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The Concept of Human Security as a Basis for the Application of Big Data Concept in Establishment of Early Warning System for Crisis Management in the Republic of Croatia

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Ivana Cesarec

Faculty of Political Science of the University of Zagreb, Zagreb, Croatia
icesarec@mup.hr
ORCID: 0000-0002-3533-1745

Robert Mikac

Faculty of Political Science of the University of Zagreb, Zagreb, Croatia
robert.mikac@yahoo.com
ORCID: 0000-0003-4568-6299

Davor Spevec

Ministry of the Interior of the Republic of Croatia, Civil Protection Directorate, Zagreb, Croatia
dspevec@mup.hr
ORCID: 0000-0001-7994-2874

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Abstract

We live in a globalised world characterized by constant crises in numerous social and geographical areas. Political instability, climate change, overpopulation, uncontrolled migration, poor governance, crime, as well as many other factors create the circumstances from which crises can develop. Each crisis given its causes and possible consequences requires different approaches and response systems. This research focuses on considering modern technological solutions that have the purpose of alerting and protecting individuals from risks and threats that can lead to their suffering, caused by natural, technical-technological and anthropogenic crisis events. It also aims to link the theory of human security and the big data concept and present their application through the development of the early warning system for crisis management in the Republic of Croatia. This research has significant value because it analyses and describes the establishment of a particular system in the world.

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Introduction

At the beginning of the debate on security (Williams 2012: 44), it is necessary to ask four key questions: What is security? Whose security are we discussing? What can we comprehend as a matter of security? How can security be achieved? Security as a basic need and value (Injac 2016: 61) "is differently understood by various actors, in line with what it comprehends, but it is necessary to have an objective assessment of its core elements." There are numerous definitions of security. Barry Buzan (1991/2007: 25) believes that the very concept of security is so poorly developed that it presents a part of the problem. Kenneth Waltz (1998: 11) sets up security analysis at three levels: individual, national, and international, while Bertel Heurlin suggests six of them: individual security; social security; state security; regional security; international security; and, global security (Heurlin 2001: 13 quoted to Injac 2016: 140). For the operational definition of the security for this research, we take the one offered by Anton Grizold (1998: 27) where "security can be defined as a state in which the balanced physical, spiritual, mental and material survival of the individual and the social community is ensured, in relation to other individuals, the social community and the nature."

The processes of internationalisation and globalisation contributed to discussions on security (Tatalović, Grizold, Cvrtila 2008: 24), as reflected in the content of national security policies. "In this framework, a new concept of security — a human security concept — emerged in theory and practice, which unlike the traditional concept of national security, highlights the primary security of individuals rather than states as entities." Today, more than ever before, different levels of security are exceptionally interconnected and (Hampson 2012: 308) "human security is of crucial importance for international security, and international order can not only rely on the sovereignty and vitality of states — this order also depends on individuals and their sense of security." Human security concept is of a newer date, and therefore according to Fen Osler Hampson (2012: 306) "there is still a significant methodological and conceptual confusion about the real meaning of human security and the definition and consequences of the human security paradigm in research or practice." Buzan believes that it is easier to apply the idea of security to things than to people and how human security cannot be easily defined (1991/2007: 49). Many authors

state how human security concept was presented by the United Nations Development Programme (UNDP) in 1994, and since then began the more extensive use. According to UNDP, human security means "firstly, the safety of such chronic threats as hunger, illness and repression. And secondly, it means protection from sudden and harmful everyday disorders — whether in homes, workplaces or in communities" (UNDP 1994: 23 quoted by Kerr 2010: 115). Heurlin observes human security concerning "circumstances that may endanger physical and economic survival" (Heurlin 2001: 13 quoted to Injac 2016: 140). Today, human security is exposed to many factors and risks that are generated from natural, technical-technological, and human-induced impacts, and they are changing and increasing. Pauline Kerr (2010: 115) states that "ensuring human security requires a sevenfold approach in response to economical, nutritional, health, ecological, personal and political security and community security."

Since its inception, the Republic of Croatia has given considerable attention to the area of human security. Its efforts ranged from the care of persons with disabilities, through the protection of the environment, the efforts to demine all suspected areas left behind after the Homeland War, the development of public policies for the prevention of various risks and threats, all to the taking commitments of all international obligations to protect individuals, whether they are nationals or foreign nationals. In the process of continually upgrading the concepts and methods of protecting human security, it is worth to point out the quotation from the National Security Strategy adopted in 2017, which states that "[t]his strategy introduces a new security paradigm based on the model of human security, that is, the safety of the individual — every citizen of the Republic of Croatia" (Croatian Parliament, 2017). The central axis and foundation of national security of the Republic of Croatia is the concern for human security and how to achieve it. Besides, the overall Strategy, as the reference point for defining the policies and instruments for accomplishing the vision, national interests and ways of attaining security conditions, instructs all holders of authority and responsibility for the development of human security in all those theoretical elements mentioned in the previous paragraph in the discussion on human security.

For the consideration of the big data concept and its application within the human security theory, firstly, we look into the

definition of big data. "Big Data" *per se* represents a massive gathering of information from internet databases. From the technology aspect, Oracle brings the definition: "Big data is larger, more complex data sets, especially from new data sources. These data sets are so voluminous that traditional data processing software just can't manage them" (Oracle.com, 2020). In that term, it is clear how challenging data processing can be, especially extracting useful information from big data. Rob Kitchin (2013: 262) also explains big data by saying that it is vast in volume, velocity, variety and exhaustive in scope. To get a more specific perspective of big data that is not just a solution, yet the enabler/resource of information, we can refer to Gartner's Glossary definition. Thus, Big data is high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation (Gartner Glossary, 2001). With this in mind, the patterns and relationships contained within big data inherently produce meaningful and insightful knowledge about complex phenomena (Anderson 2008 quoted in Kitchin 2014), also linkable to human security and its complexity.

Today, in developed countries around the world, the human security approach and the big data concept are used in many daily operations from individuals to multinational companies, and this is becoming increasingly inevitable in the contemporary world. These countries invest resources and develop systems that have dual functionality: first, human security; second, reducing the cost of reaction and eliminating the consequences that an extraordinary event could cause. These (developed) countries also invest significant resources in disaster risk reduction, public awareness, and public policies that build and realise society's resilience and ability to deal with many risks. Likewise, as this research underlines, they are investing resources in the development of new processes and systems that alert people in the time of upcoming danger. So, one of the best ways to care for one's safety is to alert people to imminent danger in time. It should be emphasized that there are dangers people can be alerted about in time, such as floods, fires, storms and similar. Nevertheless, there are also dangers, such as earthquakes that cannot be alerted because of the inability to predict them and their sudden occurrence. There is no single system in place to alert people to all the potential hazards that may endanger them. However, we must

do everything in our power to establish systems through which we can respond to most of the contemporary challenges we face proactively. Therefore, the development of early warning systems is exceptionally significant. A warning of potential or real danger can be based on traditional approaches from public alerting through radio and television to the use of sirens. However, the question here is what if people do not watch TV or listen to the radio or are not within reach of the siren sound wave. Modern solutions are directed to the option of sending a notification to mobile telephones because today it has become standard that almost all people in developed countries have at least one mobile device. As perceiving the primary interest of this research, it is necessary to give a general review of state of the art from individual countries that have developed systematic solutions of informing citizens through messages on mobile devices. Countries such as Sweden, Belgium, the Netherlands, Singapore, Australia, and the United States have developed high-tech early warning systems that work on the principle of warning and alerting of the population in a specific geographic area. The next chapter includes more details about their solutions. Unlike the countries mentioned above, the vast majority of other countries still use traditional ways of warning and alerting through TV and radio messages and the use of sirens, which are outdated and encompass fewer citizens compared to modern solutions.

This research aims to analyse ways how in the Republic of Croatia it is planned to use the possibilities and reach of the big data concept within the human security theory to establish an early warning system for crisis management. This research hypothesises that the establishment of a modern early warning system (which includes new processes, procedures and technology) for crisis management in the Republic of Croatia will increase the level of human security of its citizens and its tourists. The following research questions will help us to conduct the research and to confirm the hypothesis: 1. What is the significance of the big data concept in the development of the crisis management system? 2. What are the modern solutions of technologically advanced countries in the field of the early warning system and which solutions are foreseen to be developed in the Republic of Croatia? 3. What are the expected results of the development of the modern early warning system (as a system that includes new processes, procedures, and

technology and is more efficient than existing and available alert models) in the Republic of Croatia? The paper explores those parts of the big data concept related to the human security from natural, technical-technological and human-induced major crisis and disasters in the part of prevention and timely information on the risks threatening to human lives and material assets. This research follows the real-time project that is currently in the initial phase of its implementation in the Republic of Croatia. Under this project, the vast amount of different kind of data that will be collected. The current locations of all mobile phone users in real-time at a certain location will be collected for their further use in tracking the number, movement, and above all, for notifying of potential hazards and crisis management operations. In its next chapters, this research presents the anticipated functionalities of the new system. The scientific significance of this research is twofold. Firstly, it consists of the evaluation of current modern solutions developed by individual countries and the solution currently in the process of development in the Republic of Croatia. Secondly, the presented solutions as the results of the project mentioned above will make this research essential for the continuation of the development of this area in other countries that have not established modern early warning systems.

Big data in the crisis management system

People around the world are exposed to different influences of various crisis and disasters that cause significant adverse consequences. If we analyse data of natural disasters for 2017 only, we can see that this is a relevant indicator of the threat to people and their property. In 2017, "335 natural disasters affected over 95.6 million people, killing an additional 9,697 and costing a total of US $335 billion. This burden was not shared equally, as Asia seemed to be the most vulnerable continent for floods and storms, with 44% of all disaster events, 58% of the total deaths, and 70% of the total people affected. Despite this, the Americas reported the highest economic losses, representing 88% of the total cost from 93 disasters. China, the U.S., and India were the hardest hit countries in terms of occurrence with 25, 20, and 15 events, respectively" (ULC, CRED, USAID, 2018).

Regarding the European territory, according to Directorate-General for European Civil Protection and Humanitarian Aid

Operations (DG ECHO) Annual Activity Report in 2017, there was extensive use of EU Civil Protection Mechanism to support national capacities in crisis and disasters both inside and outside Europe. The year 2017 had a record number of activations of the Union Civil Protection Mechanism with 32 requests for assistance — including for the forest fires in Chile in February, massive flooding in Peru in March and April, earthquakes in Mexico in September and the devastating hurricanes in the Caribbean. The 2017 forest fire season in Europe has been the most severe and destructive of the last decade and resulted in significant loss of human life and property. In 2017 forest fire season, Portugal's forest fires resulted in 112 deaths. More than 520,000 hectares were burnt, representing nearly 60% of the total area burnt in the EU in 2017. Forest fires across southern Europe resulted in significant destruction of property and livelihoods with impacts on the economy, including network infrastructure, businesses, agricultural and forestry activities. The EU Civil Protection Mechanism responded nine times to forest fires inside the EU in France, Greece, Italy, and Portugal. Assistance was also provided through the Mechanism for forest fires in Albania, Chile, Georgia, Montenegro, and Tunisia (DG ECHO, 2018).

Due to its favourable geographic position, the Republic of Croatia is not exposed to natural disasters like hurricanes, tropical cyclone and tsunamis that occur in other parts of the world, causing enormous human and material damage. However, floods and large open space fires occur almost regularly. In 2017, Croatia was affected by numerous open-type fires. From 1 January to 30 September 2017, there were 6,230 fires (54.44% more than the total average of the previous 11 years) with 100,767 hectares of burned vegetation (277.54% more than the year-long perennial average), which is a significant increase compared to all previous fire seasons (internal data of the National Protection and Rescue Directorate). Incidents of technical and technological nature are also not rare. We are singling out the incident in 2018 — the pollution of the Slavonski Brod water supply system and the explosion that took place in the oil refinery in Bosanski Brod (Bosnia and Herzegovina) with the consequences of air pollution manifested in the Croatian territory. All these cases had the potential to incur a disaster and severe harm to the population. In each of these cases the 112 number, as well as other urgent numbers, have been overwhelmed for hours by citizens asking for information on what had happened and what they should do.

The year 2018 also brought a series of disasters. The best example of intensity and occurrence is just one day in which, throughout the world, several disasters happened. One of five subsidiary dams of the under-construction Xepian Xe Nam Noy project (Laos) collapsed at 8 p.m. on Monday, 23 July. There were 0.5 billion cubic meters of water released into downstream areas causing flash floods in several villages of Sanamxay district, leaving 26 people dead and more than 130 missing. According to state media, the disaster has rendered 7,000 people homeless in Attapeu, an agrarian province near the border with Cambodia and Vietnam. Prime Minister Thongloun Sisoulith called the disaster the worst to hit Laos in decades (Lao News Agency, 2018). In Greece — Mati Village, a tourist area located just 18 miles east of Athens, has seen the worst of the devastating flames. The fire broke out in the afternoon of 23 July, with fierce winds causing the fire to spread quickly towards the beach. It affected around 1,500 homes, resulting in more than 80 fatalities and close to 200 injured. Most of the victims were trapped by the flames when strong shifting winds made it impossible to escape the area (The Weather Network, 2018).

A large number of crisis and disasters withal generate a large number of data that needs to be processed and analysed. Likewise, algorithms can be extracted for those foreseeable and preventable accidents in order to enhance the response. Calculations of risks and assessments of vulnerability are of lower priority during the accident, when the main focus is on the response, so the collection of information at the actual time is not taken into consideration. That is the reason the availability and quality of information are perceived as questionable (they can be incomplete or unusable for distinct reasons), especially for systematisation of data for crisis mitigation and prevention. On the other hand, the unstructured data that used to be considered unusable, today, with the advancement of big data technologies, can be analysed to bring valuable information for effective crisis management. Monitoring and forecasting systems are using a lot of remote sensing data and data from other sources (that do not belong to their systems but are generated by other systems, such as local, private and state measuring stations related to air pollution, river water levels, and fire alarm systems). Through a high-performance computational system, they are processing huge amount of data daily. Also, in that way, big data can be used for early detection, for example, in the case of floods, with the

integration of various data format from multiple sources. Big data as such, helps decision-makers and first responders to have quicker and more concrete decision-making process where to allocate the resources, having in mind the number of affected person and type of damage. It also provides for a preventively displacing the human and material resources of the rescue forces from the unthreatened or less threatened areas to the parts of the country that are projected to be at a higher risk of danger, provided sufficient time to do that (before a potential adverse event occurs). As an example, flood defence planning in the Republic of Croatia begins and is being implemented weeks before the water levels on our rivers reach their maximum values, and the attention of the public and the media is directed towards flood protection operators and their activities.

The number of crisis endangering lives, displacing numerous people, and destroying assets and infrastructure is rising, and with that increase, consequently, grows the awareness of prevention and mitigation and the need for finding new ways of managing crisis. That is why new techniques, ideas and innovative technology are getting in use to have more efficient crisis management. One of these "solutions" used as a supporting tool in the named efforts is the big data concept which is being developed and shaped towards the incensement of human security and supporting affected people.

Emergency services providing support are dealing with a large amount of data arriving through multiple sources, from first responders, sensors, satellite networks or in a new era — social media. The storage and processing of large volumes of disaster data pose an enormous challenge for the crisis management system, civil protection, police, firefighters and other organisations and bodies managing crisis and disasters, as all of this data needs to be directed and analysed in the right way to have final, shaped information used efficiently. Communities, vulnerable to all kind of crisis from natural, technical-technological to human-made can benefit from adequate use of available data. However, it needs to be understood how to link different datasets with diverse kinds of crisis and to recognise possible ways of use. One can also combine some of the data, for example — aerial and thermal oblique can be incorporated in geospatial data analysis to detect people in the affected areas. GPS systems and wireless networks can be used for detecting people movement during the crisis, the same as tracking people.

Also, big data generated from geo-informatics and remote sensing platforms can contribute to different early warning systems. The possibilities are endless if there is a clear structure. It is, therefore, necessary to develop processes, procedures and systems that can process large volumes of collected data and enable their efficient use (with generated information continuous used in the system). It is crucial not only for those managing the systems but also for citizens who need to receive timely information about the hazards and instructions on how to proceed in the event of a crisis.

In crises, the remediation of consequences of major crisis and disasters, the availability of quality data and information — both for crisis and disaster managers and for the affected persons — is as crucial as ensuring basic living needs (accommodation, nutrition and medical care). In the aspiration to provide its citizens and operational services timely information to help them prepare and respond to an emergency event, certain European and countries around the world have introduced their early warning systems. Such systems are the most commonly, upgraded conventional alarm systems based on sirens, radio, and television. The underlying disadvantage of conventional systems is limited access to citizens who are to be alerted at a given moment, and in the case of sirens — high prices and lack of information. To increase the percentage of citizens who receive information on an emergency event and instructions for the response (in close real-time) the development of early-warning systems based on modern technologies have begun.

In order to conclude this discussion, it is necessary to highlight that it is evident that the number of major crisis and disasters has increased in recent decades, whether as the consequences of natural disasters, technical and technological causes or effects of terrorism and wars. Timely and accurate information is crucial at such moments, both to decision-makers as well as to citizens. For many potential risks, hazards and threats, scientific and professional institutions collect and own substantial amounts of data. Sensors of all kinds, from automated measuring devices, smartphone sensors to satellite hypermeter cameras, offer tremendous potential for improved recognition and risk assessment, for targeted initiation of preventive measures, including improved quality, accuracy, and early warning personalisation. The same is valid for supporting decision-making in crisis management. In

these circumstances, it is necessary to use all technology and knowledge to raise human security to the highest level. Quality application of big data concepts and solutions thus plays a crucial role. The following chapter presents a model and an example of how it is possible and necessary to use the collected data for a more efficient crisis management system.

Establishment of Early Warning System for crisis management in the Republic of Croatia

This chapter has a dual purpose: first, to show the modern early warning system solutions in some advanced countries of the world; secondly, to present a solution that is currently in development in the Republic of Croatia.

The system developed by Unified Messaging Systems and implemented in Sweden uses SMS as the main two-way communication channel, allowing citizens to respond to the message. It sends messages to all mobile phones and does not require any preconditions from citizens (such as installing applications, registering, or configuring devices, internet access). The system has several essential functionalities: Location-Based Alert System (LBAS) — SMS to cell phones by current location; Address Based Alert System (ABAS) — SMS to cell phones and voice messages to fixed lines by address database; Travel Alert System (TAS) — text messages to warn Swedish cell phones abroad (Unified Messaging Systems 2018). Belgium has for several years already been developing a system that uses SMS as the primary channel as well as other communication channels: mail, social networks, and voice messages. While it is needed to register and install the application for such messages, there is also an option that does not require registration and which uses the SMS as a communication channel, which can be sent to a predefined area. The system is still upgrading and integrating with digital technologies, and it is named Be Alert (Be Alert 2018). The Dutch system (NL Alert) was implemented in 2012 by the National Crisis Centre. Contrary to the Belgian and Swedish systems, the Dutch system as a communication channel is using Cellular Broadcasting technology. Cellular Broadcasting distributes geo-referenced one-way radio messages to all mobile phones that can receive alerts within the target area with information about the nature of the alert, not just an alert to an undetermined threat (The Ministry of Justice and Security 2017).

Likewise, outside of Europe, some advanced countries are developing similar and complementary systems. SMS alert is a functionality which is available to all teleoperator users in Singapore, including foreign roaming users. All users, whose last known location is within a marked radius, will receive a text message from 71250 number. Messages are sent for significant emergency events such as terrorist attacks, riots, great fires, and civil disasters. In addition to SMS messages, citizens can receive alerts via the SG Secure mobile application, which needs to be installed on a mobile device (The Ministry of Home Affairs 2018). In Australia, based on the lessons learned from a great fire in the state of Victoria in 2009, the Emergency Alert System was developed as a national location-based warning system. Emergency services provide for the functionality of the Emergency Alert System with the ability to send a warning message based on the address of the registered service (fixed and mobile telephony) or the last known location of mobile device on the network. Messages are broadcasted as text (voice) messages for fixed telephone lines or as short messages (SMS) for mobile phones (Emergency Alert 2018). A similar system in the United States is called Wireless Emergency Alerts and was launched in 2012. It functions as a wireless emergency alert system, a key element of emergency preparedness. Since its launch, it has been used more than 40,000 times to alert the public to dangerous weather, missing children, and other critical situations. Wireless Emergency Alerts is a public security system that enables users who have compatible wireless devices to receive geographically targeted, Cell Broadcast text messages related to security threats in their area. The system is the result of a unique public/private partnership between the national telecommunications regulator, the Federal Communications Commission, the Federal Emergency Management Agency, and mobile operators to improve public safety. The system can send three warning levels: Warnings issued by the President; Warnings that include immediate threats to safety or life; Orange warnings. The user can turn off everything except the warning issued by the President and on 3 October 2018, for the first time, such warning by President Trump was released (The Federal Communications Commission 2018).

These examples of implemented early warning systems show how advanced high-tech countries are moving in the direction of warning and alerting of the population by sending SMS messages to a specific geographic area. Other countries are

using Cell Broadcast messages as the main communication channel. The benefits of SMS are known, in particular, older mobile devices can receive them, and the network sends them even if a person is not currently in the range of signal (basement, public garages and rural areas). There are, however, known limitations in the number of possible characters and the sending speed per unit of time. It is non-negligible that when sending SMS messages to roaming users, there is a cost that domestic operators have towards the user's operator. On the other hand, Cell Broadcast messages are sent almost instantaneously to all devices in the desired area, and they do not cost the operator. Still, such messages can be only received by "smart" mobile devices, configured to receive such messages.

To increase human security in the Republic of Croatia, a project called "Early Warning and Crisis Management System" is under preparation. It aims to consider account all the advantages and limitations of the above-mentioned technological solutions applied around the world and by combining them, to create an early warning system for crisis management in the Republic of Croatia. Therefore this research follows the development of a project that establishes a technologically advanced system for solving specific risks related to severe weather conditions, floods, forest fires and other possible risks, prevention and risk management, securing resilience on disaster and development of management system in case of crisis and disaster. In addition to the management, the system would also enable reporting and display of real-time data, while respecting all legal regulations on the protection of citizens' privacy and data (GDPR). The system would show in real-time, on the map, the aggregated movement of citizens shown in groups, where no personal information can be obtained for any individual and be misused, which is relevant in both pre-crisis and crisis. As a group of citizens is shown at no point in time, any party participating in the process cannot separately detect any individual or individuals located in the selected area with this information. This system will be unique in Europe and will undoubtedly be a significant indicator of the opportunities also for countries in Southeast Europe sharing the same natural risks and technologically at a remarkably similar level of development and abilities. The opportunities so provided to neighbouring countries in the region will be related to the transfer of knowledge from the Republic of Croatia to their esteemed countries, the exchange of good practices, and the application of experience

that the Republic of Croatia will gain. Also, the project will be funded from the European Cohesion Fund, thus showing the possibility of using non-refundable external funding for the need of strengthening human security.

The purpose of this project is to provide a national system of early warning and alerting the people currently being at a specific (endangered) geographical location (area affected by a crisis). In the case of an emergency (big forest fires, floods, technological accidents or ultimately any danger with possible cascading effects), with the help of such a system, the state bodies responsible and authorized to alert and notify citizens may choose the area or segment they wish to alert. The information about a crisis occurring in the selected area is not thus sent only to the citizens currently at that location, but also to those interested in information about incidents at that location. This project idea is one of the best in Europe because it integrates the most substantial number of known modern solutions in one, unique system.

The implementation of "Early Warning and Crisis Management System" project envisages the procurement of system components (hardware and software), integration, staff training and testing of a unique solution that would cover the public security requirements for crisis management. Within the project, a technologically advanced system will be provided, which will, through a faster and more effective response of the operational forces, assist in solving specific risks related to severe weather conditions, floods, forest fires and other possible risks, prevention and risk management, disaster resilience and crisis management system development. It is foreseen that the system will have the following functionalities:

1. Emergency Management (the system enables emergency situations management through data on the number of mobile users (map display) in a specific area in near real-time);

2. Display of the user's movement (visualisation in the periods from the recent past);

3. Gateway Mobile Location Centre (GMLC) notifications (the system shows the location of the caller on the map after the number 112 is dialled);

4. Advanced Mobile Location (AML) (display of GPS location information received from the mobile device after 112 calls);

5. Internal communication (between organisations that have the interest to access information on threats such as the National Rescue and Protection Directorate, the Ministry of the Interior, Firefighting Services, the Croatian Automobile Club, public institutions, hotels, camps, and national parks);

6. Common Alerting Protocol (CAP) (CAP is a standardized format for the exchange of warnings and emergency alert signalling based on IP transmission. CAP enables the warning message to spread across all connected systems consistently and simultaneously. The system provides communication through various communication channels: email, Twitter, Facebook, Instagram);

7. Cell Broadcast mobile user notification (a message is sent to all mobile users currently present in an arbitrarily selected area. This message is instant for all users in a specific area whose mobile device supports its receiving and displaying. Operators will require from mobile devices suppliers that devices procured after the start of the project support such functionality);

8. SMS immediate alert — alert to mobile users (the system supports sending SMS alerts to all mobile users of all operators currently positioned in an arbitrarily selected area, who interacted with operators' network after the alert for that area. Unlike the language-unified Cell Broadcast message received by adequately configured mobile devices in the coverage area of the mobile network, a language-customized SMS message is received by all mobile devices that had interaction with the mobile network after alarm triggers. The SMS message is also received on devices that had no network connection at the time they were sent (if located in the basement, if the device was off in that moment or had no signal);

9. SMS later alert — notification to mobile users (alerts to users located in the selected area at a particular time in the recent past could be sent as well. Alongside with users who are currently in the selected area, also notified are those who were in that area in the specified time).

This system provides data and a tool to decision-makers of early warning and citizens alerting in the area affected by a crisis. In the event of a crisis, a state institution responsible for alerting and informing citizens can choose the area or segment that it wants to alert. In this case, information that a crisis occurs in the selected area is sent to the users currently at the site (Selected Area). User data processing only takes place after an alert has been issued. The unique feature of the system is to distinguish users of Croatian mobile networks from foreign ones. In case of a crisis, a message to foreign person can be sent on the most widely used foreign languages, in real-time, without violating the regulations on the protection of personal data. All three national telecom operators within the Republic of Croatia (HT, A1, TELE2 — operators) participate in the project, which will provide coverage of the entire state and a user base of approximately 100% of mobile users in order to ensure the mass broadcasting function.

Still, the functionality of informing citizens will remain as it is conventionally, primarily through television and local radio stations. All operators will have to co-operate not only because of the coverage of information towards Croatian citizens but also foreigners who are in Croatia at that point. Operators will adopt the part of system free of charge — an anonymisation centre to process and anonymise the location information of their users. Like the other equipment procured and installed through the project, the state will own the anonymization centre, which will bear the costs of its maintenance. The project will provide a user portal system (system control unit), and state organizational units responsible for operational crisis management will have access to it. The location of the mobile device user will be determined in accordance with the connection between the mobile device and the base station of the operator. Refreshing of the system will be related to the number of network events of each telecom operator. It will allow a visual inspection of the number of mobile connections on the territory of the Republic of Croatia. All data, which is anonymous, will fill the Hadoop base (open source programming language), containing a visualisation layer that aggregates the location of citizens on the map of the Republic of Croatia. By selected geographic area and the desired content, the system will create the appropriate message delivered to the operators' systems, and operators will send it to their users by a selected channel. The visualisation interface will show an estimated number of citizens in the

selected geographic area as well as the trends of inflow and/or departure of citizens in the selected area. The data provided will allow optimum crisis management and control over whether the action to reduce the consequences of a crisis situation will have the desired influence on the crisis area.

With this system, the Republic of Croatia will improve the current processes. It will introduce new communication channels, both in internal communication and in communication with external users, as well as with its citizens and visitors. As a final objective, it is expected that the citizens and crisis management system participants will be significantly faster informed about the threatening dangers and the measures needed to reduce human casualties and material damage. In this way, a specific system will be established, that will join warning of citizens and crisis management functions and present the realisation of part of the goals set in the National Security Strategy regarding human security.

Results of the Project in the context of the development of modern early warning system in the Republic of Croatia

In order to measure the quality and efficiency of introducing a new technological solution in the early warning system in the Republic of Croatia, three specific objectives of the project have been set, each of which should give the expected result. Specific objectives are 1) to increase the technical possibility of warning and alerting citizens in close real-time; 2) to increase the ability of quality assessment of the necessary forces and equipment for the implementation of crisis management measures; 3) to reduce the annual costs of leasing lines for the management of sirens, acquisition costs and maintenance of sirens.

Regarding the first specific objective (to increase the technical ability to warn and alert citizens in close real-time), the expected result relates to the number of citizens who will receive an early warning notification or will be alerted in case of need, with a significant increase compared to an estimation of current possibility to inform 10 per cent of citizens. Currently, the standardised method of alerting and informing the population in the Republic of Croatia is the use of sirens owned by public bodies and legal entities. In addition to sirens, loudspeakers, electronic media, and SMS devices are used for alerting and

informing. The service providers do not have conditions yet to send a large number of free SMS messages to inform and alert the population. Early warning and alert through the media is relatively slow and does not cover a sufficiently large percentage of the population. In this case, citizens must follow a particular national television channel at a certain moment. Additionally, the purposefulness of the existing siren-based alert system is more than questionable. Given the fact that there is a fewer number of (centrally managed) sirens in the Republic of Croatia then the number of local and regional self-government units (which is 576), and that the area of coverage is less than 10 per cent of the population, it is questionable whether quality alerting and warning (based on a traditional approach) is possible. The realisation of the analysed project will provide for the technical conditions for mobile operators, so all persons located at that moment in the endangered area (municipality, city, several cities or municipalities, counties, several counties, the whole of the Republic of Croatia) will receive SMS alert messages, as well as those who have been in the area for the past 24 hours. In addition to the SMS messages, the system will be able to send a "cell broadcast" messages in the same areas. This message is sent virtually instantly (SMS has considerable limitations in the number of messages sent per unit of time) and is free of charge for users of international mobile networks as well. Through the Common Alerting Protocol (CAP) it will be possible to send an early warning and alert information to all who will log on to the system and through various channels of communication like email and social networks (for example Facebook, Twitter, Instagram). After the implementation of the system and the promotional activities carried out among the citizens and tourists, the percentage of the population that will receive information through some of these channels is expected to be at least 40 per cent over five years. Moreover, through the replacement of mobile devices that will be configured to receive and display cell broadcast messages, that percentage is expected to grow to more than 60 per cent.

For the second specific objective (to increase the ability of quality assessment of the necessary forces and equipment for the implementation of crisis management measures), the expected result is an increase in the rate of reaction to the crisis event with adequate planning of the required resources for dealing with a crisis and consequently reducing damages and costs of interventions. As already mentioned, social communities are

permanently at risk from crisis and disasters related to climate change, natural disasters, technological accidents, terrorist attacks that can endanger the lives and assets of a large number of people. Any danger requires appropriate action for the prevention or mitigation of its consequences. It is imperative that the implementation of the activities of the response system is derived from previously well-designed and implemented preventive measures. The application of the early warning and crisis management system will make real-time data available to the number of people currently located in a particular area. Accordingly, it will be possible for the population in this area to receive early warning information to the upcoming hazard and to give them instructions for action. In this way, the population will be able to initiate activities promptly, to reduce the consequences of the threat, either through safety measures or by evacuation from the endangered area. In the case of sudden events, the population will be alerted, with given instructions for action (shelter, evacuation) and additional instructions and information during the event. System stakeholders and operational forces of the crisis management system will have at their disposal quality data on the number of persons located in a selected area. They will be able to make a quality decision on the necessary resources engaged in carrying out specific safety measures, such as: how many buses are needed to evacuate the population from the affected area, how many people need accommodation and nutrition and alike. The crisis response will be of optimal intensity and with a reduced time of beginning and duration of the reaction and consequently, the cost of the reaction.

In relation to the third specific objective (to reduce the annual costs of leasing lines for the management of sirens, the cost of acquisition and maintenance of sirens), the expected result is the reduction of costs on an annual basis by half of the current amount that the state has to use to supply new sirens, maintain the existing ones and lease lines for managing sirens. Currently, in the Republic of Croatia (in the public alerting system), there are more than 1200 sirens, one-third of which state-owned, whereas firefighters, legal and private persons own the rest. Less than half of the total number of sirens are connected to remote control systems, while others are managed locally. The country annually spends around 90,000.00 euros on the lease of phone pairs to manage sirens and more than 100,000.00 euros for the acquisition of new and the maintenance of the existing

sirens. In addition to the considerable cost of the state budget, the purposefulness of the existing siren-based alert system is more than questionable. By implementing the early warning and crisis management system, the country can gradually reduce the number of sirens it possesses and manages in such way that it no longer repairs electromotor and pneumatic sirens but uses them till they work. Also, part of the newer, electronic sirens will stay on existing locations, and part of them can be moved from locations that are not in the zone of a greater threat to the zones of greater threat — location near hazardous substances facilities and close to dams and accumulations. In this way, the costs of the state solely for the supply, managing and maintaining the sirens — will be reduced by half of the current amount, over three years after implementation, and the modern IT technology will replace the outdated siren technology.

This analysis showed the multilevel application of the results of the project following its implementation. The project and its development and implementation are significant from a scientific, as well as from a practical standpoint. Besides contributing to a higher level of citizens' security, the project shows the mutual value and significance of the human security theory and the big data concept in research and crisis management system application. Likewise, other countries may use the possibility to consider the scientific and practical contribution of this research and herein analysed and described project and reflect on the same or similar models in their areas of competence and responsibility.

Conclusion

The development of human security through theory and practice is precisely what the modern world makes special, advanced, and the place of astounding achievements. The theory of human security brings us closer and explains the needs and opportunities in protecting individuals from many challenges but also represents a platform for our social and individual development. It is the exceptional significance of the theoretical framework of human security, as it enables the development of new theories and concepts that have the purpose of exploring and applying new knowledge and theories in the improvement of the protection of people and their balanced development. All

of this is also a task of the institutions dealing with human security as they need to analyse the theoretical settings and the possibilities of modern technologies in building a system with the function of protecting people.

This research analysed how the big data concept could be used within the human security theory, primarily focusing on the purpose of establishing an early warning system for crisis management in the Republic of Croatia. Known advantages of big data (predictive analysis, processing of a large amount of data, efficiency) can be used in the way to enhance the protection of people from natural, technical-technological and human-induced major crisis and disasters from the aspect of the prevention to the timely information on the risks threatening people's lives, families and material assets. The central focus of this research was the overview of the real-time project that is currently in the initial phase of implementation in the Republic of Croatia and follows this dimension.

In that relation, we have set a hypothesis and research questions. The hypothesis — that the establishment of a modern early warning system (which includes new processes, procedures and technology and is more efficient than the existing and available alert models) for crisis management in the Republic of Croatia would increase the level of human security — is proved successfully. In order to confirm the hypothesis in the introduction, we have set three research questions and responded to each one of them in each subsequent chapter. The cumulative look at all three responses leads us to confirm the hypothesis that the new technological solution increases the level of human security in the Republic of Croatia. Similarly, the introductorily provided scientific contribution is confirmed because the development of such a system is not only significant and relevant from the academic aspect but also for practical applications in other countries that are searching for ways to raise human security to a higher level.

On a global level, the awareness of human security is upraising with provisions on the accessibility of information, public warning, and emergency location. Developing technology needs to be used effectively, providing the right information at the right time, so tools like public warning systems are essential to give citizens and all interested parties accurate information and instructions. As intended, big data that will be collected

includes the current locations of all mobile phone users in real-time at a certain location to be further used for tracking the number, movement, and above all, for obtaining notifications of potential hazards, as well as for crisis management operations. This research thus contributes to the aforementioned global efforts.

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