

**Conference Book of Abstracts**

**INTERNATIONAL SCIENTIFIC AND EXPERT CONFERENCE:  
SECURITY OF INFRASTRUCTURE SYSTEMS:  
CONCEPTS - REGULATIONS - PRACTICE**

12-13 October 2023, Hotel Falkensteiner, Belgrade Serbia



The Center for Risk Analysis  
and Crisis Management  
(CRACM) - Belgrade  
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## **Conference Book of Abstracts**

# **INTERNATIONAL SCIENTIFIC AND EXPERT CONFERENCE**

## **SECURITY OF INFRASTRUCTURE SYSTEMS: CONCEPTS - REGULATIONS - PRACTICE**

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**Conference is supported by the Ministry of Education, Science and  
Technological Development of Republic of Serbia**



**Republic of Serbia**

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**MINISTRY OF SCIENCE,  
TECHNOLOGICAL DEVELOPMENT AND INNOVATION**

**ISBN-978-86-902810-5-3**

**Serbia, 2023.**





**Conference Book of Abstracts**  
**International Scientific and Expert Conference:**  
**SECURITY OF INFRASTRUCTURE SYSTEMS:**  
**CONCEPTS – REGULATIONS – PRACTICE**  
**October 12-13<sup>th</sup>, 2023**

**Published by:**

Center for Risk Analysis and Crisis Management

**Editor:**

Prof. dr Zoran Keković

**Proofreading:**

Tanja Kazić, PhD Candidate

**Text wrapping:**

Snežana Trajković

**Printed by:**

Data Copy, Novi Beograd

**Copies:** 100

**Belgrade, October 2023**

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## ***SECURITY OF INFRASTRUCTURE SYSTEMS***

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## **PREFACE**

In our rapidly changing world, the main challenge is how to ensure the existential needs of citizens, the population and the overall community. Whatever threat challenges us, we are faced with existential questions: ensuring continuity in the supply of food, water energy, electricity, traffic and transport, ICT, healthcare, etc.

When it comes to armed conflicts, if you want to know what a critical resource is, just look at military targets. Nothing has changed from the bombing of targets in Serbia in 1999 to the Russian-Ukrainian conflict in the third decade of the 21<sup>st</sup> century, and the case of other regional and local conflict zones is the same as well. Destroying critical infrastructure is the most effective way to weaken the morale of the population, break economic activities or make any resistance of the opposing side pointless. It is the same situation when it comes to cyber threats, terrorism and other malicious activities.

Nature, in itself, can be the biggest bioterrorist, “moving the ground”, causing devastating tsunamis and hurricanes. And when it unites with the man, then it is the “dance of the death”. The research on the consequences of natural disasters indicates that the minority of the total effects fall on direct material and economic damage to critical entities and infrastructure, and that the indirect consequences caused by these disturbances on the survival and safety of the population and wider community are much greater.

Overall, the events that have hit the world in recent decades have imposed major challenges on scientists, academics, policy makers, and business leaders. These challenges are civilizational, cultural, geopolitical, health, economic, legal, security, etc.

The international conference: SECURITY OF INFRASTRUCTURE SYSTEMS - CONCEPTS, REGULATIONS, PRACTICE, which was held in Belgrade on October 12<sup>th</sup> and 13<sup>th</sup>, 2023, brought together a high level of expertise, with the participation of representatives of the scientific and professional public from all over the world, as well as representatives of governments, civil society organizations and business communities of the Republic of Serbia and Western Balkan countries.

**Organized by the Center for Risk Analysis and Crisis Management, and with the support of the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, the conference was opened by the Minister of Construction, Transport and Infrastructure in the Government of Republic of Serbia, Goran Vesić. The welcome speeches were also given by the Minister of Information and Telecommunications, Dr Mihajlo Jovanović, the State Secretary of the Ministry of Science, Technological Development and Innovation, prof. Dr Miroslav Trajanović, Assistant Minister of Internal Affairs and the Head of the Department for Emergency Situations, Luka Čaušić, as well as prof. Dr Zoran Keković, President of the Center for Risk Analysis and Crisis Management.**

**The conference was organized through the following panels, reflecting infrastructure sectors: safety in energy supply chains; security of ICS systems and digital infrastructure; traffic and transport systems safety; food and water supply continuity; and public services as critical infrastructure. Each panel was represented by competent experts and professionals of the academic community, government bodies and the business community.**

**Following the common vulnerabilities and interdependencies of critical infrastructure sectors, the conference results ask for the development of multifunctional and multidisciplinary approach to managing contemporary strategic risks and crises. They set high demands in the functioning and recovering the affected product and service supply chains, and thus, every disruption of this kind reflects on the functioning of economic and social activities in their entirety.**

**President of the Organizational Board**

**Prof. Dr Zoran Keković**

**Slobodan P. Simonović, PhD, Fellow, Royal Society of Canada; Fellow, Canadian Academy of Engineering; Foreign Member, Serbian Academy of Sciences and Arts<sup>1)</sup>**

### GLOBAL CHANGES AND RESILIENCE OF CRITICAL INFRASTRUCTURE

Global change encompasses profound and interconnected shifts in environmental, social, political, and economic systems. This includes climate change, population growth, land use change (notably rapid urbanization), and evolving geopolitics. Addressing these changes is crucial to shape a sustainable and resilient future. Critical infrastructure encompasses essential systems like energy, water, transportation, communication, and financial networks, vital for societal functioning and security. Disruptions by shifting global conditions could yield significant socio-economic consequences, highlighting the need for proactive protection, resilience, and measures against various threats. Global change presents multifaceted challenges to critical infrastructure. Extreme weather and rising sea levels jeopardize coastal facilities, shifting precipitation strains water systems, and higher temperatures stress energy grids. Adaptation and innovation are vital for ensuring infrastructure's resilience and function in a changing world. Quantitative resilience of critical infrastructure to global change involves assessing its disruption endurance. It quantifies performance, downtime, and recovery metrics, aiding risk evaluation and resource allocation. This data-driven approach enhances readiness and facilitates targeted enhancements, guaranteeing infrastructure functionality amid evolving challenges. Our research group's resilience measurement framework offers a systematic approach to reinforce critical infrastructure protection. By evaluating adaptive capacity, robustness, and recovery potential, vulnerabilities are identified, interventions prioritized, and resources allocated efficiently. This fosters comprehensive resilience, securing critical systems against the impacts of global change.

**Key words:** resilience, infrastructure system, multilayer network, infrastructure interdependence, restoration strategy, Greater Toronto Area

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## **PART 1: CRITICAL INFRASTRUCTURE PROTECTION – EU AND REGIONAL PERSPECTIVES**





**Aleksandar Jovanović, CEO, Steinbeis European Risk and Resilience Institute, Stuttgart, Germany; Assoc. Member ETH Risk Centre, ETH Zürich, Switzerland;<sup>2)</sup>**

**Brian Roylet, Member, The Risk and Insurance Management Society Inc., Australian Government Resilient Infrastructure Advisory Group<sup>3)</sup>**

### **ENHANCING THE RESILIENCE OF CRITICAL INFRASTRUCTURES AGAINST EMERGING RISKS: THE NEW ISO TS 31050**

The paper presents the current EU and international efforts directed towards enhancing resilience of critical infrastructures, going beyond the current practices. In particular, it highlights the efforts in the European Commission EU-CIP project and its relation to other, related activities in the area of standardization, policies, and best practices and trends in risk/resilience management. The new ISO TS 31050 (in the final stages of issuing) will be presented and discussed, in particular as related to main challenges: (a) the trans-national interdependencies among the infrastructures, (b) the emerging, complex and constantly changing nature of the new threats, especially the extreme threats (XTs, X-threats). The standard will enable defining more aligned approaches to enhancing resilience of critical infrastructures, as well as more aligned responses to emerging risks and extremes at different layers: policies, technology, national and industry standardization, management, science, none of which are able to provide an independent, stand-alone solution without the others. Within the running EU project EU-CIP, a number of EU roadmaps for protecting critical infrastructures are planned to be developed (indicators, stress-testing, extreme threats...). The application of the approach will be briefly illustrated by examples of cases from the preceding projects (EU and others) and industrial practice, e.g., in insurance.

***Key words:*** resilience, emerging risks, standardization, ISO, EU research

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**Kitti Mezei, PhD, Assistant Professor, Budapest University of Technology and Economics, Faculty of Economic and Social Sciences<sup>4)</sup>**

**ARTIFICIAL INTELLIGENCE REGULATION AND CRITICAL INFRASTRUCTURE: SAFEGUARDING THE FUTURE**

The author explores the critical relationship between AI regulation and safeguarding critical infrastructure, which forms the backbone of modern society. As AI becomes increasingly integrated into sectors like energy, transportation, healthcare, finance, and telecommunications, the potential benefits and risks become evident. This paper highlights the challenges of AI deployment in critical infrastructure, including security threats, privacy concerns, and safety issues. It emphasizes the need for effective AI regulation to address these challenges and proposes key strategies, such as establishing standards, promoting explainable AI, and fostering public-private partnerships. By striking a balance between technological advancement and risk management, this research underscores the importance of AI regulation in ensuring a secure and resilient future for critical infrastructure and society as a whole.

***Key words:*** artificial intelligence, critical infrastructure, risk management, technological advancement

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National Key Laboratory of Water Disaster Prevention, Hohai University<sup>5)</sup>**

### **CHALLENGES IN WATER SECURITY AND SUSTAINABILITY – CHINA’S WATER CULTURE AND IHP IX STRATEGIC PLAN**

Water security with regards to the climate change is of global, national or regional scale, directly linked to the status of hydrologic processes and water distribution in time and space. Sustainable development requires (1) various studies to improve knowledge and innovation to address water security challenges, (2) strengthens the science-policy interface to reach water security at all levels, and (3) facilitates education and capacity development to enhance water resources management and governance. The focal point has been the integration of natural and human-induced climate impacts on the global and regional hydrologic cycle. The presentation sheds light on China’s water culture regarding the best methods of coping with the impacts of environmental changes on water. The future effort is at the nexus of water science, governance and education for addressing these challenges.

***Key words:*** water security, water sustainability, IHP IX strategic plan, climate change

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**Dinara Fasolko, PhD, Voeikov Main Geophysical Observatory  
of the Russian Federal Service for Hydrometeorology  
and Environmental Monitoring (Roshydromet)<sup>6)</sup>**

**ADAPTATION TO CLIMATE CHANGE AT THE REGIONAL LEVEL IN  
RUSSIA: AN EXAMPLE OF SAINT-PETERSBURG**

The Russian climate change adaptation system began to take off in 2019, when the National Adaptation Plan was adopted. The Plan made it possible to prepare the necessary regulatory and methodological framework and develop adaptation plans at the sectoral and territorial levels. In 2022, the government of the Russian Federation approved the Principal Innovative Project of National Importance. The Project aims at the environmental (low-carbon) transformation of economic sectors and adaptation of the economy and population to climate change. In order to develop optimal adaptation measures and assess climate risks in the regions of Russia in accordance with the framework of the abovementioned initiatives, an assessment of observed and projected changes in climate characteristics that affect various sectors of the economy has been carried out. A list of vulnerable objects has been developed. This makes it possible to identify specific objects, taking into account possible climate impacts for a certain region, and develop optimal adaptation measures at regional and local levels. Urban water disposal systems are good examples of climate-sensitive facilities. The calculation and analysis of tailored climatic indices affecting the wastewater systems of St. Petersburg are conducted. Recommendations on adaptation have been developed, including the requirement to upgrade the existing drainage system and expand the precipitation monitoring network, as well as update the regulations on wastewater disposal.

***Key words:*** climate change, regional model, water disposal systems, adaptation

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### **FROM POST-CONFLICT RECOVERY & RECONSTRUCTION TO NATIONAL TRANSFORMATION: LESSONS FROM THE UKRAINE CRITICAL INFRASTRUCTURE EXPERIENCE**

The invasion of Ukraine on February 24<sup>th</sup>, 2022, created shockwaves not just across Europe, but in terms of the impacts that it had on multiple global networks including oil and gas, global food security, inflationary pressures and the recalibration of post-Cold War relationships. Within Ukraine itself, the immediacy of the need to response to the invasion was combined with an understanding that this could also be the opportunity to re-set Ukraine as a forward-looking member of the European family, rather than one of the least progressive of the post-Communist countries. Given that the author himself was in discussions with senior members of the Ukraine government framework within the first week of the invasion, and has been closely involved with many of the conversations concerning Ukraine's post-conflict destiny, this work looks at some of the issues that have been explored during this period, and the lessons learned for all countries in trying to create a model for their future development in the face of the unprecedented challenges that we are currently facing.

***Key words:*** post-conflict recovery, post-conflict reconstruction, national transformation, invasion of Ukraine, critical infrastructure

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## **PART 2: SECURITY OF THE ENERGY SUPPLY CHAINS**



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### **IMPORTANCE OF ENGINEERING ASSET MANAGEMENT AND RESILIENCE IN ELECTRICAL UTILITIES AT TIMES OF MAJOR, LARGE-SCALE INSTABILITIES AND DISRUPTIONS**

Modern electrical power utilities (EPU), as key parts of national critical infrastructure, are capital-intensive organizations that are fairly complex in terms of their internal structure, operations and deployed technologies. They also function in an increasingly complex business and operational environment, characterized by significant uncertainties (evolution of markets/customers, changing regulatory framework, new technologies, climate change, etc.). High-impact, low-frequency (HILF) events, such as extreme weather/natural disasters, malicious human actions, major geomagnetic disturbances, pandemics and cyberattacks, have become more frequent. Furthermore, electrical utilities must deal with the replacement of large parts of their assets as they reach the end of their useful life or become obsolete due to technological changes. Major upgrades are also necessary due to the need to grow capacity. Such a complex environment offers great opportunities for EPU, but also introduces large-scale vulnerabilities, posing serious threats to society, even when external shocks/disruptions are absent. With the growing complexity, as well as density and strength of interactions, EPU become unstable, creating potentially uncontrollable situations, and cascading system-level failures, even when decision-makers are highly competent, possess data and technological means at their disposal, and do their best. Such breakdowns may consist of a) serious physical damages and destruction of their physical assets or b) large functional disruptions with no physical damages. A majority of the abovementioned sources of risks are external to EPU. They are unable to control them, but are deeply affected by those risks.

The latest cases of the COVID-19 pandemic or the ongoing armed conflict in Ukraine demonstrate the fragility of critical infrastructure. It is affecting not only electrical utilities, but all sectors of life and businesses worldwide. It convincingly shows that we need to think, plan and act globally in order to deal with such situations that will also take place in the future. Thus, electrical utilities have to find ways of coping with this reality to remain economically viable. We are of opinion that the concepts of structured Engineering Asset Management (EAM) and

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resilience, put together, may provide an efficient framework in this regard. A case study from Hydro-Quebec, a major North American electrical utility, demonstrates the approach used in coping with an exceptional ice storm with significant damages of its physical assets.

***Key words:*** complexity, major disruptions, asset management, resilience, extreme weather

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### MONTE CARLO MODELLING OF NATURAL HAZARDS TO WIND FARMS

Renewable energy installations have been the fastest growing energy sources in the European Union, with 80% of new capacities being based on renewables. Specifically, wind energy is expected to become the main source of electricity in the 2030s due to increasing onshore and offshore installations across Europe. The growth of renewable sources of energy, such as wind, was not halted even during 2020, when the economies were severely affected by *COVID-19* lockdowns. Because the energy sector contributes to approximately three-quarters of the greenhouse gas emissions, further investments into renewables in terms of new technologies, policy adaptations, diversification of energy sources, cost of production, as well as reliability of energy supplies, are expected to continue. For example, in the Republic of Serbia-which is a fairly new wind energy market in Europe-the total installed capacities of wind energy and solar energy plants are exceeding 25 MW and 10 MW, respectively, and the numbers are expected to continue increasing over time.

However, wind turbines and solar panels are prone to physical damage caused by severe winds and other weather perils (e.g., icing, lightning, etc.). For example, the International Energy Agency reported in 2021 that they “...estimate that around a quarter of the world’s electricity networks face a high risk of destructive cyclone winds”. Some of these winds are severe thunderstorm winds, such as downbursts and tornadoes. In this presentation, we shall present a robust Monte Carlo methodology for assessing risks and damage caused by severe thunderstorm winds to wind turbines. We shall consider a published example of Germany wind energy market, given their large annual frequency of tornadoes (for European conditions) and the large number of installed wind turbines. However, we shall also discuss many of these methodologies in the form of their adaptation and adoption in the Western Balkans, and the Republic of Serbia in particular. Climatology of severe wind in Serbia will also be discussed.

**Key words:** natural hazard, risk assessment, energy, wind energy, wind turbine, thunderstorm

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**ENERGY SECURITY IN THE NEW STRATEGIC FRAMEWORK  
OF THE REPUBLIC OF SERBIA<sup>11)</sup>**

The energy system of the Republic of Serbia was the backbone of the economic and social development. To remain so in the future, it must be fundamentally changed and adapted to the development of the economy and society, especially in terms of sustainability. The Republic of Serbia has accepted a series of agreements at the international level, directing it to the energy transition path (Paris Climate Agreement, Sofia Declaration on the Green Agenda for the Western Balkans, Energy Community Treaty, etc). For these reasons, in the Republic of Serbia, the process of defining a new strategic framework in the energy sector is currently underway, consisting of the National Integrated Plan for Climate and Energy and the new Energy Development Strategy.

The global escalation of geopolitical conflicts completely changed the previous international circumstances in the energy sector, particularly on the European continent. Due to sanctions and embargos on energy imports from Russia, as well as physical sabotage, the long time ago established routes for Europe's oil and gas supply are interrupted. The focus is again on energy security in the strictest meaning – providing enough amount of energy and energy sources for the functioning of the economy and society.

The new geopolitics circumstances indicate that energy security improvement, achievement of maximally possible energy independence, and economic sustainability of energy systems remain the dominant goals in the energy policy of the Republic of Serbia. The new strategic framework defines that the available resources and reserves of low-caloric lignite will have to remain the support of the Serbian electricity sector, until the moment when the electricity generation from renewable sources, infrastructure for transmission and distribution, as well as storage capacities, and the capacity for integrating renewable energy sources, are developed to the extent enabling reliable replacement of this fossil fuel. The import dependence in the oil and gas sector will inevitably increase due to a natural decline in indigenous production of these energy

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<sup>11)</sup> This paper is a result of the research project funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia (No TP3301) „Exploring the possibility of increasing energy efficiency by using energy potentials on the example of NIS-Naftagas“.

sources. This growth can be somewhat mitigated by enhancing the energy efficiency of these resources' utilization and introducing renewable sources into the transport and heating sectors. Nevertheless, it is necessary to work intensively on the diversification of oil and gas supply sources and routes, as well as on the building of the required infrastructure, increasing strategic oil reserves and capacities for gas storage. Additionally, the possibility of introducing nuclear energy in the Serbian energy sector after 2040 is being considered.

***Key words:*** energy security, national energy and climate plan, energy strategy, energy indicators, Serbia

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**CRITICAL EVENTS IN THE TRANSMISSION POWER SYSTEM  
OF SERBIA CAUSED BY EXTREME WEATHER EVENTS  
IN THE PERIOD 2013 - 2023**

The ongoing climate changes more and more often lead to extreme weather events that impact all aspects of life, including the safe operation of the transmission system. The transmission system in Serbia, as in all other countries, is designed in a way that most of the equipment is located outdoors and exposed to various weather influences. Although designed to withstand various types of natural disasters, extreme weather conditions can cause failures and outages, and sometimes accidents in the transmission system, which affect the supply of electricity to consumers.

The paper aims at presenting how natural disasters can lead to breakdowns in the transmission system and how resilience can be increased. Different types of natural disasters are described, with an overview of their potential to lead to accidents, while a clear distinction is made between faults and accidents.

Through the analysis of a 10-year period, accidents that occurred in the transmission system when the primary cause was natural disasters are described. The authors also presented how resilience and readiness of EMS AD to respond to possible crisis situations have been improved over the years.

***Key words:*** natural disasters, accidents, resilience, crisis management

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### **MANAGEMENT OF SECURITY RISKS IN THE PROTECTION OF THE CRITICAL INFRASTRUCTURE OF THE TRANSMISSION SYSTEM OPERATOR**

The Electric Network of Serbia (EMS AD) in Belgrade, as a transmission system operator, meets all legal and by-laws criteria regarding the identification of critical infrastructure in the Republic of Serbia. In doing so, an assessment of the possible consequences that may occur due to disruption of critical infrastructure has been taken into account.

Corporate security department of the EMS AD aims to ensure the vital values of the company in accordance with the applicable legal provision and thus justify its place in the national security system. In addition to the protection function, it also includes crisis management and risk analysis in order to neutralize threats, reduce consequences of their manifestation and ensure business continuity.

Managing security risk in order to protect critical infrastructure of operator's transmission system includes a systematic approach, especially bearing in mind the need for continuous control of security officers work at all EMS AD Belgrade facilities. Such an approach of the Service for Defence & Security Department contributed to the reduction of attempted thefts in all EMS AD Belgrade units. By applying the adopted internal standards in the field of physical and technical protection, illegal intrusions into EMS AD Belgrade facilities are reduced to minimum.

***Key words:*** Joint Stock Company “Elektromreža Srbije”, security of infrastructure, systemic approach, managing security risks.

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## **PART 3: SECURITY OF ICS SYSTEMS**



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### **AMENDMENTS TO THE LEGAL FRAMEWORK FOR ICT SYSTEMS OF SPECIAL IMPORTANCE**

In this paper, the provisions of the Draft Law on Information Security are presented. The Draft Law was prepared in order to facilitate harmonization with the new legislative framework of the European Union, as well as with the aim of improving the application of the current legal framework of information security. During the presentation, the new classification of ICT system operators of special importance and their protection will be discussed, as well as the formation of a new state body - the Office for Information Security.

***Key words:*** information security, ICT systems of particular importance, law, harmonization of regulations, establishing Office for Information Security

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## **THE LAST 120 DAYS OF CYBERATTACKS AGAINST SERBIA**

In recent times, cyber threats have evolved in complexity and frequency, posing significant challenges to nations worldwide. This paper delves into a comprehensive statistical data analysis of cyberattack attempts against Serbian critical infrastructure over the last 120 days. During the course of this paper, we will explore the following four segments of statistical data: (a) attacks originating from Serbia, where we will conduct a deep dive into the nature and extent of cyberattacks initiated within the Serbian borders, shedding light on potential internal threats; (b) correlated attacks, where we will provide an examination of patterns and sequences in cyberattacks, identifying any synchronized or coordinated efforts that might indicate larger, organized cyber campaigns against Serbian assets; (c) advanced attacks, where we will provide an overview of sophisticated cyber threats that employ cutting-edge techniques and tools, in which segment we will also highlight the evolving nature of cyber threats and the importance of staying abreast with the latest trends in cyber defence mechanisms; and (d) targeted attacks, wherein we will focus on cyber-attacks that were specifically aimed at certain sectors or organizations within Serbia's critical infrastructure. This last segment will provide insights into potential vulnerabilities and the sectors that are at a higher risk.

By the end of this paper, the readers will gain a holistic understanding of the cyber threat landscape facing Serbia, empowering them with the knowledge to bolster defence, strategize responses, and foster a resilient cyber ecosystem for the nation.

**Key words:** cyberattacks, Serbia, critical infrastructure, internal threats, correlated attacks, advanced threats, targeted attacks, cyber defence

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### **PRECONDITIONS FOR THE RESILIENCE OF THE POWER CRITICAL INFRASTRUCTURE TO CYBER THREATS**

Preventing a cyberattack, and if it does occur, reducing or, in the best case, completely removing possible consequential damages, is the primary goal of activities directed towards protection of critical infrastructures. In other words, the goal is to achieve the resilience of critical infrastructure to cyber, or in a broader context, combined hybrid physical and cyber threats and attacks. The prerequisites for straightforward, economically justified, efficient and effective achievement of the primary objective of the protection of critical infrastructures, while respecting the specificity and principle of subsidiarity in each individual case are presented.

***Key words:*** critical infrastructure, electricity, cyber threats, resilience, protection

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## **CYBER RESILIENCE OF FINANCIAL INSTITUTIONS**

The main goal of this paper is to provide an overview of the complexity of the ecosystem of potential cyber threats to financial institutions and their response, depicted in organization of teams under the umbrella of CERT/CSIRT in order to raise cyber resilience of the financial sector as a whole. A historical overview of CERT teams and CERT specific organizations is given. Current initiatives in the field of cyber security in the European Union, with an emphasis on the exchange of information and knowledge about cyber threats and incidents between financial institutions, will be dully presented. Moreover, this presentation will also provide insights into the current state of relevant regulations in the Republic of Serbia.

***Key words:*** Financial CERT/CSIRT, FIN-CSIRT, CIISI-EU, DORA, NIS1, NIS2, TIBER-EU

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Violeta Nešković-Popović, Institute for Standardization of Serbia<sup>19)</sup>

### WHAT IS NEW IN INFORMATION SECURITY STANDARDS

The ISO/IEC 27001:2022 and ISO/IEC 27001:2022 have undergone significant changes in their 2022 edition. A concise overview of the noteworthy changes introduced in new edition will be presented. These changes encompass updated terminology, enhanced risk management, a stronger focus on resilience, business continuity planning and incident response, the concepts taken from cyber security as well as increased alignment with other ISO management standards. Understanding these changes is crucial for anyone involved in information security, compliance, or risk management.

**Key words:** Standard, standardization, information security

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## **CYBER SECURITY IN SMART CITIES – CHALLENGES AND SOLUTIONS FOR SUSTAINABLE TOURIST DESTINATIONS**

In the current circumstances of intense expansion of technologies, with a particular focus on the increasing use of artificial intelligence, an impact on the tourism industry is expected, given that it is a crucial economic sector for many cities. Smart cities are recognized as innovative models aimed at improving functionality, preserving the environment, enhancing the comfort of residents and visitors, and raising the level of security. Simultaneously, these locations are expected to be more susceptible to risks in the field of cyber security.

The aim of this study, besides investigating and identifying these challenges, is to propose functional solutions based on existing examples. The research encompasses an analysis of the technical, legislative, and societal aspects of cyber security in smart cities, with a specific focus on protecting data and infrastructure crucial for tourism. Furthermore, issues of privacy principles and ethics in such a dynamic environment are being considered as well. Apart from the expected contribution of this research to the understanding of the complexity of cyber security in smart cities, providing guidance for sustainable tourist destinations in the era of digital transformation is significant.

The anticipated research results are expected to be useful for shaping future policies and practices that will ensure the safety of tourists and infrastructure, while supporting the economic sustainability of cities and regions. Through the analysis of previous best practices in the region and worldwide and by comparing the potential for application in test locations, we can anticipate adequate recommendations and conclusions with the purpose of promoting application of smart city technologies, with the benefits and early recognition of risks to the safety of individuals, infrastructure, and property.

***Key words:*** cyber security, smart cities, tourism, sustainability, data protection

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## **PART 4: SECURITY OF TRAFFIC AND TRANSPORT INFRASTRUCTURE**



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### **RESILIENCE OF LOGISTICS SYSTEMS AND SUPPLY CHAINS<sup>23)</sup>**

Logistics and supply chains have long become the key links of market connection and networking. However, in recent years, they have been exposed to various disorders and have become very “vulnerable” and sensitive to various risks and threats. It is estimated that, in the next decade, the biggest challenge will be the creation of logistics systems and the design of supply chains that will be able to successfully respond to crisis situations and challenges such as pandemics, wars, civil unrest, political-economic sanctions, natural disasters, economic fluctuations, etc. In order for supply chains to remain competitive in the market and meet the needs of the economy and society, it is necessary for them to be resilient. The resilience of logistics systems and supply chains is their ability to respond to disruptions, downtime, and risks, and to quickly return to their original state or transition to a new desirable state. Each supply chain entity has a role to play in creating and maintaining the overall resilience. A resilient system has the ability to overcome disruptions and transform itself to meet changing user demands and expectations. This paper deals with the resilience of logistics systems and supply chains in different circumstances, challenges and risks. A hierarchical approach is used to determine the resilience of supply chains, whilst the resilience of the supply chain is determined based on the resilience index of individual logistics systems and companies in the chain. Aggregation can be applied if the performance indicators of individual companies in the chain are independent and if all indicators have the same measurement unit. Different approaches are used to determine the resilience index of the supply chain, based on the resilience index of individual logistics systems in the chain, which are presented in more detail in the paper.

**Key words:** resilience, logistics, supply chains

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<sup>23)</sup> This paper was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, through the project TR 36006: „Optimization of distribution and return flows in logistics systems“.

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**DIGITAL INFORMATION SYSTEMS IN THE FUNCTION  
OF IMPROVING MARITIME SAFETY, MONITORING AND  
PROTECTION OF THE SEA POLLUTION FROM VESSELS**

This paper provides an overview of current trends in maritime safety and security in order to protect critical maritime infrastructure and the environment and facilitate a safe mode of regular maritime activities within the national coastal zone. Besides the almost traditional IT systems used for maritime surveillance, the paper reviews the recently developed technologies used for monitoring and surveillance of vessel activities in waterways and port areas, increasing the surveillance capabilities, and deploying several new technologies to protect the infrastructure with the aim of enabling safe operations of maritime transport in the national domain. Specifically, maritime transport safety and security require persistent broad surveillance, conducted by the maritime operational centres (VTS/MRCC), which use modern technologies for monitoring the situation at sea, collecting/processing/delivering data from various sources and over special devices, collaborative platforms, and services, in order to transmit information to relevant agencies. In order to enable a resilient chain of maritime safety, the systems for vessel traffic monitoring and information sharing (VTMIS), AIS, LRIT data, radars, meteorological sources, etc., as well as the connectiveness with EU data centres, are of a huge importance. Another important set of devices consists of UAV and AUV fleets, integrated with special object detection modules and supported by the recent development of a 5G network for the purpose of employing a vast number of *IoT* sensors, including reliable communication in critical missions. Lastly, a core component in this approach are the operational assets, such as boats and highly specialized equipment, used in on-site actions, especially in search and rescue missions, environmental risks mitigation, and related damage treatment, as well as the protection of critical maritime infrastructure, such as port facilities, anchorages and objects at sea. Therefore, a concept based on an integrated approach of the Digitalized Information Systems Deployment (DISD) for ensuring maritime transport operations safety, provides us with a systematic perspective, combining the benefits of the new *IT* technologies and available operational assets for environmentally friendly and holistic

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protection of humans, properties, maritime infrastructure and water ecosystems. Particularly, the case study described in this paper comprehends the experiences and capacities of the national authorities of Montenegro, gained through several innovation and development projects, used as subjects in the system of maritime safety and security directed towards increasing critical infrastructure protection.

***Key words:*** maritime safety, security, critical infrastructure, digitalization, pollution prevention

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**CIVIL AVIATION AS CRITICAL INFRASTRUCTURE -  
AVIATION THREATS, CHALLENGES AND IMPLEMENTATION  
OF APPROPRIATE SECURITY MEASURES**

The transport system, and especially aviation as its integral part, requires a higher level of security in comparison to some other critical infrastructures, due to its specificity and vulnerability that could have catastrophic and insurmountable consequences. The aviation industry relies on a very complex infrastructure, integrated into multiple entities so that its protection is approached from both individual and a modern holistic approach. New technological advances, tools that are in daily use, including cyberattacks, cause concern regarding the resilience of the current protection systems. Therefore, given the entities that work within this field, the analysis of the range of threats, and taking into consideration the fact that predictions warn of a continuously increasing trend of attacks, it is necessary to proportionally improve the protection.

For these reasons, through evaluation and improvement of the aviation industry, the aim of this paper is to promote the parallel progress of procedures and the need for proactivity of advanced protection systems, with the sole goal of improving aviation safety. In this paper, we will present an analysis, in which air traffic will be elaborated as a critical infrastructure. Given that this is one of the most regulated areas, supported by relevant regulations, advanced protection systems and appropriate work methodologies, the presented research will give direction towards improvement but also towards possible applicability in other critical infrastructure fields as well. Through the guidelines of the EU directive 2557 of 2022, a review will be made of what is being done and what should be done in order to improve the protection of critical entities in the creation of a state's security policy.

***Key words:*** aviation, security, cybersecurity, new technology, drone management

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### CRITICAL INFRASTRUCTURE – URBAN TRAFFIC AND STORMWATER, CASE STUDY OF THE CITY OF NOVI SAD

Critical infrastructure includes systems, networks, facilities or their parts. The interruption of functioning or the supply of goods or services can seriously affect national security, health and lives of people, property, the environment, safety of citizens, and economic stability, i.e., endanger the functioning of the Republic of Serbia. The identification and protection of critical infrastructure has recently become a priority for all countries world-wide. More and more often, natural disasters affect safety and resilience of these buildings and systems, thereby jeopardizing the basic functions of a modern society. Different countries include different sectors in critical infrastructure, depending on their importance for the basic functioning of a society. Although they have different approaches, developed countries refer to more or less the same elements. The sectors in which critical infrastructure is identified and determined in Serbia are energy, transport, water and food supply, health, finance, telecommunications and information technologies, environmental protection and functioning of state bodies.

These sectors are also interdependent in hazardous conditions, which is particularly pronounced for the transport sector, on which functioning many others depend. In this paper, the author will analyze the threat to the functioning of critical infrastructure in the urban transport sector, using the example of the urban area of the city of Novi Sad. The analysis was done during the torrential waters *occurrence*, as a result of heavy rains. In this case, there was a city traffic congestion and stoppage, as well as interruptions in the city entrance and exit points. Based on the available data, an analysis was conducted for the hundred-year rains in 2021 and 2022 that recurred quickly and caused damage to the city, unprepared for these events. Recommendations for improvement and prevention activities for heavy precipitation - torrential water hazard in urban areas are provided in the conclusion.

**Key words:** traffic, urban environment, torrential water, prevention, resilience

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**PART 5: SECURITY OF FOOD AND WATER SUPPLY**



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### WATER AND ARTIFICIAL INTELLIGENCE: OPPORTUNITIES AND CHALLENGES

The term “climate emergency” is often cited as a new phase in climate change, framing that is hoped to invigorate more climate action (McHugh et al. 2021). However, even in 1979 at the First World Climate Conference (in Geneva 1979), scientists from 50 nations concluded that climate change was alarming and urgently needed to be addressed. That is even more evident today, with the global increase in hydrometeorological (floods, storms, heat waves) and climatological disasters (droughts, wildfires). This increase indicates a likely link between climate change and water security, making climate emergency also water security emergency.

From ancient civilizations, water played a significant role in shaping human society. As humankind existence depends on water, various challenges with water security have to be seriously addressed. There are different dimensions of enduring human goals related to water security, from flooding, droughts and water pollution to landslides, water disputes and water-related diseases. The new digital age brings developments in hydroinformatics approaches, including data collection through remote sensing, the use of virtual sensors and artificial intelligence (AI) methods, to name but a few, and offers new opportunities for water security management (Markopoulos and Savić 2019).

The use of hydroinformatics and AI has contributed to significant advances across all dimensions of global water security. In order to illustrate a way forward in assessing and improving global water security, a number of notable technologies, issues, and perspectives will be presented. For example, the results of the survey of global water utilities, conducted by Daniel et al. (2023), will demonstrate how they benefit from those technologies. Furthermore, a number of lessons learned from other industries that are ahead of the water sector (Savic, 2022) will be presented to help avoid some common mistakes with digitalization and automation.

**Key words:** artificial intelligence, water security, hydroinformatics

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## **FOOD AND WATER SAFETY IN MONTENEGRO IN REGULAR AND CRISIS SITUATIONS**

In this article, the authors analyse general safety of food and water in Montenegro. It is a well-known fact that nutrition is one of the most important factors determining the health and longevity of citizens. Therefore, the authors will present the legal framework in Montenegro, along with the wider societal context contributing to the formation of good practice in crisis situations. Additionally, in this article, the author will explore and expand upon actual problems when it comes to food and water safety in Montenegro, as well as the conclusions and recommendations from Montenegrin public authorities. Under regular circumstances, the goal is the improvement and control of food and water quality, while in times of crises and security challenges, the goal is to provide an active endeavour to maintain food and water quality in accordance with the international standards.

***Key words:*** safety, food, drinking water, crisis situation, Montenegro

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### **ASSURING THE PROTECTION OF THE FOOD AND AGRICULTURE SECTOR IN THE REPUBLIC OF SERBIA IN THE AGE OF THE FOURTH INDUSTRIAL REVOLUTION<sup>35)</sup>**

The protection of the food and agriculture sector in the Republic of Serbia in the age of the Fourth Industrial Revolution (4IR) is essential to national security. It is encouraging to see the efforts of the science and academic community on stage, as well as that the policymakers are attempting to meet the needs of state and local governments, farmers, and the industry. The Republic of Serbia (RS) is a country devoted to achieving the goals and targets set out in the 2030 Sustainable Development Agenda (SDG2). Hence, SDG2 (end hunger, achieve food security and improved nutrition and promote sustainable agriculture) is one of the priorities of policymakers in the RS. Serbia's Smart Specialization Strategy, related to other public policy documents in the RS (the Serbian Government 2020, the Serbian Parliament 2018), especially with the Agriculture and Rural Development Strategy 2014-2024 (the Serbian Government 2014) contributes to this goal. The Government extended the law system, focused on preventive measures and effective mitigation of CI if dangerous events occur. Despite all, there is a lot of room for future improvement. In numerous reports on the damages in this sector, it is obvious that national security services neither adopted all the needed legislation, nor established a process for collecting, verifying, and updating information on critical assets, systems, networks, and functions of this CI, etc.

In this article, the author scrutinizes the current situation in the vulnerable agriculture sector as a part of the national system of critical infrastructure. Therefore, the main objective of this article is to initiate interested parties in the urgent need for enforcing the innovative strategy and plans for the protection of this CI. The author used methodologies suitable for social sciences and defined the objective of the article. As this article is a result of the "desktop study", the author used all kinds of reliable and available data in analyses of documents, historical approaches, and comparative analyses. The documents were collected from

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<sup>35)</sup> This research was supported by the Ministry of Science RS and IMSI no 451-03-47/2023-01/20053, and Science Fund of the Republic of Serbia, #GRANT No 7742318, "Evaluation of the Microplastics in the Soils of Serbia - EMIPLAST S.o.S".

electronic sources: *EBSCOHost*, *Academic OneFile*, *e-Library*, and National Serbian academic database *KOBSON*, printed material (books, journals, official documents, and libraries from various universities). Broader use in the practice of the new and innovative products of the *4IR* based on all eight technologies would significantly increase the safety of this critical infrastructure and mitigate existing threats (climate change, extreme weather events, wars, natural disasters, etc.)

The results present the roadmap for the policymakers and other interested parties towards redefining their approach to food security and food self-sufficiency (FSS). According to the 2020 Global Security Index, Serbia is on 61<sup>st</sup> place out of 113 countries (the Economist and Corteva 2022). The adequate approach to all these challenges requires that all stakeholders define their place in the digitized world of agriculture, as well as identify and develop the right capabilities system to succeed in it. By providing adequate security for the food and agricultural sector, the national security services will actively contribute to the adopted concept of the new circular economy.

***Key words:*** food, agriculture, innovation, critical infrastructure, food self-sufficiency.

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### **FLOODS OF AUGUST 2023 IN SLOVENIA AND THEIR IMPACT ON CRITICAL ENTITIES, ACTIVITIES AND INFRASTRUCTURE**

In August 2023, several river basins in Slovenia were affected by precipitation, that significantly exceeded 500-year return period. In this article, the author analyses this event and its impact on critical entities and their activities. In addition to the critical entities, other impacts are analysed and mechanisms for restoring the functioning of society after such an intense precipitation event that caused flooding, landslides, erosion, and debris flows on a large scale, are identified.

The event showed that certain areas (subjects) listed in the EU Directive 2022/2557 on the resilience of critical entities and their services can be severely affected, leading to a reduction in services for the population and organizations. The most affected services were: transportation (access), water supply and sanitation, telecommunications, and energy supply. The analysis shows that the entities which took appropriate and proportionate technical, operational, and organizational measures to address the risks (risk analysis, continuity management, contingency plans, education, etc.) restored their services relatively efficiently and effectively. A specific example of a comprehensive risk assessment related to water supply systems, in light of the EU Drinking Water Directive 2020/2184, which requires a risk assessment in accordance with the standard ISO EN 15975 (Part 2), is provided. The event, tragic as it was, also provides an opportunity to learn from the experience in order better identify potential risks and improve the resilience and response mechanisms of all critical entities in the future.

**Key words:** floods, EU Directive 2022/2557, resilience of critical entities, critical infrastructure

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## **STRATEGIC APPROACHES IN THE DISPOSAL OF HAZARDOUS WASTE**

Waste management means implementation of measures prescribed for waste management regarding collecting, transport, storing, treatment and disposal of waste, including supervision over those activities and care about waste management facilities upon their closure. Waste management is performed in the manner which ensures lowest risks regarding endangerment of human life, health and environment, by controlling and implementing measures to reduce pollution of water, air and soil; danger to plants and animals; risk of accidents, explosion or fire; negative effects on landscape and natural resources of special value; level of noise and odours. Waste is managed integrally, with attention dedicated to prevention, prevention, minimization, identification, collection, sorting, recording, storage, controlled movement within the organization and safe transport to the treatment facility, efficient usage and ultimately safe disposal, with minimalized negative effects to the environment.

Legal grounds for regulations in waste management in the Republic of Serbia are established by the Law on Environmental Protection and the Law on Waste Management. Strategic framework is set by the Waste Management Program in Republic of Serbia for the period 2022-2031. The Program establishes strategic goals for the improvement of the waste management system, as well as the basic principles that should guide all actors in waste management sectors towards achievement of the strategic goals. Hazardous waste management calls for special attention, i.e., clear roles and transparent engagements of the leading actors: competent authorities and legal entities and entrepreneurs authorized to manage this type of waste. Additionally, precisely in the field of hazardous waste, the principle of extended responsibility of the producer gains higher importance.

The author reflects in this paper on the current situation concerning hazardous waste management in the Republic of Serbia. The biggest problems arise with industrial hazardous waste, lack of infrastructure and low level of treatment capacity, to mention just a few. This research also highlights the reasons why the strategic approach to hazardous waste management should be realized and implemented in accordance with the real needs or requirements of the economy

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and through multilevel processes and how strategic approaches in the disposal of hazardous waste are linked to security of food and water supply.

***Key words:*** waste management, collecting, transport, storing, treatment and disposal of waste, hazardous waste storage



**PART 6: OTHER CRITICAL SUBJECTS AND ENTITIES -  
PUBLIC AUTHORITIES AND SERVICES**



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### **NATIONAL RISK ASSESSMENT TYPOLOGIES - THE BALKAN CONNECTION**

Assessing the risk of money laundering and terrorist financing is complex. It is implemented at the national and supranational levels, and represents the basis of its implementation at the level of obliged entities. The ways of its recognition, understanding, and mitigation imply timely detection of the most significant threats, with the aim of establishing new methodologies of money laundering and terrorist financing. The insight into predicate offenses and risk assessment by sector allows perception of vulnerable points and possible consequences for the integrity and stability of financial institutions and trust in the financial system. Frequent threats are detected in the non-financial sector as well, indicating the need to raise awareness of established vulnerabilities, strengthen supervisory mechanisms, monitor new technological developments, and intensify international cooperation.

***Key words:*** risk assessment, money laundering, terrorism, drug, tax evasion, corruption, human trafficking, smuggling

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## **PREDICTION AND PREVENTION OF EPIDEMIC OUTBREAKS IN SITUATIONS OF NATURAL DISASTERS CAUSED BY SEISMOLOGICAL PHENOMENA**

Natural disasters, including earthquakes, floods and tornadoes, can lead to outbreaks of infectious diseases when they lead to population displacement, changes in the environment, lack of hygienic food and water, increased exposure to existing pathogens, as well as the emergence of new pathogens. Assessing the risk of epidemics of infectious diseases in situations of natural disasters caused by seismological phenomena is essential for prevention and rapid implementation of control measures through the provision of health care, establishment of water supply, delivery of humanitarian aid, etc. The availability of relevant data on the spatial and temporal spread of infectious diseases and the characteristics of disasters caused by seismological phenomena in real time is made possible by the expert system for monitoring and preventing the spread of the epidemic - the Epidemiological Locational Intelligence System (*ELIS*).

This system was developed within the project of the Academy of Sciences and Arts of Bosnia and Herzegovina for the purpose of monitoring the *COVID-19* pandemic. The experience gained through the use of the *ELIS* system during the *COVID-19* pandemic shows that its effectiveness is related to the quality of information flow between local institutions that collect, update and maintain epidemiological data. Also, it was shown that the timely selection of measures to prevent the epidemic depends on the availability of spatial data sets on the population (population density, migration, vulnerable categories), environmental data related to climate, vegetation, pollution and seismic phenomena, communal infrastructure, and health care capacities.

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The last improvement of *ELIS*, which is described in this paper, refers to the development of a model for predicting the occurrence of an epidemic in the conditions of an earthquake. For this purpose, an analysis of statistical data of seismic phenomena in Bosnia and Herzegovina was carried out, with the definition of preventive and control measures to suppress the epidemic, based on the prediction model of its occurrence and spread.

***Key words:*** epidemic outbreaks, natural disasters, seismological phenomena, predicting model, preventive and control measures

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### PANDEMIC AS A SECURITY THREAT TO CRITICAL INFRASTRUCTURE

The objective of this paper is to point out the pandemic as a security phenomenon. In the contemporary security practice, it has shown a low frequency of manifestation, but also a great destructive potential. Every segment of the critical infrastructure system can be threatened by a massive public health crisis of global proportions. The vulnerability of the system to the pandemic as a security threat rests on the development of the human resources capacity that it possesses. In other words, the more the system is based on the human factor in the organizational and functional sense, the more vulnerable it is to the pandemic.

For accountable and efficient management of critical infrastructure systems during a pandemic, it is necessary to understand the fundamental nature of this type of a security threat. It is based on the interaction of a pathogenic microorganism on one hand, and a person as a “target” on the other. However, not all segments of critical infrastructure, nor all their parts, are equally vulnerable to the harmful effects of the pandemic. In this context, it is of crucial importance to define essential functions and positions within the critical infrastructure system, in which the human factor has a vital role.

From the historical perspective, the harmful impact of pandemics on critical infrastructure systems, with a special emphasis on *Covid-19*, reveals the unpreparedness of various segments of critical infrastructure for this type of unconventional threats. This imposed the need to review the existing crisis management protocols, but also to fundamentally change the perception of the pandemic not only as a public health crisis, but also as an economic, social, and even security crisis.

We cannot predict precisely when the next pandemic will appear, nor which virus will cause it. Nevertheless, we can work responsibly to develop precise crisis management and communication plans, improving resilience of the critical infrastructure. That will make us more effective in preventing a harmful event and controlling the possible damage caused by the pandemic. At the same time, its global character imposes the need not only for an integrated systemic response within national frameworks, but also for developed regional and wider international cooperation in this field.

**Key words:** *Covid-19* pandemic, critical infrastructure, human resources

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### **PREVENTION VS. REACTION – WHAT IS MORE IMPORTANT IN DEALING WITH THE COVID-19 PANDEMIC?**

The COVID-19 pandemic has proven that regardless of the relative strength and prosperity of a country, it is still quite vulnerable to the cascade effect this kind of event brings with itself. More importantly, this pandemic showed how good early crisis management can result in the minimization of the relative impact of certain security threats. On the other hand, it showed how poor crisis management can, not only halt a comprehensive response but also prolong both the duration of a security threat as well as the long-lasting consequences. One of the important aspects when judging different approaches to solving complex issues (i.e., security-related threats arising from a pandemic) is handling information. That being said, it's important to note that there was a direct correlation between good crisis management and how relevant information is communicated to the public. However, the same is true in the opposite case (bad crisis management resulted in bad communication of information to the public). With all of this in mind, this paper aims to point out two different approaches when it comes to handling pandemics as a global security threat. The first approach is centered around prevention (i.e., New Zealand's reaction when the first cases were reported), while the second approach is a reactionary one (i.e., Serbia's approach once more than a thousand cases were already reported in Italy). Once that is pointed out, the paper will, relative to the visible consequences, conclude which type of handling was, in fact, more effective and more in line with the necessary measures to overcome this security threat.

**Keywords:** COVID-19; crisis management; pandemic

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**SECURITY OF EDUCATIONAL INSTITUTIONS IN AN UNSAFE  
WORLD: SAFE SCHOOLS IN AN UNSAFE WORLD<sup>49)</sup>**

The shooting and mass murder at the “Vladislav Ribnikar” school in Belgrade in May 2023 put the issue of safety of educational institutions in the centre of public attention. Schools in terms of physical structures are subject to absolutely the same risks from natural disasters as other buildings. Their physical location can make them vulnerable to technical and technological disasters. Finally, schools can be places where different forms of peer violence, but also mass murders and terrorist incidents take place, and can thus be the object of attacks in the case of war conflicts. It is not possible to achieve absolute school safety, but some risks can be avoided, others can be reduced, and in the rest of the cases, resilience can be significantly increased and negative consequences of unwanted events can be reduced. Some of these activities can be undertaken by schools themselves, while some require involvement and active cooperation of the wider social community and coordination of activities of a whole range of institutions. The Faculty of Security dealt with aspects of prevention and response to security risks in schools as part of the development research project entitled “Security and Protection of the Organization and Functioning of the Education System in the Republic of Serbia” (basic principles, principles, protocols, procedures and means) (No. 47917), which resulted in publishing a total of five books - collections of papers. The most significant findings and results of the project will be synthetically presented in this paper.

***Key words:*** school, safety, risks, resilience, crisis, crisis management

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<sup>49)</sup> This paper is a result of the research project: „Safety and protection of the organization and functioning of the educational system in the Republic of Serbia (basic principles, principles, protocols, procedures and resources” (No. 47017), funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

Hajrudin Hajrović, MSc, President of the Local Security Council of Novi Pazar<sup>50)</sup>

### CRITICAL INFRASTRUCTURE - EXPERIENCES OF LOCAL MUNICIPALITIES: NOVI PAZAR, SERBIA CASE STUDY

Good management of the integrated system of critical infrastructure protection, in addition to the adopted normative legal framework and instructions for practical action, is not possible without an active role and coherent participation of forces and resources of local self-governments. By affirming the competence of local self-governments in the Republic of Serbia, this imposes a need and obligation to raise capacities of their administrative bodies responsible for implementation of the Law on the Critical Infrastructure, as well as the continuous implementation of the training of personnel responsible for performing these very important tasks in local self-governments. Serbian citizens perform an important role in building a safe community by active participation in the local security councils, which present advisory bodies of local assemblies formed by mayors of municipalities. In this paper, the good practice of the City of Novi Pazar presented, through examination of the construction of the safe local environment through participation of citizens through their representatives within the local security council.

**Key words:** good governance, security system, Security Council of the City of Novi Pazar

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**HUMAN RESOURCES MANAGEMENT IN THE MINISTRY  
OF INTERIOR AND THE MINISTRY OF DEFENCE**

Critical infrastructure is a part of the infrastructure systems which is of crucial importance for national security. In the Republic of Serbia, the subject and the protection of critical infrastructure are specifically dealt with by the Law on Critical Infrastructure, which assigns the role of the primary legal actor that organises, plans, coordinates and controls activities related to critical infrastructure to the Ministry of Interior, while allocating a significant role to the Ministry of Defence, responsible for, in accordance with the Law on Defence, management and protection of facilities of special importance for the defence of the country.

This paper presents a comparative analysis of the two most recognisable systems in the domain of critical infrastructure protection, the Ministries of Defence and Interior, from the perspective of the human resources management function.

The paper aims to propose that the key point for the management of critical infrastructure, in addition to the integrated and responsible attitude of all subjects, is human resources management, particularly in security and defence systems. It is the human resources management function that should provide professional and motivated personnel to effectively and timely protect the critical infrastructure of the Republic of Serbia. Also, efforts are being made to encourage the wider scientific community to study the role of the human resource management function in the process of protecting critical infrastructure.

In compliance with the subject and aim of the research, the paper introduces us to the concept of critical infrastructure, the role of human resources management in security management and its connection with the management function of organisational systems. Furthermore, the attention is directed to the human resources management function; a comparative overview of this function in the Ministries of Defence and Interior is provided, serving as a basis for the models of further development.

**Key words:** critical infrastructure, Ministry of Defence, Ministry of Interior, human resources, security

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### **ANALYSIS OF HUMAN SECURITY IN TERMS OF INFRASTRUCTURE SYSTEMS**

In this paper, the authors present the application of the concept of human security as an analytical framework used for determining the impact of infrastructure systems on the level of safety and quality of life of the citizens. The analysis was conducted at the regional level, based on available statistical data. Critical infrastructure sectors with potential significant influence on citizens' quality of life were selected based on previous research from the available literature. Guided by assumed relationships, we chose statistical indicators from the selected critical infrastructure sectors. The selection of indicators in accordance with the dimensions of human security, temporally and spatially conditioned, relied on official statistical data for the territory of the Republic of Serbia. Through the application of statistical analysis procedures (correlation, regression, and cluster analysis), we analysed and ranked within the chosen regional domains. The obtained results depict the level of human security and quality of life in the region, taking into account the state of its infrastructure systems. Thus, a statistically significant connection between the state of infrastructure systems and the level of human security in the selected regions has been established. The territory of the Republic of Serbia was chosen for demonstrating the applied methodology. Depending on the available data, this proposed approach enables the analysis of other geographical areas as well.

**Key words:** human security, infrastructure systems, quality of life, statistical analysis, the Republic of Serbia

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**SPATIAL DISTRIBUTION, DURATION AND TRENDS  
OF URBAN PRECIPITATION IN SERBIA<sup>56)</sup>**

Hail is a weather phenomenon that can cause significant damage to crops, infrastructure, buildings and motor vehicles. It affects Serbia severely during the warm season. The spatial distribution of a hailstorm, which can be measured by hail frequency and size reports and remote sensing products, is important for assessing the hail risk of an area. Hail is a small-scale phenomenon that forms in strong updrafts of organised convection, whether it is a single-cell, multicell or supercell storm. The surrounding area should be rich in supercooled droplets. The area affected by hail is small, usually several square kilometres. Therefore, using hail data from dense network of hail suppression stations (called rocket launch stations) provides a nearly realistic picture of hail characteristics. Two subsets of data are analysed: the first originating from the area of Serbia, excluding the province of Vojvodina, in the period 1981-2015 (P1) and the second from the entire area of Serbia in the period 2002-2015 (P2).

Orography has been shown to have a significant influence on the development of cumulonimbus clouds and consequently hail: the highest annual number of days with hail per rocket launch station is found in the mountainous areas of southwestern Serbia, with a maximum mean of 1.2. The analysis shows that hail occurs mainly in the afternoon and evening and lasts less than 5 minutes in about 75% of the cases, with an average of 3.56 minutes in P1 and 3.18 minutes in P2. Very rarely does hail last longer than 10 minutes. The average seasonal duration of hail shows a decreasing trend, which is significant in P1 and not significant in P2. There is no linear trend in the number of hail days in P1, while a positive monotonic trend was observed in P2. Hail of all sizes or of one size category does not occur more frequently, or earlier in the season. However, there is an increasing monotonic trend that is significant at the 6.7% significance level for the smallest hailstones. This suggests the need to explore the upper atmosphere and the behaviour of the zero isotherm. Remote sensing of strong convective cells showed good concurrence with reports of hail damage.

**Key words:** hail trend, hail duration, risk, melting level height, Serbia

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<sup>56)</sup> This research was created within the project supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, entitled “Meteorological extremes and climate changes in Serbia”, Grant 451-03-47/2023-01/200162.

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### TRENDS OF EXTREME VALUES OF METEOROLOGICAL PHENOMENA IN BELGRADE

Climate is a set of atmospheric phenomena that characterise the average physical state of the atmosphere in a place or region over a long period of time. The climate changes on a large time scale. One of the basic characteristics of the moderate-continental climate in Serbia is the daily change of meteorological conditions. During these changes, extreme values of certain meteorological parameters occasionally occur, causing great material damage and posing a potential threat to human life. According to World Meteorological Organization, human activities, principally emissions of greenhouse gases (CO<sub>2</sub>), have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020. It is said that the rising temperatures cause more frequent and intense extreme weather events. Every opposed hypothesis is evaluated as pseudoscientific and is rarely presented in public. However, an episode of extreme weather does not mean climate change. A long series of instrumental data is necessary and desirable to consider the frequency and trend of extreme values. For example, the Central England data (1659-2020) show nothing unusual about the evolution of current air temperatures. And because there is really nothing special about Central England, it is reasonable to expect that no place in the world is experiencing anything unusual in the modern era, in comparison with other epochs since 1659. Analysis of the extreme values of sixteen most important meteorological parameters recorded at the Belgrade Meteorological Observatory in the period 1888-2023 shows that the trend of change for most of them is not statistically significant (absolute annual maximum temperature, number of days with  $T_{\max} \geq 35^{\circ}\text{C}$ , number of days with  $T_{\max} \geq 37^{\circ}\text{C}$ , minimum and maximum monthly precipitation, maximum daily and monthly precipitation, number of days with precipitation  $\geq 30$  mm, annual sum of precipitation, number of days with thunderstorms, number of days with snow cover, annual maximum of snow depth and number of days with snow cover  $\geq 10$  cm). Decreasing and increasing trends within the analysed period represent periodic fluctuations and are not indicators of climate change. There is a moderate decreasing trend only in three out of sixteen parameters: annual maximum wind speed ( $r=0.667$ ), yearly number of days with minimum air temperature below  $-5^{\circ}\text{C}$  ( $r=0.606$ ) and below  $-10^{\circ}\text{C}$  ( $r=0.504$ ), where

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'r' is the correlation coefficient. Absolute yearly minimum air temperature has a moderate increasing trend ( $r=0,4688$ ). This can be explained by the change in microclimatic conditions due to urbanisation and strengthening of the urban heat island. No significant changes in the climate regime should be expected in the coming decades. There will be repeated episodes of extreme weather conditions with already recorded parameter values, which may threaten certain critical infrastructure systems: economic facilities and other property of citizens, roads, energy networks, telecommunications, agricultural land, people's health and lives. In some rare situations, this may have national security implications.

***Key words:*** climate, weather extremes, trends

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### SPACE TECHNOLOGIES: CONCEPTUAL DESIGN OF CUBESAT FOR OBSERVING THE SUN

The orbital decay of CubeSats in low Earth orbits is significantly influenced by atmospheric drag, particularly during periods of increased solar activity. This solar activity follows an 11-year cycle, with the next maximum expected in 2025. During such solar maxima, the Sun emits increased extreme ultraviolet radiation, leading to the expansion of the thermosphere. Consequently, the thermosphere's density at a given altitude increases by an order of magnitude compared to seasons of low solar activity. This has a direct impact on the orbital lifetime of CubeSats, reducing it significantly during periods of high solar activity compared to their counterparts in seasons of lower solar activity. On the other hand, the typical geometry of a 3U CubeSat, especially those equipped with deployable solar panels, offers the flexibility to vary its ballistic coefficient by an order of magnitude, depending on the spacecraft's attitude. We explore the possibilities for modelling the aerodynamic environment around a 3U CubeSat designed for observing the Sun in the soft X-ray domain. This CubeSat is currently in development at the University of Belgrade, with a primary goal of enhancing its orbital lifetime to enable observations over an extended portion of the upcoming solar maximum season. This effort not only extends the CubeSat's operational window, but also maximizes its scientific output, aligning with the concept of a CubeSat designed for solar observations.

***Key words:*** CubeSAT, Sun observation, Solar activity

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CIP - Каталогизација у публикацији  
Народна библиотека Србије, Београд

005.334:351.759.6(048)

005.334:61(048)

**INTERNATIONAL scientific and expert conference (2023)**

Conference Book of Abstracts / International scientific and expert conference Security of infrastructure systems: concepts - regulations - practice, [October 12-13th, 2023] ; [editor Zoran Keković]. - Belgrade : Center for risk analysis and crisis management, 2023 (Novi Beograd : Data copy). - 60 str. ; 25 cm

Tiraž 100. - Str. 7-8: Preface / Zoran Keković.

ISBN 978-86-902810-5-3

- а) Управљање ризиком -- Безбедносни сектор -- Апстракти
- б) Кризни менаџмент -- Апстракти

COBISS.SR-ID 130746121



center

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for risk analysis and  
crisis management

**ISBN 978-86-902810-5-3**