agriculture, Forestry and Food,
- Ministry of the Interior, the Police,
- Ministry of Transport,
- Ministry of Education, Science and Sport,
- Ministry of Infrastructure,
- Ministry of Labour, Family, Social Affairs and Equal Opportunities,
- Ministry of Foreign Affairs,
- Ministry of the Economic Development and Technology,
- Ministry of Public Administration,
- Ministry of Finance, Customs Administration of the Republic of Slovenia,
- Communication Office of the Government of the Republic of Slovenia,
- The Protection, Rescue and Relief Forces: the Civil Protection Commander of the Republic of Slovenia, the Deputy of the Civil Protection Commander of the Republic of Slovenia and the Civil Protection Headquarters,
- civil protection units and services,
- fire-fighting units, and units and services of associations and other non-governmental organisations,
- protection, rescue and relief units, services and centres organised by government, and
- other bodies.

They have to be prepared, knowing which are their response roles and how to undertake safety actions in a case of emergency.

Goal 10 of the Resolution on Nuclear and Radiation Safety in the Republic of Slovenia – for the period 2013–2023 (Resolucija o jedrski in sevalni varnosti v Republiki Sloveniji za obdobje 2013–2023 [ReJSV13–23], 2013) also states that, in the use of nuclear energy and radiation practice in the Republic of Slovenia,

emergency preparedness must be ensured in order to reduce the impact on humans and the environment in such events. Furthermore, the Inter-ministerial commission for monitoring the implementation of the National emergency response plan for nuclear and radiological accidents convenes regularly ones or twice per year, to direct and coordinate the preparedness on the national level (SNSA, 2019b).

Emergency preparedness is one of the key processes of SNSA, coordinated by the Emergency Preparedness Division, with cooperation of the entire SNSA. This means that, in the event of any nuclear or radiological emergency, the SNSA Emergency Response Team is activated immediately (Tomažič, 2019). SNSA is only one of the stakeholders that would start implementing actions in the event of a nuclear or radiological emergency. All organisations with a response role in the event of a nuclear or radiological emergency are defined by the *National emergency response plan for nuclear and radiological accidents* (Vlada Republike Slovenije [Government of the Republic of Slovenia], 2010). This is a pre-prepared action plan in the event of a nuclear or radiological emergency that requires the activation of national forces, including ministries and other authorities, civil protection service, healthcare, firefighters, police and other responding organisations. The main body responsible for the preparation and maintenance of the national plan is the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (ACPDR), while SNSA participates in preparation of all parts of the plan.

In 2017, International Atomic Energy Agency (IAEA) conducted an international EPREV mission to determine how Slovenia ensures nuclear and radiation safety. An EPREV mission is one of the services provided by the IAEA to member states, in the field of peaceful use of nuclear energy, and nuclear and radiation safety. Its purpose is to provide an expert review of the country's preparedness for nuclear or radiological accidents, and responses to such accidents, based on IAEA safety standards. As part of the two-week review, the international mission reviewed the entire national framework in this field, including legislation and regulation, plans and procedures on all levels, as well as personnel and material capacities of Slovenia for responses in the event of nuclear or radiological accident. It made 19 recommendations representing actions to address non-compliance with IAEA requirements and standards, 12 proposals that represent actions to more effectively implement requirements and standards and 3 good practices (International Atomic Energy Agency [IAEA], 2017). The main recommendations of the EPREV mission were finalization of revision of national plan; overall protection strategy (including monitoring strategy) for all phases of emergency, especially arrangements for the later phases of response; concept of operations for a nuclear or radiological emergency; detailed assessment of needs and available resources of all stakeholders; overall trainings and exercise programs for all response organizations; arrangements for dosimetry of all emergency workers and arrangements for general practitioners and emergency medical services to be trained to recognize the symptoms of radiation exposure and national response procedures (IAEA, 2017).

The mission report was the basis for the action plan, adopted by the Government of Slovenia, which includes tasks needed to be undertaken by

Slovenia to improve the system of preparedness. An action plan with 31 actions, which include the mission's observations and findings, the action to be taken, the leading and participating organizations and deadlines for the implementation. Some of the actions (amendment of the Hazard assessment for nuclear and radiological emergencies, analysis of the notification and activation system of the SNSA emergency response team, poster for emergency workers, including for the purposes of providing non-designated emergency workers with just-in-time trainings, a poster on information for general public on the health hazards and health effects in case of radiological emergency, addressing also the most vulnerable members of the public, amended procedures for requesting and receiving international assistance, exercise of SNSA's officer on duty to provide advice remotely during initial response to a radiological emergency, etc.) were completed in 2018. Less than a half of actions is still ongoing, including revision of national emergency plan, protection strategy, decontamination procedures, guidelines for treatment, or for the designation of medical personnel to treat radiation injuries, etc. In general, the mission praised the preparedness of Slovenia to nuclear and radiological accidents, and highlighted, amongst other things, the excellent cooperation of all stakeholders and organisations involved in responding to such accidents (SNSA, 2018).

The mission also highlighted three cases of good practices, which serve as examples of great performance in certain area to all countries around the world. The first one is communication and coordination system, called KID, which allows rapid sharing of technical and operational information across a wide range of national and international response organizations. The second one is a Geographic information system of regional emergency notification centres that includes the location of all High Activity Sealed Sources in the country which provides for a rapid assessment of the hazard and appropriate emergency response. The third good practice was conducting a simulated EPREV mission which provided a good basis for improving emergency preparedness and response arrangements in the country and updating the national self-assessment before the mission itself (SNSA, 2018).

3.1 Emergency Preparedness Division

Coordination of emergency preparedness is one of the key processes of SNSA and is one of the tasks of the Emergency Preparedness Division. The task of the Emergency Preparedness Division is to ensure the highest possible level of preparedness of SNSA for emergency response, with cooperation of the SNSA Emergency Response Team members. To ensure the highest possible level of preparedness, it is necessary to conduct regular trainings of SNSA staff as they are all SNSA Emergency Response Team members, to check emergency connections and equipment once per month, and to prepare procedures that precisely define the activities and work of SNSA and SNSA Emergency Response Team members, development of tools, etc. The tasks of the Division therefore include: providing trainings, ensuring personnel and responsiveness of the SNSA Emergency Response Team, ensuring that Emergency Response Team's procedures are current

and comprehensive, and that the equipment, premises and documentation for the team's needs are operational. The SNSA emergency response capability is ensured through regular trainings of SNSA Emergency Response Team members, regular maintenance and review of the operation of software and other equipment, regular review of all relevant organisational regulations and instructions, participation in international activities, review of responsiveness in all circumstances, and review of full system preparedness using domestic and international exercises. As the tasks during an emergency generally differ significantly from the regular work of SNSA employees, trainings of SNSA Emergency Response Team members is very important. An analysis of previous year's trainings is conducted at the end of each, to review the number of trainings courses conducted in the year and the average number of trainings hours undertaken by SNSA Emergency Response Team members. In 2019, 112 individual and group trainings courses, tests and exercises were conducted for SNSA Emergency Response Team members, for a total of 442 hours with SNSA Emergency Response Team member participation. Almost a third of the trainings constituted of exercises (30%) – 15 different types in 2019. The implementation of the professional trainings and preparedness programmes of the Nuclear Accident Analysis Expert Group and the Dose Assessment Expert Group is the responsibility of the Head of the Nuclear Safety Division and the Head of the Monitoring Section. The Head of Emergency Preparedness Division is responsible for planning, management, and coordination of programmes (Kuhar, 2020).

3.2 Emergency Response Team

In the event of an emergency, the SNSA Emergency Response Team is activated (Tomažič, 2019). It is composed of sub-groups, whose roles are pre-defined. The Emergency Team Director is responsible for managing an emergency, making all key decisions and communicating with external stakeholders and public. The Emergency Team Director approves all outgoing documents prepared by the Emergency Response Team.

According to Tomažič (2019) the Head of the SNSA Emergency Response Team helps the Emergency Response Director with operational management of the SNSA Emergency Response Team and is the Director's deputy. Additionally, the SNSA Emergency Response Team includes: Nuclear Accident Analysis Expert Group and the Dose Assessment Expert Group, incoming and outgoing communicators, technical support, representatives in the Off-site Support Center of the Krško Nuclear Power Plant, in the Civil Protection Headquarters of the Republic of Slovenia, and in the inter-ministerial operating group. SNSA Emergency Response Team members are appointed by the SNSA director. The work is organised in two shifts, meaning that the members' shifts are limited to 12 hours.

Tomažič (2019) also explains that the Nuclear Accident Analysis Expert Group is activated only in the event of a nuclear accident. The task of the Nuclear Accident Analysis Expert Group is to use the available data to analyse a nuclear accident, assess the situation in the nuclear facility where the emergency is

underway, to determine its likely course, and to forecast the potential development of the incident. Their main tool of assessment is Emergency Response Data System (ERDS), the system which is directly connected with the Krško Nuclear Power Plant providing all essential parameters of safety and other systems of the nuclear power plant. Using the ERDS the SNSA has the same information of the nuclear power plant parameters as the operator of the facility, allowing SNSA Emergency Response Team to perform its own independent evaluation of the emergency situation. The Nuclear Accident Analysis Expert Group is also tasked with assessing the amount of radioactive material during an actual or potential release. The Head of the Nuclear Accident Analysis Expert Group reports directly to the Emergency Team Director.

The task of the Dose Assessment Expert Group is (Tomažič, 2019) to propose protective actions, based on the situation at the site of the accident (radiological situation in the field, level of risk at the Krško Nuclear Power Plant), with potential consideration of dose assessment model results, primarily for the purpose of protective actions optimisation. In case of a nuclear accident in Slovenia or abroad, their main tools are the real-time on-line decision support systems DOZE and RODOS which provide consistent and comprehensive information on the present and future radiological situation, in order to help members of the Dose Assessment Expert Group to decide on emergency response strategies. The Head of the Dose Assessment Expert Group reports directly to the Emergency Team Director.

Five communicators, who report directly to the Head of the Emergency Response Team, are according to Tomažič (2019) planned for communication with external stakeholders. One shift is composed of two incoming communicators and three outgoing communicators whose key tasks are informing the public, neighbouring countries and international community (European Union [EU] and IAEA). Uninterrupted operation of the necessary devices is the responsibility of the technical support person. SNSA representatives at Civil Protection Headquarters of the Republic of Slovenia, the Off-Site Support Center of the Krško Nuclear Power Plant, and the inter-ministerial operating group are responsible for direct information and presentation of SNSA position regarding the emergency situation.

SNSA has an employee (a Duty Officer) on permanent duty (24/7), who must have a mobile phone and some emergency procedures with him at all times. Their task, within the framework of emergency preparedness, is activation of the Emergency Team Director, followed by the activation of all SNSA Emergency Response Team in the extent determined by the Emergency Team Director. An important task of the Duty Officer is also providing advice on call to first responders or users of radioactive sources in case of radiological accidents. In case of this kind of accidents, the SNSA Inspector can be sent to the emergency location.

All tasks and duties of the Emergency Response Team members are pre-defined and trained regularly.

All written communication of the SNSA Emergency Response Team is conducted using the KID (Communication during the emergency). According to Kuhar (2019) KID is an online communication system for communication during

the nuclear or radiological emergency. Communication can be carried out on two levels, specifically on internal level between SNSA Emergency Response Team members and on the inter-ministerial (and even cross-border) level. Communication by KID is:

- *immediate*: a sent message is immediately received,
- *direct*: a message is received by all users,
- *secure*: internal and inter-ministerial KID operate on an independent and secure network,
- *full*: unlimited number of messages with attachments,
- *private*: private messages are possible,
- *controlled*: it is possible to confirm and check the delivery of messages and
- *recorded*: messages and attachments are archived.

In addition to communication, the KID website includes a sub-page StatusID, which shows all important information on the emergency on one page. SNSA regularly maintains and updated the KID, and conduct trainings for external users (Kuhar, 2019).

According to Kuhar (2020) 36 organisations[1] involved in responding to nuclear or radiological accidents were included in the KID in end of 2019. KID communication represents one of the best known solutions in this area, both in Europe and throughout the world, as it represents a safe, quick, reliable, controlled and transparent tool for communication and coordination of protective actions for all stakeholders in the country when responding to a nuclear or radiological accident, and also provides effective and quick cross-border communication with the Croatian Civil Protection Directorate, allowing appropriate and timely harmonization of protective measures which is essential, considering the location of the Krško Nuclear Power Plant in the vicinity of the border.

4 DESCRIPTION OF THE METHOD, SURVEY DESIGN AND THE PRESENTATION OF NUCLEAR AND RADIATION SAFETY EXERCISES ATTENDED BY THE SNSA IN 2019

To ensure the highest level of competence, SNSA Emergency Response Team members participate in various exercises. As a minimum, every SNSA Emergency Response Team member attends at least one exercise per year (Kuhar, 2020), while employees of the Emergency Preparedness Division generally participate in all exercises. Participation in exercises represents the main basis for the evaluation of

1 *The Notification Centre of the Republic of Slovenia, Civil Protection Commander of the Republic of Slovenia, Administration of the RS for Civil Protection and Disaster Relief, Krško Nuclear Power Plant - Technical Support Center, Krško Nuclear Power Plant – Off-Site Support Center, Slovenia Nuclear Safety Administration, Civil protection Posavje, Zasavje, Dolenjska, E Štajerska, W Štajerska, Ljubljana, Krško, Brežice, Sevnica, Kostanjevica, Regional Notification Centre Brežice, Novo mesto, Trbovlje, Celje, Maribor, Ljubljana, Communication Office of the Government of the Republic of Slovenia, Slovenian Environment Agency, Mobile unit/mobile laboratory of Jožef Stefan Institute, Rapid Response Unit, Radioactive Waste Management Agency, Institute of Occupational Health, Ministry of Interior, Police, Ministry of Health, Ministry of Infrastructure, Ministry of the Environment and Spatial Planning, Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Food, Croatian Civil Protection Directorate.*

competence of SNSA Emergency Response Team members, and consequently the capability of SNSA to respond to emergencies. After every exercise an analysis of SNSA Emergency Response Team members' work and performance in carrying out the necessary actions, in relation to the event played during an exercise, is conducted. The analysis is the foundation for the preparation of action plans, which act as a basis for further trainings or improvements of equipment or procedures.

In the following sections we will outline the types, frequency and analysis of the exercises in which the members of SNSA and the SNSA Emergency Response Team participated in 2019. The data collection method will be participatory observation, and for the purposes of analysis we will analyse the following data: the number of participants or participating organizations, the activation time of Emergency Response Team, the public information performance and the main findings of the analysis after the exercise will be summarized. The analysis will include data that do not represent any degree of secrecy in their content. The discussion will present proposals for the future improvements in the coming period, based on the analysis. Individual exercises will be presented in each section in accordance with the analysis approach described earlier.

4.1 Krško Nuclear Power Plant Exercises

The Krško Nuclear Power Plant organises two exercises each year, with the participation of SNSA. The goal of the exercises at SNSA is to review emergency operations of SNSA and SNSA Emergency Response Team, communication and coordination between Krško Nuclear Power Plant and SNSA. At the same time, organisational procedures and instructions are also reviewed. Exercises can be announced or unannounced, and run for few hours to a day or even more, starting at various times of the day. Exercises can also include practical (on the job) trainings of individual new members of the Emergency Response Team. During exercises, members practice performing their pre-defined tasks and duties and providing expected products of the SNSA in emergency situation – proposals of protective actions and measures for affected public, press releases for the domestic and foreign public and notifications for neighbouring countries, IAEA and the EU. All these products are based on the information received from the Krško Nuclear Power Plant operator, data provided by early notification network and other measurements in the environment, if available, and on assessment and analyses of the expert groups of the SNSA Emergency Response Team. Besides Krško Nuclear Power Plant (its Technical Support Center, Off-Site Support Center, occasionally also main control room and operational support centre) and SNSA the following organisations also usually participate in these exercises: regional notification centre Brežice, Notification centre of the Republic of Slovenia and Slovenian Environment Agency. Other stakeholders participate occasionally. For the past few years some stakeholder with important role during a response (such as the Civil Protection Commander of the Republic of Slovenia, The Government Communication Office, etc.) were simulated by the SNSA Emergency Preparedness Division as a part of the leadership of exercises. It would be advisable for this stakeholders to participate in future exercises more often.

4.2 Emergency Response Team Activation Exercise

The purpose of the Emergency Response Team activation exercise is to check the response time of the SNSA Emergency Response Team and the activation time of the SNSA Emergency Response Team shift in all circumstances. These exercises are therefore unannounced and are performed twice per year. The area of SNSA Emergency Response Team notification and activation is regulated by two SNSA documents, the organisational procedure and the work instructions. Notification and activation is carried out in accordance with a specific procedure. The goal of the exercise is to determine the response time of SNSA Emergency Response Team members and the time necessary to form an effective (operative) SNSA Emergency Response Team shift in the event of an emergency outside SNSA working hours.

Both team response exercises that were conducted in year 2019 started by the Emergency Notification Centre of the Republic of Slovenia informing the SNSA Duty Officer to start the exercise. The response of SNSA Emergency Response Team was quick and the activation would be on time according to pre-defined target times.

4.3 IAEA Exercises

The main tasks of the IAEA in case of nuclear or significant radiological emergency anywhere in the world are exchanging information, providing assistance, and informing the public. The legal basis that defines the role of IAEA and its member states are two international conventions, specifically the Convention on Early Notification of a Nuclear Accident (IAEA, 1986a) and the Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency (IAEA, 1986b). The country, where the emergency occurred, notifies IAEA via fax or Unified System for Information Exchange in Incidents and Emergencies (USIE). Notification of IAEA and other countries is obligatory in all cases where cross-border effects occur or may occur. In other cases (low-level emergencies) notification is highly encouraged.

IAEA conducts three types of exercises (Nizamska, 2019), called Convention Exercises (ConvEx), attended also by members of the Emergency Response Team. The basis type of exercise involves communication tests, aimed at checking whether notification centres, which must operate on 24/7 basis (in Slovenia this is the Emergency Notification Centre of the Republic of Slovenia) and competent authorities (SNSA) received the first notification of emergency within the expected timeframe, and whether the primary communication channels were correct.

Small-scale or medium-scale exercises are conducted with hypothetical scenarios. Their purpose is to check whether organisations can correctly fill reporting forms and whether they conduct appropriate procedures for exchanging information and requesting and/or offering assistance. The most extensive exercise, which usually lasts two to three full days, without interruptions, is conducted once every three to five years. It is used to test national and international emergency response arrangements for a severe nuclear or radiological emergency (Nizamska, 2019).

In 2019 SNSA participated in four IAEA exercises. Two of them were conducted for communication tests where only the Duty Officer and a member of Emergency Notification Centre of the Republic of Slovenia participated. Their mission, response to the received notification, was completed successfully and within the stipulated time. The purpose of the third exercise was to allow member states and international organizations to exercise the national and international processes for requesting and/or offering assistance following a nuclear or radiological emergency. The Republic of Slovenia was a member state who offered the assistance and because of this the SNSA Emergency Response Team was activated the second and third day of exercise. Administration of the Republic of Slovenia for Civil Protection and Disaster Relief also participated in this exercise. That was important, since this administration in all emergencies situations prepares proposals for the Government of the Republic of Slovenia to decide in immediate time. The analysis of the exercise showed that there was a need to make some further improvements to the SNSA's procedures for preparation of an offer of international assistance. In addition, the Response and Assistance Network (RANET) database had to be refreshed, as some new features were introduced by the IAEA. The goal of the fourth exercise was to complete and submit the appropriate emergency communication forms and to practice the International Radiation Monitoring Information System (IRMIS) which issued for collection of radiation monitoring data. The analyses of both exercises revealed that the SNSA Emergency Response Team was activated at the time planed for activation, all tasks were completed on time and in accordance with procedures.

4.4 KiVA

Because cybersecurity is becoming more and more important for nuclear and radiation safety, the first such exercise in the nuclear sector, called KiVA[2019], was organised in 2019. All domestic stakeholders (nuclear facility operator, competent authority, technical support organization and suppliers of computer equipment), which would take action in the event of such a cyberattack were participating in the exercise (Tomažič, Bernik, & Tomažič, in press). The exercise was of table-top nature and its scenario involved a cyberattack in a nuclear facility, with access to the physical security control system and theft of sensitive information. Participants received different injects, based on their field of work, so the exercise heavily emphasised mutual communication and exchange of information. All participating organisations actively participated in the exercise. The analysis of the exercise revealed that the communication between the stakeholders caused some difficulties. Public information has also proved to be both a weakness and a security challenge. There were some questions about with whom to share information, when to share, and what should be the criteria for sharing information. Despite the identified challenges the exercise was extremely successful and, as such, represents the cornerstone for further conduct of this type of exercises – the next one is under preparation for 2020.

4.5 KID Exercises

As the KID is essential for an organisation participating in the emergency response – nuclear or radiological emergency, SNSA conducts KID exercise once a year, with participation of all KID users. The goal is to include all external KID users in the exercise, and to test the capacity of the KID server (SNSA, 2019c).

82% of all organizations with access to KID participated in the exercise in 2019. The exercise consisted of two short tasks: the use of attachment messages and the simultaneous upload of large-scale files to the system to verify that the KID server was carrying the load. The tasks were successfully completed in 98% of the cases. Despite this success some suggestions and comments were made by participants regarding the operation and improvements of the communication system.

4.6 On-call Advice

One of suggestions of EPREV mission was also for the SNSA to conduct regular yearly based trainings and exercises for SNSA Duty Officers, who provide on-call advice to persons with less adequate knowledge on ionising radiation and measures to be taken for proper response and their own protection. Such advice would be needed in cases of radiological emergencies where no experienced staff of the facility operator would be available (finding of an orphan source, detection of elevated level of ionizing radiation, traffic accident involving radioactive source, field work with radioactive source, etc.). In 2019 all SNSA staff, performing tasks of the Duty Officer, were trained and exercised. Training consisted of lectures on duties and procedures to be used by the Duty Officer and the exercise consisted of a simulated call from the trainer asking for advice in specific situation. Different scenarios are foreseen for this type of exercise.

4.7 Radiological Exercises Under the ENRAS Project

Exercises for ensuring the safety of first responders in the event of nuclear or radiological emergencies in the framework of the ENRAS project (Ensuring Radiation Safety [ENRAS], 2018) were carried out in 2019, with further exercises planned in 2020. These are joint exercises of Slovenian and Croatian firefighting units, used to exercise procedures used in different scenarios. Their purpose is to improve the preparedness of firefighters in the event of a nuclear and radiological accident, and to ensure appropriate safety during response. The goal of the project is to develop and implement a new system of trainings, and to sign an agreement on the implementation of a new structure, which will promote cross-border cooperation for ensuring safety in the event of accidents involving the threat of radiation. The project includes 31 fire-fighting units of wider importance in Slovenia, with the authorisation to respond in accidents involving dangerous materials. The planned approach aims to provide the trainings and cross-border integration of intervention teams and administrative bodies responsible for such accidents, to ensure safety for the entire population of the cross-border area and wider region.

Practical exercises have revealed some of the challenges that can occur in the event of a firefighter's response to a radiological emergency, but the details about this because of the project's progress cannot be disclosed.

5 DISCUSSION AND CONCLUSION

Ensuring nuclear and radiation safety is a complex matter. One of the key stakeholders in this field in Slovenia is the SNSA, which performs its work professionally and successfully. SNSA must ensure preparedness to respond during emergencies, which could represent a radiological threat to the territory of the Republic of Slovenia. To prevent nuclear or radiological emergency and to minimise the impacts from nuclear and radiological incidents and emergencies if they occur effective national response arrangements and capabilities are essential.

In 2017, the EPREV mission was conducted in Slovenia. The mission reviewed the activities of all organisations involved in response to a nuclear or radiological emergency under the National Protection and rescue plan in case of nuclear or radiological accident. The mission found that Slovenia ensures good nuclear and radiation safety and made some recommendations and proposals that represent actions to more effectively implement requirements set in international safety standards. These represent useful guidance for continued improvements in this field. Although the preparedness of Slovenia is on a high level, following the lessons learned from the accidents at the nuclear power plant in Chernobyl in Ukraine and Fukushima in Japan the necessary steps have to be taken for upgrading the safety actions to prevent nuclear or radiological emergencies and to improve the means for the successful mitigation of their consequences. If nuclear or radiological emergency occurs, the SNSA Emergency Response Team is activated, which has at its disposal working equipment, infrastructure, and the competence and knowledge of necessary actions. Regular trainings, exercises and updated procedures help to ensure that personnel are well trained and can conduct their work effectively.

To further improve overall emergency preparedness in Slovenia, the fulfilment of all EPREV Action plan from 2018 is required. A lot of actions were concluded in 2018 and 2019 while some very important ones still need to be completed. The most important are revision of the current National emergency response plan for nuclear and radiological accidents, adoption of the Draft Protection strategy of the Republic of Slovenia in the event to nuclear or radiological accident and drafts of other related documents (Decontamination procedures, etc.). After fulfilment of the EPREV Action plan Slovenia will invite EPREV follow-up mission to assess the progress done since the 2017 mission.

In the future a lot of work needs to be done also at the field of practical arrangements between SNSA and Croatian Civil Protection Directorate to facilitate harmonized response to nuclear or radiological emergencies that impacts both countries or are of common interest.

Exercise analyses in 2019 revealed some challenges that will need to be addressed in the future with additional trainings and exercises. In addition, it will be necessary to improve certain SNSA procedures, continue to participate

in similar exercises and train informing the public. It would be advisable for the nuclear power plant's future exercises to include the Civil Protection Commander of the Republic of Slovenia and The Government Communication Office, now simulated by a member of SNSA Emergency Response Team.

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