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Disasters and Deviant Behaviour: Risk Factors and Citizens' Perceptions in Serbia; An Integrated Risk Management Algorithm for Economic Catastrophes: From Exogenous Shocks to Endogenous Vulnerabilities; Management of the Extreme Situation in the Climate Change Zone (Republic of Serbia): Criticism, Political-Ecological Perspective, and Complexitas Rerum; Analysis of Physical and Psychological Safety Strategies in Schools and their Impact on the Protection and Safety of Students; Operationalizing the Resilience of Local Communities to Flood Risk: A Capital Approach and Assessment Model; Continuity of State Functions and Protection of Classified Information in Disaster Conditions: Theoretical Framework and Strategies of Digital Resilience; Experiences in Organizing and Implementing Evacuation Drills for People at Risk From Educational Facilities; Organization of Emergency Response and Rescue Units in Emergencies Caused by Hazardous Materials; Disaster Resilience in Serbia: A Narrative Synthesis of Institutional, Social, and Perception-Based Evidence; The Role of Electronic Communications and the Media in Integrated Risk Management: The Case of a Public Warning System; The Role of Higher Education Institutions in the Development of Multidisciplinary and Integrated Risk Management; The Importance, Content, and Implementation of Environmental, Social, and Governance Principles in the Field Of Sustainability And Local Community Development; Legal and Institutional Framework for Emergency Management in the City of Belgrade; Corporate Security as an Integral Part of the Disaster Risk Reduction and Emergency Management System; Artificial Intelligence in Integrated Disaster Risk Management: Sustainability and Human Security in the Republic of Serbia; Earthquake Risk and Insurance in the Banking System; Application of Location-Based Services as Part of an Integrated Natural Disaster Risk Management System; The Role of the Media in Shaping the Perception of Terrorism; The Role of the Faculty of Security Studies in Educating Future Professionals for Contemporary Integrated Risk Management.

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THEMATIC CONFERENCE PROCEEDINGS
MODERN INTEGRATED DISASTER RISK MANAGEMENT

Fourth Memorial Scientific and
Professional Conference "Predrag Marić"

MODERN INTEGRATED DISASTER RISK MANAGEMENT

Faculty of Security Studies, University of Belgrade
University of Belgrade
Ministry of Internal Affairs of the Republic of Serbia,
Institute for International Politics and Economy

THEMATIC CONFERENCE PROCEEDINGS

March 19, 2026



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MODERN INTEGRATED DISASTER RISK MANAGEMENT

UNIVERSITY OF BELGRADE
FACULTY OF SECURITY STUDIES

FOURTH MEMORIAL SCIENTIFIC AND
PROFESSIONAL CONFERENCE "PREDRAG MARIĆ"

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MODERN INTEGRATED DISASTER RISK MANAGEMENT

PROCEEDINGS

19 March 2026 • Belgrade, Serbia

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and Professional Conference "Predrag Marić"

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Prof. Dr. Vladimir M. Cvetković

University of Belgrade – Faculty of Security Studies
Belgrade, 2026

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Foreword

It is with great respect and pleasure that we present the Proceedings of the Fourth Memorial Scientific and Professional Conference "Predrag Marić", held on March 19, 2026, under the theme "Modern Integrated Disaster Risk Management". The conference was jointly organized by the Faculty of Security Studies, University of Belgrade, the Ministry of Internal Affairs of the Republic of Serbia, and the Institute for International Politics and Economics. Its central purpose was to advance scientific knowledge, strengthen professional dialogue, and improve institutional and community capacities for disaster risk reduction, preparedness, mitigation, response, and recovery. This volume brings together scientific and professional contributions reflecting contemporary challenges, new research directions, and practical approaches to disaster resilience.

The memorial conference is dedicated to Police General Predrag Marić, a long-serving Assistant to the Minister of Internal Affairs, Head of the Emergency Situations Sector, and lecturer at the University of Belgrade – Faculty of Security Studies. His exceptional professional achievements, institutional leadership, and commitment to developing the disaster risk reduction system in the Republic of Serbia left a lasting legacy. His vision of a systematic approach integrating scientific knowledge, regulatory frameworks, institutional coordination, and operational practice continues to provide a foundation for contemporary disaster risk management. This publication is both a tribute to his contribution and a commitment to further developing the principles and professional standards he advocated.

The conference theme reflects the growing recognition that contemporary disaster risks cannot be adequately addressed through isolated disciplinary, institutional, or sectoral approaches. Increasingly interconnected natural, technological, environmental, economic, and societal risks demand comprehensive analytical frameworks, coordinated governance, and cooperation among researchers, public authorities, emergency services, local communities, the private sector, and civil society. Integrated disaster risk management encompasses the full management cycle: risk identification, hazard and vulnerability assessment, prevention and mitigation, preparedness, emergency response, recovery, and reconstruction, with particular emphasis on sustainability, adaptability, and long-term resilience.

The present proceedings go beyond the preliminary scientific perspectives presented in the Book of Abstracts. They contain full-length papers offering developed theoretical arguments, methodological approaches, empirical findings, institutional analyses, and practical recommendations. The contributions address disaster resilience and community capacities, climate-related and environmental challenges, economic vulnerabilities, institutional and legal frameworks, emergency response and rescue operations, critical infrastructure, and the continuity of essential state functions. Attention is also devoted to public warning and communication systems, education and professional training, corporate security, insurance, and contemporary technological solutions.

An important feature of this volume is its interdisciplinary orientation and the diversity of perspectives represented. Disaster risk management is examined not only as a technical or operational activity, but also as a multidimensional field shaped by social, political, economic, legal, environmental, and technological processes. Research on the social consequences of disasters, citizens' perceptions, local community resilience, institutional preparedness, and the protection of vulnerable populations appears alongside contributions addressing artificial intelligence, location-based services, digital resilience, media communication, and sustainable governance. Together, these perspectives demonstrate the value of connecting scientific evidence, innovation, institutional responsibility, and professional experience.

The scientific and professional significance of the proceedings also lies in their capacity to connect theory with practice. By presenting research findings alongside institutional experience and operational considerations, the volume encourages critical examination of existing approaches, identification of organizational challenges, and development of recommendations for improving disaster risk governance. This exchange is particularly important amid increasing complexity, uncertainty, cascading consequences, and interdependence among critical societal systems. The research presented here can inform evidence-based policies, preventive measures, inter-institutional coordination, and innovative approaches to strengthening community resilience.

The organizers and editorial team express their sincere gratitude to all authors whose contributions made these proceedings possible. We are also grateful to the members of the Scientific and Program Committee for their academic expertise, professional commitment, and contribution to the scientific orientation of the conference. Particular appreciation goes to its Chair, Prof. Dr. Mladen Milošević, and to committee members from the University of Belgrade and partner institutions. We likewise thank the Organizing Committee for coordinating the organizational, logistical, and operational activities required for the successful realization of the conference.

We believe that these proceedings will serve as a valuable reference for researchers, university teachers, students, policymakers, decision-makers, emergency management professionals, protection and rescue services, and other stakeholders involved in disaster risk reduction and resilience building. Beyond documenting the results presented at the conference, the publication provides a foundation for further research, interdisciplinary dialogue, institutional cooperation, and practical improvements in policies, planning, preparedness, response, and recovery.

Furthermore, we hope that this publication will encourage new research partnerships, the exchange of professional experience, and the transfer of good practices at local, national, regional, and international levels. The complexity of contemporary risks requires sophisticated analytical and technological capabilities, but also a sustained commitment to prevention, responsibility, institutional cooperation, and sustainable development. By promoting these principles, the proceedings reinforce the relationship between science and practice and contribute to a more comprehensive understanding of the measures needed to reduce disaster consequences.

Finally, may the contributions collected in this volume preserve and further develop the legacy of Police General Predrag Marić. His dedication to professional responsibility, institutional development, and the protection of human life continues to inspire researchers and practitioners. Effective disaster risk management is founded upon the integration of knowledge, experience, cooperation, and responsibility; building safer and more resilient communities requires a shared and sustained effort.

Prof. Dr. Vladimir M. Cvetković

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Disasters and Deviant Behaviour: Risk Factors and Citizens' Perceptions in Serbia

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Abstract

In addition to immediate material losses, disasters can trigger secondary psychosocial processes that increase the risk of various forms of deviant and violent behavior. This paper examines citizens' perceptions in Serbia regarding the association between disasters and violence and deviant behavior, as well as the factors related to awareness, self-assessed readiness to respond, and attitudes about the role of institutions in prevention. The study was conducted via an online survey of 106 respondents in Serbia. Likert-type items (P26–P30) and categorical variables (P12–P25) were analyzed using descriptive statis-

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tics, Pearson correlations, chi-square tests of independence, one-way ANOVA, and multiple linear regression. The findings indicate a very high level of basic awareness of natural disasters and violence, but also a pronounced perception that a significant share of the Serbian population lacks adequate practical knowledge about post-disaster consequences and actions (M = 4.39). Respondents strongly recognize the impact of disasters on mental health (M = 4.21) and the importance of competent services in preventing violence (M = 4.12), while self-assessed readiness to respond is moderate (M = 3.82). The strongest association among attitudes is observed between support for education and the assessment of the impact of disasters on mental health ($r = 0.40$; $p < 0.001$). Chi-square analyses indicate several significant associations between gender and income (small to moderate effects). At the same time, ANOVA differences were confirmed in two cases: by gender for the PTSD/mental-health attitude and by income for self-assessed response readiness. Regression models suggest limited explanatory power of sociodemographics for attitudes, suggesting a likely greater role for experiential and contextual factors (disaster experience, trust in institutions, exposure to training). The results support the need for systematic risk communication and practically oriented educational programs, which—together with clear reporting protocols and inter-institutional coordination—can reduce the risk of escalation of violence and deviant behavior under crisis conditions.

Keywords

Disasters; deviant behaviour; violence; gender-based violence; mental health; citizens' perceptions; awareness; readiness to respond; risk communication; Serbia.

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1. Introduction

The frequency and intensity of disasters caused by natural and anthropogenic hazards in the contemporary period are increasingly associated with climate change. At the same time, it is important to emphasise that their consequences extend far beyond immediate material damage. In addition to infrastructure destruction and loss of life, disasters can trigger a range of secondary social processes that increase the vulnerability of individuals and communities, including risks of various forms of violence and deviant behaviour, especially among children and other vulnerable groups (Cerna et al., 2019). In crisis conditions, when everyday routines are disrupted, and access to resources is constrained, stress, uncertainty, and tensions intensify, creating favourable conditions for the escalation of conflicts and violent behavioural patterns within households and the broader community (Sloand et al., 2015).

Conceptually, a disaster is often defined as an extremely serious disruption in a community's functioning that results in human, material, economic, and/or environmental losses, the scale of which exceeds the affected community's capacity to cope independently (Cerna et al., 2019). This definition is important because it emphasises that a disaster is not merely an "event", but a process that includes disruption of normal life, weakening of support systems and institutional capacities, and the potential for these to become overwhelmed. In empirical analyses, natural disasters are often classified by hazard source (hydrometeorological, geophysical, and climatological), enabling more precise comparisons of risks and consequences across contexts.

From a psychosocial perspective, numerous studies indicate that exposure to disasters can significantly affect people's mental health and emotional functioning, especially amid increasingly pronounced climate risks (Chen et al., 2020). Among children and adolescents, impacts may be particularly strong; the literature highlights an elevated risk of post-traumatic stress disorder, depression, and anxiety following catastrophic events (Dyregrov, Yule, & Olff, 2018). Moreover, disasters can indirectly influence long-term life trajectories through interruptions in schooling and disruptions of developmental conditions, with potential lasting consequences for social inclusion and future risks (Kousky, 2016).

Within the broader social context, violence is not viewed as an isolated phenomenon but as a complex one shaped by power relations, social structures, and existing inequalities (Jovičić, 2013). Therefore, disasters may accelerate pre-existing tensions: in situations of scarcity, insecurity, and struggle for basic needs, the risk of conflict and violent behaviour may increase (Sloand et al., 2015). This perspective is important for understanding deviant behaviour in crises, as it points to the interaction between individual stress reactions and structural conditions that shape everyday life and opportunities for protection.

A specific dimension concerns gender-based violence and domestic violence in the context of disasters. Within the European legal and policy framework, the Istanbul Convention has set standards for preventing and combating violence against women and domestic violence, emphasising that gender equality is a key element of prevention and protection (Jovašević, 2018). At the same time, contemporary operationalisations of violence include a wide spectrum of forms—from physical and sexual to emotional, domestic, and cyber violence—which is important for a more precise interpretation of risks and mechanisms in crisis contexts (Sardoč, 2019).

Empirical evidence from different contexts suggests that major stressors and disasters may be accompanied by changes in the frequency and structure of violence, including intimate partner violence (Rao, 2020). In addition,

some studies emphasise that women, in certain situations, are more susceptible to post-traumatic and depressive consequences after disasters, and these outcomes may be associated with a higher risk of violence in intimate partner relationships (Bell & Folkerth, 2016). These findings are important because they indicate that the mechanisms linking disasters and violence can be multidimensional and mediated through mental-health consequences, social conditions, and access to support.

Beyond natural disasters, the experience of the COVID-19 pandemic has further demonstrated how prolonged social disruptions can alter the dynamics of violence and vulnerability. Under lockdowns and movement restrictions, children's and adolescents' exposure to domestic violence and other household risks became more pronounced, highlighting the need for systemic support and interventions (Mazza et al., 2020). At the same time, research on the economic effects of crisis events and climate risks suggests that economic insecurity can indirectly contribute to social tensions and risks within households and communities (Boustan et al., 2020).

Building on these theoretical and empirical insights, this paper examines factors associated with perceptions of the impact of disasters on deviant behaviours and violence, with particular emphasis on awareness, attitudes, readiness to respond, and the role of institutional actors. By analysing citizens' attitudes and knowledge, it is possible to identify areas where risk communication, prevention programmes, and educational interventions need strengthening, especially in the domain of gender-based violence and mental-health support after disasters.

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1.1. Literature review

Contemporary literature increasingly shows that, besides visible physical impacts, disasters also produce less noticeable but socially highly significant outcomes reflected in changes in social relations, increased stress, and heightened vulnerability of certain groups. In this framework, a disaster is defined as a serious disruption of community functioning that exceeds local capacities for response and recovery. In contrast, natural disasters in empirical studies are often classified by hazard source (hydrometeorological, geophysical, climatological), which enables more precise comparisons of risks and consequences (CRED & UNISDR, 2015; Cerna-Turoff et al., 2019).

Studies addressing violence in the context of disasters particularly emphasise risks of violence against children and gender-based violence. Systematic reviews indicate a statistically and conceptually recognisable association between natural disasters and increases in child victimisation and

violence, confirming the need to integrate protection and prevention into all phases of disaster management (Cerna-Turoff et al., 2019). Beyond review studies, findings from specific crisis contexts further corroborate these risks and highlight barriers to protection and reporting.

An important segment of the literature focuses on psychological mechanisms that may mediate the relationship between disasters and deviant/violent behaviour. It is emphasised that children and adolescents, after exposure to disasters, are at higher risk of PTSD, depression, and anxiety (Dyregrov, Yule, & Olff, 2018), while disruptions to schooling and developmental conditions can have long-term consequences for social inclusion and future risks (Kousky, 2016). In the domain of intimate partner violence, studies suggest that women may be particularly vulnerable to post-traumatic and depressive outcomes after disasters, which can be associated with increased risk of violence (Bell & Folkerth, 2016).

Beyond psychological mechanisms, a growing number of studies emphasise the broader context in which disasters operate: climate change and extreme events can affect emotional states, social stability, and economic security, indirectly shaping relationships within households and communities (Chen et al., 2020; Boustan et al., 2020). In situations where resources are limited and populations strive to meet basic needs, tensions may rise, and the risk of conflict and violence may increase (Sloand et al., 2015).

In the area of standards and policies, the Istanbul Convention represents a key instrument that provides a framework for preventing and protecting against violence against women and domestic violence, highlighting gender equality as a preventive factor (Jovašević, 2018). At the same time, broader definitions of violence—covering physical, sexual, emotional, domestic, and cyber violence—support a more precise research approach and better interpretation of results in different crisis contexts (Sardoč, 2019). Finally, the disaster-education and preparedness literature emphasizes the importance of proactive learning and training in building resilience and reducing risks (Shiwaku & Shaw, 2008).

The literature emphasises that, besides immediate physical destruction, natural disasters create conditions that can intensify social tensions and increase the risk of conflict and violence in affected communities, especially under scarcity and difficulties in meeting basic needs (Sloand et al., 2015). In this framework, disasters are described as serious disruptions that cause significant losses and exceed local capacities, potentially straining informal support networks and services that usually protect vulnerable individuals.

A distinct body of work indicates that disasters are associated with increased risk of gender-based violence, including violence within households

and communities, particularly in post-disaster conditions of displacement, loss of shelter, and compromised safety (Sloand et al., 2015). For example, in the post-disaster context following the 2010 Haiti earthquake, risks and barriers to preventing gender-based violence were documented, as well as specific vulnerabilities of internally displaced adolescent girls (Sloand et al., 2015; Sloand et al., 2017). In addition, quantitative reviews emphasise that natural disasters are also linked to violence against children, highlighting the need to integrate prevention and protection across all phases of disaster management (Cerna et al., 2019).

Psychological mechanisms are central for understanding links between disasters and deviant/violent behaviour. Research shows that children's disaster exposure may increase risks of PTSD, depression, and anxiety (Dyregrov, Yule, & Olff, 2018), and that these impacts can be compounded by educational disruption and altered developmental trajectories (Kousky, 2016). In the domain of intimate partner violence, studies point to women's heightened vulnerability to post-traumatic and depressive outcomes after disasters, which may be associated with increased violence risk (Bell & Folkerth, 2016).

Beyond natural disasters, crises such as the COVID-19 pandemic have further highlighted the issue of violence under prolonged disruptions, pointing to the importance of continuity of psychiatric and social services and inter-agency cooperation in preventing domestic violence (Gulati & Kelly, 2020). At the same time, the literature underscores that the economic consequences of disasters and long-term disruptions of economic activity may indirectly affect social stability and household risks (Boustan et al., 2020), while the impacts of climate-related disasters have also been linked with anxiety and resilience as relevant psychological outcomes (Chen et al., 2020). In the domain of prevention, several authors stress the importance of education and strengthening community capacity, especially in schools and through models of co-learning and proactive risk education (Ocal & Topkaya, 2011; Shiwaku & Shaw, 2008), as well as the broader development of a culture of safety and resilience (UNESCO, 2005).

2. Methods

2.1. Research design and approach

The study was designed as a quantitative, non-experimental survey conducted using an online questionnaire. The selected approach enabled the collection, in a relatively short time, of data on (1) the level of awareness, (2) attitudes and perceptions regarding the link between disasters and deviant/

violent behaviour, (3) self-assessed readiness to respond, and (4) perceptions of the role of institutions in prevention.

2.2. Sample

The target population comprised all adult citizens of the Republic of Serbia. The sample included 106 respondents. Inclusion criteria were: (a) adulthood, (b) voluntary participation, and (c) a questionnaire completed to an extent that allows statistical analysis. In some analyses, the number of valid responses may vary due to missing values (listwise or pairwise, depending on the analysis). The gender structure indicates slightly higher participation among women (n = 55, 51.9%) than among men (n = 49, 46.2%). The largest share of respondents was in the 18–27 age group, followed by the 27–37 age group, while older age groups were less represented. Education levels were predominantly secondary and higher/university education.

Table 1. Sample characteristics (N=106).

Characteristic	Category	n (%)
Gender	Female	55 (51,9%)
	Male	49 (46,2%)
Age (years)	18-27	65 (61,3%)
	27-37	25 (23,6%)
	37-50	4 (3,8%)
	50-60	7 (6,6%)
	over 60	3 (2,8%)
Level of education	Three-year secondary school	8 (7,5%)
	Four-year secondary school	23 (21,7%)
	Higher education (college)	10 (9,4%)
	University education	42 (39,6%)
	Master's studies	20 (18,9%)
	Doctoral studies	2 (1,9%)
Father's education	Three-year secondary school	18 (17,0%)
	Four-year secondary school	53 (50,0%)
	Higher education (college)	10 (9,4%)
	University education	15 (14,2%)
	Master's studies	7 (6,6%)
	Doctoral studies	1 (0,9%)

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Mother's education	Three-year secondary school	21 (19,8%)
	Four-year secondary school	55 (51,9%)
	Higher education (college)	10 (9,4%)
	University education	10 (9,4%)
	Master's studies	6 (5,7%)
	Doctoral studies	2 (1,9%)
Marital status	Single (unmarried)	60 (56,6%)
	In a relationship	24 (22,6%)
	Engaged	4 (3,8%)
	Married	15 (14,2%)
	Divorced	2 (1,9%)
Household size	One-member household	7 (6,6%)
	Two-member household	11 (10,4%)
	Three-member household	17 (16,0%)
	Four-member household	38 (35,8%)
	Five-member household	22 (20,8%)
	Households with more than five members	10 (9,4%)
Monthly household income (RSD)	up to 30,000	3 (2,8%)
	30.000-50.000	10 (9,4%)
	50.000-80.000	16 (15,1%)
	80.000-100.000	28 (26,4%)
	More than 100,000	47 (44,3%)
Employment status	Employed	61 (57,5%)
	Unemployed	44 (41,5%)
Number of employed household members	1	16 (15,1%)
	2	47 (44,3%)
	3	32 (30,2%)
	4	9 (8,5%)
	More than 4	1 (0,9%)
Occupation	Student	24 (22,6%)
	Administrative staff/Technician or associate professional	9 (8,5%)
	Craft worker/related occupation	7 (6,6%)
	Self-employed entrepreneur	5 (4,7%)
	Service or retail occupation	4 (3,8%)
	Manager	3 (2,8%)
	Professional/Artist	2 (1,9%)
	Other	51 (48,1%)

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2.3. Questionnaire

For this study, a structured questionnaire was used, organised into three parts:

(A) The sociodemographic block (P1–P11) includes the basic characteristics of respondents and their households, treated in the analysis as independent variables and control factors. This section collected information on gender (including the option "prefer not to say"), age (using predefined categories), level of education, father's and mother's education, marital status, household size, approximate monthly household income, employment status, occupation, and the number of employed household members. In addition to its descriptive function and presentation of the sample structure, this set of variables enables comparisons of perceptions and attitudes across different sociodemographic groups, as well as identification of potential patterns in self-assessed preparedness and risk assessments.

(B) The awareness and perceptions block (P12–P25) is designed to assess several interrelated dimensions: basic awareness of key concepts (e.g., natural disaster and gender-based violence), perceptions of risk and the perceived connection between disasters and violence (including attitudes about a potential increase in aggression in partner relationships), perceptions of contextual experiences and social facts (e.g., within the COVID-19 context and related risks of violence), assessments of personal and collective exposure (e.g., the likelihood that natural disasters may occur in one's surroundings), as well as assessments of readiness to help, volunteer, and attend educational programmes. Items in this block are formulated as questions with three response options ("Yes", "No", "Do not know"), which enables a clear distinction between respondents who have a formed opinion/knowledge and those who express uncertainty. This distinction is particularly important for planning risk communication and designing preventive-educational interventions aimed at increasing awareness and practical competencies.

(C) The Likert-scale attitudes block (P26–P30) measures the intensity of respondents' agreement with key statements on a five-point scale. This section includes: assessment of the role of additional education (in the context of COVID-19) in mitigating post-disaster consequences; attitudes about the impact of disasters on mental health and the risk of post-traumatic outcomes; self-assessed ability to respond appropriately when violence is observed in communities affected by a disaster; assessment of the importance of competent authorities and services in preventing and suppressing violence against vulnerable groups; and the assessment that a significant part of the population lacks sufficient knowledge and awareness of possible post-disaster consequences. Compared to dichotomous items, this block allows more precise,

graded measurement of attitudes. It supports the application of more complex statistical procedures (correlational and regression analyses) to examine relationships among attitudes and their associations with sociodemographic characteristics.

2.4. Variable operationalisation and coding

The independent variables in the study comprise respondents' and households' sociodemographic characteristics (P1–P11), which were treated as predictors and control variables in the analyses. For analytical clarity and to ensure more stable statistical estimates, certain categories were, where justified, recoded into a smaller number of broader groups (for example: age into three analytic groups, education into three levels, and income into three levels), in line with the analysis plan and the frequency distributions in the sample. Categorical dependent variables include items P12–P25, with response options "Yes", "No", and "Do not know". These variables were analysed as nominal categories, with the "Do not know" option, when relevant, additionally interpreted as an indicator of uncertainty, insufficient information, or indecision—particularly important for interpretation in the domain of risk communication and preventive education. Likert-dependent variables included items P26–P30 and were coded on a 1–5 scale, with higher values indicating greater agreement with the statement (1 = strongly disagree, 5 = strongly agree). This coding scheme enabled calculation of descriptive indicators (means and variability), examination of inter-item associations, and the application of procedures for testing group differences and modelling predictors.

2.5. Data analysis

Data processing and analysis were carried out through several interconnected steps. First, descriptive statistics were used to present the sample structure and basic distributions: sociodemographic variables were reported using frequencies and percentages; categorical items P12–P25 were presented through distributions of responses ("Yes/No/Do not know"); and for Likert items P26–P30, means, standard deviations, and ranges were calculated. Next, correlation analysis was performed to examine relationships among the Likert items (P26–P30) using Pearson's correlation coefficient. Subsequently, tests of differences and associations were applied: the chi-square test of independence was used to examine relationships between the categorical dependent variables (P12–P25) and sociodemographic characteristics, with Cramer's V reported as a measure of effect size; one-way analy-

sis of variance (ANOVA) was used to test differences in mean Likert scores across sociodemographic groups, with η^2 reported as an indicator of effect size. Finally, multivariate analysis was conducted using multiple linear regression for selected Likert outcomes (P26–P30), including sociodemographic indicators as independent variables to estimate their unique contribution while controlling for other factors. Before applying parametric procedures, basic assumptions relevant to the applied tests were considered (distribution characteristics, presence of extreme values, and homogeneity of variances), and results were interpreted with methodological caution given the sample size and the measurement approach.

2.6. Ethical aspects

The study was conducted in accordance with basic ethical principles applied in social research, including voluntary participation, anonymity, and data confidentiality. Before accessing the questionnaire, respondents were informed about the study's purpose and how the data would be used. Participation implied the right to withdraw at any time without any consequences.

3. Results

Descriptive indicators for continuous variables (1–5) show a generally high level of respondents' agreement with the statements (Table 2). The highest mean value was obtained for the item: "A large part of the population of the Republic of Serbia does not possess adequate knowledge about potential consequences that may occur after a natural disaster." (M=4.39), suggesting broad endorsement of this assessment. The lowest mean value was recorded for the item related to additional education about the COVID-19 pandemic and mitigating post-disaster consequences, indicating a more moderate level of agreement. Overall, respondents recognise the relevance of mental-health impacts and the role of institutions, while self-assessed readiness to respond is somewhat lower.

Table 2. Descriptive statistics for Likert dependent variables (P26–P30).

Variable	n	M	SD	Min	Max	Skewness	Excess kurtosis
Additional education about the COVID-19 pandemic can mitigate consequences after a natural disaster.	105	3,55	1,21	1,00	5,00	-0,51	-0,44
Natural disasters can become a major cause of post-traumatic stress disorder and substantially affect people's mental health.	105	4,21	0,94	1,00	5,00	-1,36	1,81
If I notice that violence has occurred in communities affected by a natural disaster, I would know how to respond appropriately.	105	3,82	0,91	1,00	5,00	-0,58	0,05
Competent authorities/services play an important role in preventing and eliminating phenomena such as violence against women, girls, and older persons.	105	4,12	0,93	2,00	5,00	-0,84	-0,16
A large part of the population of the Republic of Serbia lacks adequate knowledge of the potential consequences of a natural disaster.	105	4,39	0,70	2,00	5,00	-0,88	0,23

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Frequency analysis of categorical dependent variables shows that awareness of basic concepts is very high. Almost all respondents reported having heard of the term natural disaster (Yes=99.0%) and knowing that violence includes physical, sexual, and emotional forms (Yes=96.2%). The percentage who have heard of gender-based violence is also high (Yes=89.5%). However, for some questions, a higher share of "Do not know" responses appears, indicating room for additional education and clearer risk communication. Respondents' perceptions also suggest that many recognise the possibility of increased violence after disasters and the need for institutional engagement in prevention.

Table 3. Frequencies of categorical dependent variables (P12–P25).

Variable	n (valid)	Yes (%)	No (%)	Do not know (%)
Have you ever heard of the term natural disaster?	105	104 (99,0%)	0 (0,0%)	1 (1,0%)
Have you heard of the term gender-based violence?	105	94 (89,5%)	8 (7,6%)	3 (2,9%)
Do you think women are more exposed to violence than men after the outbreak of a natural disaster?	104	51 (49,0%)	37 (35,6%)	16 (15,4%)
Are you aware that natural disasters can increase aggression in partner relationships?	104	59 (56,7%)	41 (39,4%)	4 (3,8%)
Did you know that violence includes physical, sexual, and emotional violence?	105	101 (96,2%)	4 (3,8%)	0 (0,0%)
Do you think gender-based violence increases after a natural disaster?	104	48 (46,2%)	32 (30,8%)	24 (23,1%)
Do you agree that there is a considerable correlation between natural disasters and violence?	104	51 (49,0%)	19 (18,3%)	34 (32,7%)
Are you aware that during the COVID-19 pandemic, there was an increase in domestic violence, according to the emergency medical service report?	105	71 (67,6%)	32 (30,5%)	2 (1,9%)
Did you know that one in three women is a victim of gender-based violence in the EU?	105	31 (29,5%)	63 (60,0%)	11 (10,5%)
Are you aware that gender-based violence is a health and social problem?	105	83 (79,0%)	17 (16,2%)	5 (4,8%)
Do you think natural disasters may occur in your surroundings?	105	68 (64,8%)	16 (15,2%)	21 (20,0%)
Are you sure you feel ready to help a person who finds themselves at the site of a natural disaster?	105	79 (75,2%)	16 (15,2%)	10 (9,5%)
Would you volunteer in the event of a natural disaster in your country?	104	85 (81,7%)	7 (6,7%)	12 (11,5%)
Do you feel ready to attend educational programmes aimed at preventing gender-based violence after a natural disaster?	105	75 (71,4%)	17 (16,2%)	13 (12,4%)

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Pearson correlation analysis among Likert attitudes indicates mostly weak to moderate positive associations (Table 4). The strongest relationship is between the statements "Additional education about the COVID-19 pandemic can mitigate consequences after a natural disaster," and "Natural disasters can become a major cause of post-traumatic stress disorder and substantially affect people's mental health." ($r = 0.40$, $p<0.001$). This suggests that respondents who more strongly support education also more strongly recognise mental-health impacts. Other correlations are lower but generally positive, indicating partially aligned perceptions across the measured dimensions.

Table 4. Pearson correlation matrix for Likert dependent variables (P26–P30).

Variable	1	2	3	4	5
1. Additional education about the COVID-19 pandemic can mitigate consequences after a natural disaster.	—				
2. Natural disasters can become a major cause of post-traumatic stress disorder and substantially affect people's mental health.	0,40***	—			
3. If I notice that violence has occurred in communities affected by a natural disaster, I would know how to respond correctly and appropriately.	0,15	0,20*	—		
4. Competent authorities/services play an important role in preventing and eliminating phenomena such as violence against women, girls, and older persons.	0,26**	0,25*	0,10	—	
5. A large part of the population of the Republic of Serbia does not have adequate knowledge about the potential consequences that may occur after a natural disaster.	0,15	0,09	-0,01	0,27**	—

Chi-square tests of independence examined associations between categorical dependent variables (P12–P25) and key sociodemographic independent variables (gender, age, education, income, employment status, and marital status). In total, 84 relationships (14×6) were tested, of which 16 were statistically significant ($p<0.05$). Effect sizes in most significant findings were small to moderate (Cramer's $V\approx0.22–0.36$).

The most consistent pattern was as follows: gender was significantly associated with several indicators of knowledge and perception (e.g., awareness that natural disasters may increase aggression in partner relationships, awareness of increased domestic violence during COVID-19, and the per-

ceived association between natural disasters and violence), with moderate effects (Cramer's V≈0.30–0.36). Income was significantly associated with perceptions that women are more exposed to violence after disasters, with perceptions that gender-based violence increases after disasters, and with perceptions that natural disasters may occur in one's surroundings (V≈0.23–0.27). Age and marital status were associated with the perceived correlation between natural disasters and violence, as well as with knowledge that "one in three women" experiences gender-based violence in the EU (V≈0.22–0.25). Education and marital status showed significant associations with willingness to volunteer in the event of a natural disaster (V≈0.25–0.27). In contrast, employment status was associated with willingness to attend educational programmes (V≈0.30).

Table 5. Chi-square tests of independence for categorical dependent variables (P12–P25) in relation to sociodemographic independent variables.

Dependent variable	Independent variable	n	χ^2 (df)	p	Cramer's V
Have you ever heard of the term natural disaster?	Gender	104	0,00 (1)	0,954	0,01
	Age	104	0,61 (2)	0,739	0,08
	Education	105	1,03 (2)	0,598	0,10
	Income	104	2,74 (2)	0,254	0,16
	Employment status	105	0,03 (1)	0,869	0,02
	Marital status	105	0,76 (2)	0,685	0,08
Have you heard of the term gender-based violence?	Gender	104	0,52 (2)	0,773	0,07
	Age	104	2,67 (4)	0,615	0,11
	Education	105	4,70 (4)	0,320	0,15
	Income	104	1,46 (4)	0,834	0,08
	Employment status	105	0,17 (2)	0,918	0,04
	Marital status	105	2,53 (4)	0,640	0,11
Do you think women are more exposed to violence than men after the outbreak of a natural disaster?	Gender	103	15,28 (2)	<0,001	0,39
	Age	103	6,65 (4)	0,156	0,18
	Education	104	5,38 (4)	0,251	0,16
	Income	103	15,25 (4)	0,004	0,27
	Employment status	104	1,37 (2)	0,503	0,11
	Marital status	104	3,70 (4)	0,448	0,13

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Are you aware that natural disasters can increase aggression in partner relationships?	Gender	103	9,29 (2)	0,010	0,30
	Age	103	7,45 (4)	0,114	0,19
	Education	104	2,93 (4)	0,569	0,12
	Income	103	6,44 (4)	0,169	0,18
	Employment status	104	5,88 (2)	0,053	0,24
	Marital status	104	7,90 (4)	0,095	0,19
Did you know that violence includes physical, sexual, and emotional violence?	Gender	104	0,15 (1)	0,694	0,04
	Age	104	1,52 (2)	0,469	0,12
	Education	105	1,46 (2)	0,481	0,12
	Income	104	3,43 (2)	0,180	0,18
	Employment status	105	0,00 (1)	1,000	0,00
	Marital status	105	0,39 (2)	0,823	0,06
Do you think gender-based violence increases after a natural disaster?	Gender	103	11,92 (2)	0,003	0,34
	Age	103	4,20 (4)	0,380	0,14
	Education	104	9,51 (4)	0,050	0,21
	Income	103	11,20 (4)	0,024	0,23
	Employment status	104	1,45 (2)	0,485	0,12
	Marital status	104	7,90 (4)	0,095	0,19
Do you agree that there is a considerable correlation between natural disasters and violence?	Gender	103	13,65 (2)	0,001	0,36
	Age	103	10,56 (4)	0,032	0,23
	Education	104	6,17 (4)	0,187	0,17
	Income	103	7,08 (4)	0,132	0,19
	Employment status	104	1,36 (2)	0,507	0,11
	Marital status	104	10,62 (4)	0,031	0,23
Are you aware that during the COVID-19 pandemic, there was an increase in domestic violence, according to the emergency medical service report?	Gender	104	11,91 (2)	0,003	0,34
	Age	104	3,48 (4)	0,481	0,13
	Education	105	8,94 (4)	0,063	0,21
	Income	104	1,69 (4)	0,792	0,09
	Employment status	105	0,40 (2)	0,819	0,06
	Marital status	105	3,24 (4)	0,519	0,12
Did you know that one in three women is a victim of gender-based violence in the EU?	Gender	104	3,54 (2)	0,171	0,18
	Age	104	12,54 (4)	0,014	0,25
	Education	105	7,22 (4)	0,125	0,19
	Income	104	4,51 (4)	0,341	0,15
	Employment status	105	2,01 (2)	0,366	0,14
	Marital status	105	9,90 (4)	0,042	0,22

Are you aware that gender-based violence is a health and social problem?	Gender	104	5,14 (2)	0,076	0,22
	Age	104	1,34 (4)	0,855	0,08
	Education	105	1,08 (4)	0,898	0,07
	Income	104	4,73 (4)	0,317	0,15
	Employment status	105	1,06 (2)	0,588	0,10
	Marital status	105	3,03 (4)	0,553	0,12
Do you think natural disasters may occur in your surroundings?	Gender	104	0,71 (2)	0,702	0,08
	Age	104	3,48 (4)	0,481	0,13
	Education	105	5,22 (4)	0,265	0,16
	Income	104	11,56 (4)	0,021	0,24
	Employment status	105	6,24 (2)	0,044	0,24
	Marital status	105	1,63 (4)	0,803	0,09
Are you sure you feel ready to help a person who finds themselves at the site of a natural disaster?	Gender	104	10,38 (2)	0,006	0,32
	Age	104	3,26 (4)	0,515	0,13
	Education	105	1,30 (4)	0,861	0,08
	Income	104	2,37 (4)	0,669	0,11
	Employment status	105	0,51 (2)	0,775	0,07
	Marital status	105	7,50 (4)	0,112	0,19
Would you volunteer in the event of a natural disaster in your country?	Gender	103	2,87 (2)	0,238	0,17
	Age	103	20,17 (4)	<0,001	0,31
	Education	104	12,65 (4)	0,013	0,25
	Income	103	1,41 (4)	0,843	0,08
	Employment status	104	0,60 (2)	0,743	0,08
	Marital status	104	14,81 (4)	0,005	0,27
Do you feel ready to attend educational programmes aimed at preventing gender-based violence after a natural disaster?	Gender	104	1,82 (2)	0,403	0,13
	Age	104	1,97 (4)	0,741	0,10
	Education	105	2,04 (4)	0,728	0,10
	Income	104	3,63 (4)	0,458	0,13
	Employment status	105	9,37 (2)	0,009	0,30
	Marital status	105	5,79 (4)	0,215	0,17

One-way ANOVA examined differences in mean ratings of Likert dependent variables (P26–P30) across sociodemographic groups. Out of 30 tested effects (5×6), significant differences were found in 2 cases ($p<0.05$), with small to moderate effect sizes ($\eta^2=0.055–0.085$). Specifically, significant findings were obtained for the item on PTSD/mental-health impacts by gender and for the item on responding to violence in disaster-affected communities by income group.

Table 6. One-way ANOVA for Likert dependent variables (P26–P30) in relation to sociodemographic independent variables.

Dependent variable	Independent variable	n	F (df1,df2)	p	η^2
Additional education about the COVID-19 pandemic can mitigate consequences after a natural disaster.	Gender	104	3,44 (1,102)	0,066	0,033
	Age	104	2,47 (2,101)	0,089	0,047
	Education	105	2,63 (2,102)	0,077	0,049
	Income	104	1,12 (2,101)	0,330	0,022
	Employment status	105	1,20 (1,103)	0,275	0,012
	Marital status	105	2,58 (2,102)	0,080	0,048
Disasters can become a major cause of post-traumatic stress disorder and substantially affect people's mental health.	Gender	104	5,89 (1,102)	0,017	0,055
	Age	104	0,54 (2,101)	0,582	0,011
	Education	105	1,52 (2,102)	0,223	0,029
	Income	104	2,08 (2,101)	0,131	0,040
	Employment status	105	1,02 (1,103)	0,315	0,010
	Marital status	105	0,38 (2,102)	0,686	0,007
If I notice that violence has occurred in communities affected by a natural disaster, I would know how to respond appropriately.	Gender	104	0,44 (1,102)	0,511	0,004
	Age	104	0,60 (2,101)	0,550	0,012
	Education	105	0,06 (2,102)	0,940	0,001
	Income	104	4,66 (2,101)	0,012	0,085
	Employment status	105	1,17 (1,103)	0,281	0,011
	Marital status	105	0,62 (2,102)	0,540	0,012
Competent authorities/services play an important role in preventing and eliminating phenomena such as violence against women, girls, and older persons.	Gender	104	0,01 (1,102)	0,942	0,000
	Age	104	2,75 (2,101)	0,069	0,052
	Education	105	0,28 (2,102)	0,754	0,006
	Income	104	1,70 (2,101)	0,188	0,033
	Employment status	105	0,54 (1,103)	0,465	0,005
	Marital status	105	1,10 (2,102)	0,336	0,021
A large part of the population of the Republic of Serbia lacks adequate knowledge of the potential consequences of a natural disaster.	Gender	104	2,24 (1,102)	0,138	0,021
	Age	104	0,55 (2,101)	0,579	0,011
	Education	105	0,22 (2,102)	0,803	0,004
	Income	104	0,64 (2,101)	0,529	0,013
	Employment status	105	0,63 (1,103)	0,429	0,006
	Marital status	105	0,36 (2,102)	0,699	0,007

Multiple linear regression indicates that the set of sociodemographic predictors explains 15.1% of the variance in ratings for the item "Natural

disasters can become a major cause of post-traumatic stress disorder and substantially affect people's mental health." (R^2=0.151, adjusted R^2=0.060, F(10,93)=1.66, p = 0.103; n = 104). The most notable predictor is gender (male vs. female) (B=-0.46, p = 0.022), which is associated with a lower average rating. In addition, the 27–37 age group (vs. 18–27) appears as a significant predictor in this model, while other predictors do not reach conventional significance levels.

Table 7. Multiple linear regression: dependent variable – Disasters can become a major cause of post-traumatic stress disorder and substantially affect people's mental health.

Predictor	B	SE	β	t	p
Gender: male (ref.=female)	-0,46	0,20	-0,24	-2,33	0,022
Age: 27–37 (ref.=18–27)	0,53	0,24	0,24	2,19	0,031
Age: 37+ (ref.=18–27)	0,35	0,60	0,13	0,58	0,566
Education: higher/university (ref.=secondary school)	-0,41	0,24	-0,22	-1,75	0,083
Education: postgraduate (ref.=secondary school)	-0,20	0,28	-0,09	-0,74	0,464
Income: 80,000–100,000 (ref.=≤80,000)	0,07	0,25	0,03	0,28	0,781
Income: >100,000 (ref.=≤80,000)	-0,18	0,23	-0,09	-0,78	0,435
Employment status: employed (ref.=unemployed)	-0,11	0,19	-0,06	-0,58	0,561
Marital status: married (ref.=single)	-0,27	0,58	-0,10	-0,46	0,645
Marital status: other (ref.=single)	0,15	0,22	0,07	0,68	0,496

Note. B – unstandardised coefficient; SE – standard error; β – standardised coefficient; t – t-statistic; p – significance level. Model: n=104, R^2=0.151, adjusted R^2=0.060, F(10,93)=1.66, p=0.103. Reference categories are indicated in the predictor descriptions.

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Multiple linear regression indicates that the set of sociodemographic predictors explains 12.3% of the variance in ratings for the item "If I notice that violence has occurred in communities affected by a natural disaster, I would know how to respond correctly and appropriately." (R^2=0.123, adjusted R^2=0.027, F(10,93)=1.28, p=0.250; n=104). Overall model fit is limited, and only a small number of predictors make noteworthy contributions, suggesting that experiential and situational factors may more strongly shape readiness to respond than basic sociodemographics.

Table 8. Multiple linear regression: dependent variable – If I notice that violence has occurred in a community affected by a natural disaster, I would know how to respond appropriately.

Predictor	B	SE	β	t	p
Gender: male (ref.=female)	0,15	0,19	0,08	0,78	0,435
Age: 27–37 (ref.=18–27)	0,22	0,23	0,10	0,94	0,352
Age: 37+ (ref.=18–27)	-0,24	0,58	-0,09	-0,41	0,679
Education: higher/university (ref.=secondary school)	-0,05	0,23	-0,03	-0,24	0,814
Education: postgraduate (ref.=secondary school)	0,07	0,27	0,03	0,25	0,807
Income: 80,000–100,000 (ref.=≤80,000)	-0,08	0,24	-0,04	-0,31	0,760
Income: >100,000 (ref.=≤80,000)	-0,60	0,22	-0,34	-2,74	0,007
Employment status: employed (ref.=unemployed)	-0,06	0,19	-0,03	-0,31	0,759
Marital status: married (ref.=single)	0,37	0,56	0,14	0,66	0,510
Marital status: other (ref.=single)	-0,08	0,22	-0,04	-0,37	0,709

Note. B – unstandardised coefficient; SE – standard error; β – standardised coefficient; t – t-statistic; p – significance level. Model: n=104, R^2=0.123, adjusted R^2=0.028, F(10,93)=1.30, p=0.242. Reference categories are indicated in the predictor descriptions.

Multiple linear regression indicates that the set of sociodemographic predictors explains 15.3% of the variance in ratings for the item "Competent authorities/services play an important role in preventing and eliminating phenomena such as violence against women, girls, and older persons." (R^2=0.153, adjusted R^2=0.062, F(10,93)=1.68, p=0.096; n=104). The model shows limited overall explanatory power, with only some predictors showing modest effects. This pattern again underscores the importance of contextual determinants such as institutional trust, prior experience, and exposure to information.

Table 9. Multiple linear regression: dependent variable – Competent authorities/services play an important role in preventing and eliminating violence against women, girls, and older persons.

Predictor	B	SE	β	t	p
Gender: male (ref.=female)	0,00	0,19	0,00	0,02	0,982
Age: 27–37 (ref.=18–27)	0,07	0,24	0,03	0,30	0,765
Age: 37+ (ref.=18–27)	1,68	0,59	0,62	2,84	0,006
Education: higher/university (ref.=secondary school)	0,26	0,23	0,14	1,13	0,260

Education: postgraduate (ref.=secondary school)	0,14	0,27	0,06	0,53	0,600
Income: 80,000–100,000 (ref.=≤80,000)	-0,13	0,25	-0,06	-0,50	0,616
Income: >100,000 (ref.=≤80,000)	-0,49	0,22	-0,26	-2,17	0,033
Employment status: employed (ref.=unemployed)	0,21	0,19	0,11	1,09	0,277
Marital status: married (ref.=single)	-1,13	0,57	-0,43	-2,00	0,048
Marital status: other (ref.=single)	-0,33	0,22	-0,16	-1,51	0,133

Note. B – unstandardised coefficient; SE – standard error; β – standardised coefficient; t – t-statistic; p – significance level. Model: n=104, R^2=0.153, adjusted R^2=0.062, F(10,93)=1.68, p=0.097. Reference categories are indicated in the predictor descriptions.

Multiple linear regression for the item "A large part of the population of the Republic of Serbia does not possess adequate knowledge…" indicates that sociodemographic predictors explain a limited share of variance. This suggests that perceptions of population-level preparedness and knowledge may be shaped more strongly by broader societal narratives, media exposure, and general trust in institutions than by respondents' individual sociodemographic characteristics alone.

Table 10. Multiple linear regression: dependent variable – A large part of the population of Serbia does not possess adequate knowledge about potential consequences after a disaster.

Predictor	B	SE	β	t	p
Gender: male (ref.=female)	-0,24	0,15	-0,17	-1,55	0,124
Age: 27–37 (ref.=18–27)	0,18	0,19	0,11	0,95	0,345
Age: 37+ (ref.=18–27)	0,38	0,47	0,19	0,81	0,422
Education: higher/university (ref.=secondary school)	-0,02	0,19	-0,01	-0,10	0,918
Education: postgraduate (ref.=secondary school)	0,09	0,22	0,05	0,41	0,680
Income: 80,000–100,000 (ref.=≤80,000)	-0,22	0,20	-0,14	-1,12	0,268
Income: >100,000 (ref.=≤80,000)	-0,12	0,18	-0,09	-0,70	0,487
Employment status: employed (ref.=unemployed)	-0,09	0,15	-0,07	-0,61	0,542
Marital status: married (ref.=single)	-0,17	0,45	-0,09	-0,38	0,703
Marital status: other (ref.=single)	-0,03	0,18	-0,02	-0,19	0,847

Note. B – unstandardised coefficient; SE – standard error; β – standardised coefficient; t – t-statistic; p – significance level. Model: n=104, R^2=0.058, adjusted R^2=–0.043, F(10,93)=0.57, p=0.831. Reference categories are indicated in the predictor descriptions.

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4. Discussion

This study confirms that respondents recognize that disasters cause not only material damage but also secondary psychosocial effects that can heighten the risks of conflict, deviant behavior, and violence in communities. This perception aligns with the fact that disasters provoke sudden changes in living conditions—such as income loss, routine disruptions, displacement, and limited access to services (Chan, 2017; Gousse-Lessard et al., 2022; Kiran et al., 2020; Yofrido & Harjana, 2019). These changes can increase stress and diminish capacities for self-control and social support, especially within families and close relationships (Cerna-Turoff, Fischer, Mayhew, & Devries, 2019; Chan & Zhang, 2011; Molyneaux et al., 2019; Sheikhi et al., 2025; Weitzman & Behrman, 2016).

Nevertheless, the two significant findings are theoretically and practically relevant. First, a gender difference was found for the attitude that natural disasters can be a major reason for the occurrence of post-traumatic stress disorder and deterioration of mental health. This can be interpreted through differences in: (a) recognising and verbalising psychological consequences; (b) gender-conditioned roles and burdens during crises (care for children, older persons, household responsibilities); and (c) greater exposure to gender-based risks and "invisible" forms of violence when support systems are disrupted (Czepiel et al., 2024).

Second, a significant difference by income appears in respondents' attitudes toward how they would react if they noticed violence in communities affected by a disaster. This finding can be interpreted through the concept of self-efficacy and access to resources: higher income is often associated with better access to information, support networks, and insti-tutions, as well as a stronger sense of personal control and knowledge of procedures (whom to report to, how to react safely)(Johnston, Kung, & Shields, 2021; Rhodes et al., 2010).

An opportunity to leverage this readiness to target interventions that address the specific operational gaps in the population's understanding of post-disaster protocols (Cerchiello, Ceresa, & Monteiro, 2017). This readiness highlights a critical entry point for authorities to design and implement training modules that specifically bridge the gap between general awareness and practical application of safety measures. At the same time, lower income may be associated with greater exposure to stressors and less trust that reporting violence leads to effective protection mechanisms, particularly in contexts where social safety nets are less robust (Cerna-Turoff, Fischer, Mansourian, & Mayhew, 2021). These interventions should therefore go beyond general awareness to equip individuals with concrete skills for identifying risks, reporting incidents, and accessing support services (Reddy & Goodman, 2019).

The regression analysis also provided valuable insight regarding the attitude that "a large part of the population lacks adequate knowledge," which was not statistically significant. This indicates that demographics alone do not explain perceptions of insufficient knowledge (Chan, 2017; Johnston, Kung, & Shields, 2021; Rhodes et al., 2010), and that other factors—such as prior disaster experience, awareness levels, trust in institutions, media exposure, and participation in preparedness programs (Johnston, Kung, & Shields, 2021; Molyneaux et al., 2019; Reddy & Goodman, 2019; Weitzman & Behrman, 2016)—likely play a more important role, even though they were not included in the model. This highlights a key area for future research: rather than adding more demographic variables, it seems more beneficial to incorporate indicators related to experience, knowledge, and engagement in preparedness activities (Johnston, Kung, & Shields, 2021; Molyneaux et al., 2019; Rhodes et al., 2010; Weitzman & Behrman, 2016).

The findings suggest that a notable portion of respondents are willing to attend educational programs aimed at preventing gender-based violence after disasters. This presents a valuable opportunity for prevention: developing short, repeatable, and well-structured programs—whether in schools, local communities, workplaces, or online—that go beyond general messages to teach concrete actions such as recognizing violence, responding safely, reporting incidents, and accessing services and support. Such efforts can strengthen community resilience and reduce the risk of a crisis triggering violence or secondary victimization (Cvetković et al., 2025; Cvetković, Nikolić, & Lukić, 2024; Cvetković & Martinović, 2020; Ivanov & Cvetković, n.d.; Renner, Cvetković, & Lieftenegger, 2025). Additionally, incorporating gender-sensitive approaches into training curricula is crucial, as research shows women often report lower confidence in preparedness despite engaging in more household safety behaviors, while men perceive themselves as more prepared and actively involved in the community (Cvetković, Roder, Öcal, Tarolli, & Dragićević, 2018). Therefore, educational efforts should aim to empower women, educate men, and foster cooperation to challenge gender stereotypes and strengthen household and community resilience (Cvetković & Ivković, 2022; Cvetković, Roder, Öcal, Tarolli, & Dragićević, 2018).

5. Conclusion

This study showed that citizens, to a considerable extent, recognise that disasters may be accompanied by an increase in psychosocial risks and deviant behaviour, and that there is a pronounced perception of insufficient awareness and knowledge about potential post-disaster consequences. This finding indicates that prevention in non-crisis periods is critical: without

continuous education and clear response protocols, the risk of incorrect reactions, increased conflict, and violence may be higher when everyday life is disrupted. Analyses of differences and predictors suggest that, overall, sociodemographic characteristics have limited explanatory power for attitudes. ANOVA identified only two significant effects out of 30 tested, suggesting that attitudes are more shaped by factors such as experience, information, exposure to education, and self-efficacy than by gender, age, or education as isolated categories. In addition, the regression model for the assessment that "citizens do not have adequate knowledge" did not identify significant demographic predictors, strengthening the need for future studies to include variables measuring knowledge, experience, and educational exposure. From a practical perspective, the findings support recommendations from the master's thesis that it is necessary to design and implement new programmes for "developing and raising awareness" among citizens of all generations, through social-media campaigns, programmes in schools and universities, as well as periodic trainings/lectures (e.g., every six months) in the public and private sectors.

These programmes must be linked to concrete procedures: what citizens should do when they notice violence in the community after a disaster, whom they should report to, how inter-institutional coordination works, and what support is available to victims. Overall, the paper indicates that the following are key to reducing the risk of deviant behaviour after disasters: (1) systematic education and risk communication, (2) clear mechanisms for reporting and responding to violence in crisis conditions, and (3) strengthening the role of institutions through coordination and visible support measures. Such an orientation can contribute not only to reducing the consequences of disasters but also to strengthening community resilience through better preparedness, greater trust, and more effective prevention of violence escalation under crisis conditions.

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Appendix A. Survey questionnaire – Examining factors of disaster impact on the increase of deviant behaviour among people

Instructions for respondents: Please circle one answer for each question, unless otherwise stated. The questionnaire is anonymous, and the collected data will be used exclusively for scientific purposes.

A) Sociodemographic data

1. Gender:
   a) Male b) Female c) Prefer not to say
2. Age (in years):
   a) 18–27 b) 27–37 c) 37–50 d) 50–60 e) Over 60
3. Highest completed level of education:
   a) Primary school
   b) Three-year secondary school
   c) Four-year secondary school
   d) Higher education (college)
   e) University education
   f) Master's studies
   g) Doctoral studies
4. Highest completed level of father's education:
   a) Incomplete primary school
   b) Three-year secondary school
   c) Four-year secondary school
   d) Higher education (college)
   e) University education
   f) Master's studies
   g) Doctoral studies

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5. Highest completed level of mother's education:
   a) Incomplete primary school
   b) Three-year secondary school
   c) Four-year secondary school
   d) Higher education (college)
   e) University education
   f) Master's studies
   g) Doctoral studies
6. Marital status:
   a) Single (unmarried)
   b) Married
   c) Divorced
   d) Engaged
   e) Widowed
7. Household size (total number of members):
   a) 1 member b) 2 members c) 3 members d) 4 members e) 5 members f) More than 5 members
8. Approximate monthly household income (RSD):
   a) Up to 30,000
   b) 30,000–50,000
   c) 50,000–80,000
   d) 80,000–100,000
   e) More than 100,000
9. Employment status:
   a) Employed b) Unemployed
10. Occupation (closest to yours):
    a) Student
    b) Craft worker/related occupation
    c) Service or retail occupation
    d) Administrative staff/Technician or associate professional
    e) Self-employed entrepreneur
    f) Manager
    g) Professional/Artist
    h) Other

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11. Number of employed household members:
    a) 1 b) 2 c) 3 d) 4 e) More than 4

B) Awareness, perceptions, and readiness

(circle: Yes / No / Do not know)

12. Have you ever heard of the term natural disaster?
    Yes / No / Do not know
13. Have you heard of the term gender-based violence?
    Yes / No / Do not know
14. Do you think women are more exposed to violence than men after the outbreak of a natural disaster?
    Yes / No / Do not know
15. Are you aware that natural disasters can increase aggression in partner relationships?
    Yes / No / Do not know
16. Did you know that forms of violence include physical, sexual, and emotional violence?
    Yes / No / Do not know
17. Do you think gender-based violence increases after a natural disaster?
    Yes / No / Do not know
18. Do you agree that there is a significant association between natural disasters and violence?
    Yes / No / Do not know
19. Are you aware of the claim that during the COVID-19 pandemic, there was an increase in reports/calls related to domestic violence?
    Yes / No / Do not know
20. Did you know that "one in three women" is a victim of gender-based violence in the EU?
    Yes / No / Do not know
21. Are you aware that gender-based violence is a health and social problem?
    Yes / No / Do not know
22. Do you think natural disasters may occur in your surroundings?
    Yes / No / Do not know

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23. Do you feel ready to help a person who finds themselves at the site of a natural disaster?
    Yes / No / Do not know

24. Would you volunteer in the event of a natural disaster in Serbia?
    Yes / No / Do not know

25. Do you feel ready to attend educational programmes aimed at preventing gender-based violence after a natural disaster?
    Yes / No / Do not know

C) Attitudes

(Likert scale – circle one number for each statement)

Scale (circle a number):

1 = Strongly disagree | 2 = Disagree
| 3 = Neither agree nor disagree | 4 = Agree | 5 = Strongly agree

26. Additional education about the COVID-19 pandemic can mitigate consequences after a natural disaster.
    1 2 3 4 5

27. Natural disasters can contribute to the development of post-traumatic reactions and significantly affect people's mental health.
    1 2 3 4 5

28. If I notice that violence has occurred in a community affected by a natural disaster, I would know how to respond correctly and appropriately.
    1 2 3 4 5

29. Competent authorities/services have an important role in preventing and suppressing violence against women, girls, and older persons.
    1 2 3 4 5

30. A significant share of citizens of the Republic of Serbia does not have sufficient knowledge and awareness of potential consequences after a natural disaster.
    1 2 3 4 5

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Review

An Integrated Risk Management Algorithm for Economic Catastrophes: From Exogenous Shocks to Endogenous Vulnerabilities

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Abstract

Modern economic catastrophes are increasingly driven by the endogenous accumulation of risk rather than by isolated exogenous shocks. Although natural disasters, financial crises, and trade disruptions continue to act as triggers, their economic impact is largely determined by structural conditions that evolve gradually and rupture under stress. This paper develops an integrated risk management algorithm that conceptualizes catastrophe risk as a dynamic and systemic process rather than a discrete event. Building on a four-layer framework – hazards, exposure, vulnerability, and resilience – the study synthesizes insights from disaster economics, systemic risk theory, and the literature on global trade fragmentation to propose a transferable analytical architecture applicable across economic domains. Time dynamics and governance quality are introduced as cross-cutting dimensions that shape the transmission, amplification, and mitigation of shocks. Instead of aiming at deterministic crisis prediction, the algorithm enables continuous monitoring of slow-forming structural fault lines, interaction effects, and potential threshold points. The paper is designed as a conceptual review and methodological synthesis that demonstrates how integrated risk assessment can support proactive economic governance. Adaptive policy instruments, technological upgrading, diversification, and institutional coordination are interpreted as

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protective layers that deepen systemic resilience and reduce the probability of catastrophic outcomes. By shifting the analytical focus from ex post crisis response toward structured foresight and resilience-oriented policy design, the framework contributes to contemporary debates on stability in an increasingly fragmented global economy. The proposed algorithm provides a flexible foundation for future empirical modeling and cross-sectoral applications.

Keywords

Integrated risk management; economic catastrophes; systemic risk; resilience; global fragmentation

7. Introduction

Economic catastrophes are increasingly the result of risks that accumulate endogenously within economic systems rather than the direct consequence of isolated exogenous shocks. Global financial crises, pandemic-induced supply disruptions, energy price volatility, and climate-related disturbances demonstrate a common pattern: similar external pressures generate profoundly different economic outcomes across countries and regions. This asymmetry suggests that the magnitude of disruption is determined less by the shock itself than by the structural depth of the system it encounters. In this perspective, catastrophe represents the visible rupture of slow-forming systemic fault lines.

The dominant economic and policy literature has long conceptualized crises as discrete, rare, and largely external events that temporarily displace otherwise stable systems. From early analyses of macroeconomic volatility to influential historical studies of financial crises, the analytical focus has been placed on identifying the origin of disturbance and estimating its impact on output, employment, and financial stability (Lucas, 1987; Reinhart & Rogoff, 2009). Within this framework, risk appears as an exogenous force acting upon a fundamentally equilibrating economy.

In parallel, the risk management tradition – particularly in finance and corporate governance – has developed sophisticated instruments for measuring exposure, pricing uncertainty, building buffers against volatility, and finance resilience (Knight, 1921; Taleb, 2007; OECD, 2008; OECD, 2021). This direction of risk management is accompanied by a growing number of initiatives that have been developed to invest in disaster and climate change preparedness and prevention (Simpson et al., 2021; Mechler et al., 2016; Kreimer & Arnold, 2000; Mahefasoa et al., 2022). Yet these approaches remain predominantly static and outcome-oriented. They are designed to minimize losses once volatility materializes rather than to trace the dynamic processes

through which vulnerability is produced, deepened, and transmitted across sectors and over time.

A different analytical shift emerges in the resilience and complex systems literature, where economies are understood as adaptive, path-dependent structures characterized by non-linearity, multiple equilibria, and institutional co-evolution (Arthur, 1994; Rodrik, 2011). The focus moves from shocks to system architecture – toward diversification, technological capability, governance quality, and policy coordination as determinants of how disturbances propagate (Williams, 2011). Similarly, global risk assessments emphasize cascading and interconnected crises rather than isolated events (WEF, 2023).

However, even within this dynamic tradition a critical gap remains. The literature provides powerful diagnostic concepts – fragility, tipping points, black swans, resilience – but offers limited operational methodologies for observing how structural weaknesses and external pressures co-evolve in real time. We have rich descriptions of systemic fault lines, but no analytical workflow for mapping their formation, depth, and interaction (Chernov & Sornette, 2020).

This paper positions economic disasters not as shocks but as the visible rupture of long-forming systemic fault lines. What is missing in the existing body of work is a methodological architecture capable of capturing this slow-moving process – linking endogenous policy depth with the changing topology of external pressures.

The central objective of the paper is to develop an integrated analytical algorithm for economic catastrophes that conceptualizes catastrophe risk as a dynamic and multi-layered process. Building on the interaction between hazards, exposure, vulnerability, and resilience, and embedding these dimensions within a temporal and governance-oriented framework, the paper proposes a transferable methodological architecture for continuous monitoring and proactive management of systemic risk. The dynamic function $C_t=F(H_t,E_t,V_t,R_t\|G)$ does not aim at deterministic prediction. Instead, it operationalizes continuous monitoring, enabling the identification of slow-building pressures, interaction effects, and potential threshold points.

In this framework, the economy is conceptualized as a developmental path whose depth reflects institutional capacity, technological upgrading, and policy responsibility, while external disturbances constitute shifting lateral pressures. Catastrophe occurs where accumulated structural shallowness meets intensified external stress.

The objective of the paper is therefore to develop an integrated methodological workflow for systemic economic resilience that transforms risk

management from a reactive stabilization tool into a continuous governance function. By synthesizing insights from disaster economics, systemic risk theory, and the literature on global economic fragmentation, the paper contributes a unified conceptual language linking previously disconnected strands of research; also, a dynamic and operational definition of economic catastrophe as a process rather than an event; and finally, a transferable analytical framework for proactive and resilience-oriented economic policy. In doing so, the study responds to the growing need for analytical models capable of supporting economic stability in an era of deep interdependence, structural transformation, and cascading global risks.

The remainder of the paper is structured as follows. Section 2 presents the methodological foundations of the integrated algorithm. Section 3 develops the conceptual interpretation of the model through the interaction of its five components. Section 4 illustrates the functional dynamics of the framework through a comparative analytical mapping. Section 5 discusses policy implications and the broader cross-disciplinary applicability of the proposed approach. The final section is conclusion.

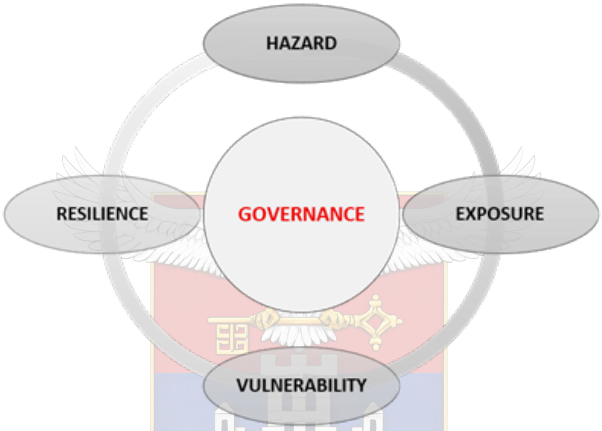
8. Methods

This study adopts a conceptual-analytical research design with an operational methodological framework, combining qualitative synthesis with a structured comparative data architecture. The aim is not to estimate a single empirical model but to develop a reproducible workflow for continuous monitoring of systemic economic catastrophe risk through the dynamic function. Similar to Slotsvik et al. (2025), where they use a 'min-max concept formation strategy' for good disaster risk management practice. In methodological terms, the research follows a theory-building and model-operationalization strategy, where conceptual integration is supported by transparent indicator selection and a replicable analytical sequence (Creswell & Creswell, 2018; Kothari, 2004).

The study is designed as a mixed-methods conceptual review with a structured comparative analytical component. The qualitative dimension synthesizes the literature on disaster economics, systemic risk, resilience, and global economic fragmentation in order to define the functional relationships between hazards, exposure, vulnerability, resilience, and governance. The quantitative-analytical dimension translates these theoretical constructs into measurable proxy indicators, enabling their use in a continuous monitoring framework rather than in a single ex-post evaluation. This approach corresponds to model-based analytical research in which theoretical con-

structs are operationalized through observable variables to allow replication and future empirical testing (Jaccard & Jacoby, 2020). Rather than predicting crises, the paper develops a reproducible analytical workflow that enables their continuous monitoring and governance, transforming economic catastrophe from an unexpected event into a structurally observable process (see Scheme 1).

Scheme 1. Integrated Economic Catastrophe Algorithm as a Recursive Risk-Governance Cycle



Source: Author's Loop

Note: The figure presents the functional flow of the proposed model in which hazards enter the system through existing exposure channels, interact with structural vulnerabilities, and are mediated by resilience capacity, while governance operates as a cross-cutting coordination and adaptation mechanism. The recursive feedback loop transforms realised disturbances into policy learning and structural adjustment, reconfiguring the system for subsequent periods.

While economic catastrophes cannot be fully predicted or prevented, an integrated risk management algorithm enables early identification of systemic vulnerabilities, continuous monitoring of exposure, and the design of adaptive policy layers that significantly reduce the likelihood and severity of catastrophic outcomes. Put another way, the algorithm does not predict catastrophes, it identifies where and how they may emerge.

The empirical architecture relies exclusively on secondary data from internationally harmonized and publicly available macro-structural databases. These include global datasets covering macroeconomic stability, trade integration, sectoral structure, institutional quality, financial development, energy dependence, and technological capacity. The use of internationally

standardized sources ensures cross-country comparability and longitudinal consistency, which are essential for systemic risk analysis (WB, 2022; IMF, 2023; WEF, 2023).

Each component of the function $Ct = F(Ht, Et, Vt, Rt \parallel G)$ is represented through a set of proxy variables:

- Hazard (H) – indicators of external volatility and shock intensity
- Exposure (E) – measures of trade openness, import concentration, financial integration, and energy dependence
- Vulnerability (V) – structural and institutional fragility indicators
- Resilience (R) – fiscal space, policy flexibility, technological capability, and social adaptive capacity
- Governance (G) – coordination quality, regulatory effectiveness, and institutional depth

The analytical framework is designed for cross-country and cross-sectoral application. For demonstrative purposes, the sampling logic follows a comparative purposive strategy, selecting economic systems that differ in structural depth, institutional capacity, and integration into global production networks. This allows the model to capture variation in the interaction between endogenous structural characteristics and exogenous pressures, which is the core mechanism of the proposed algorithm (Flyvbjerg, 2006).

The unit of analysis is the national economic system observed over time, while the time dimension enables the identification of slow-forming structural pressures and threshold effects.

The study relies exclusively on aggregated secondary data from publicly accessible international databases, which contain no personal or confidential information. Consequently, it does not require formal ethical approval. The research follows international standards of data transparency, reproducibility, and proper source attribution in accordance with open science principles (OECD, 2007).

The analytical procedure follows a dashboard-based and process-tracing approach. First, proxy indicators are assigned to each functional component of the model. Second, their evolution over time is examined to identify structural trends and interaction effects. Third, the analysis maps the co-movement between increasing external pressure and changes in structural depth.

The objective is not to aggregate variables into a composite index, but to interpret their dynamic relationships within the functional logic of the model. This corresponds to a systemic risk mapping strategy, where emphasis is placed on transmission channels, feedback loops, and potential threshold

zones rather than on point prediction (Acemoglu et al., 2015; Battiston et al., 2016).

The framework is fully compatible with future econometric implementation. The operational workflow can be implemented in standard statistical environments such as Stata allowing panel-data estimation, network analysis, or early-warning signal detection in subsequent empirical research.

9. Results

9.1. The Changing Nature of Economic Disasters: From Exogenous Shocks to Systemic Fault Lines

Traditional economic crisis analysis has largely been built on the assumption that catastrophic outcomes are triggered by identifiable exogenous shocks – financial crashes, commodity price spikes, natural disasters, or abrupt geopolitical disruptions. In this view, the shock is treated as the primary analytical object, while the structure of the affected economy is considered a passive transmission mechanism. Such an approach proved analytically useful in a world of relatively contained interdependence, where disturbances were episodic and recovery paths were broadly aligned with cyclical adjustment. However, the increasing density of global production networks, financial integration, technological dependence, and energy interconnections has fundamentally altered the anatomy of economic disasters. Contemporary crises rarely emerge as isolated events; instead, they unfold as cascading processes in which multiple disturbances interact with pre-existing structural conditions.

In this new environment, catastrophic outcomes are less the result of the magnitude of a single shock and more the consequence of accumulated systemic stress. Slow-moving processes – such as declining diversification, institutional erosion, persistent external imbalances, technological dependence, demographic pressures, or rising inequality – create latent fault lines within the economic system. These structural weaknesses remain largely invisible during periods of stability but become decisive under conditions of stress, when even moderate external disturbances can trigger disproportionate and non-linear effects. Economic disasters therefore increasingly resemble phase transitions: the visible rupture occurs at a specific moment, but its causes are embedded in long-term structural configurations.

At the same time, the boundary between exogenous and endogenous risk has become progressively blurred. External shocks propagate through trade, financial, energy, and technological networks whose architecture is itself the

outcome of domestic development strategies and policy choices. Exposure is therefore not an exogenous condition but a co-produced structural feature, while vulnerability reflects the depth, quality, and adaptability of the national economic system. This implies that crisis intensity is determined not only by the nature of the disturbance but by the interaction between network position, internal resilience, and governance capacity. As a result, two economies facing the same external shock may experience entirely different trajectories, ranging from rapid adaptation to systemic breakdown.

These transformations reveal the limitations of analytical frameworks that focus exclusively on shock identification or on the ex post measurement of losses. What is required is an integrated perspective capable of capturing the dynamic interaction between hazards, transmission channels, structural sensitivity, and adaptive capacity. The integrated algorithm proposed in this paper responds to this need by shifting the analytical focus from event-based crisis detection to the continuous mapping of systemic risk. By formalising the recursive relationship between hazard, exposure, vulnerability, resilience, and governance, the framework makes it possible to interpret economic disasters not as isolated disruptions but as the realisation of stresses accumulated along structural fault lines. In doing so, it provides a coherent analytical bridge between crisis theory, resilience economics, and risk governance, and establishes the basis for a process-oriented approach to prevention, absorption, and transformation.

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9.1.1. Sub-subsections

Use further subdivisions if needed to clarify complex findings.

- **Bullet points** can be used for highlighting specific observations.
- **Numbered lists** are useful for stepwise descriptions.

Numbered lists can be added as follows:

1. First item
2. Second item
3. Third item

9.2. Figures, Tables, and Schemes

Figure 1, Table 1, etc.

Figure 1. This is a figure. Captions/titles should be placed **below the figure** (not above).

Table 1. This is a table. Tables should be placed in the main text near the first time they are cited.

Title 1	Title 2	Title 3
entry 1	data	data
entry 2	data	data [1]

[1] Tables may have a footer.

10. Discussion

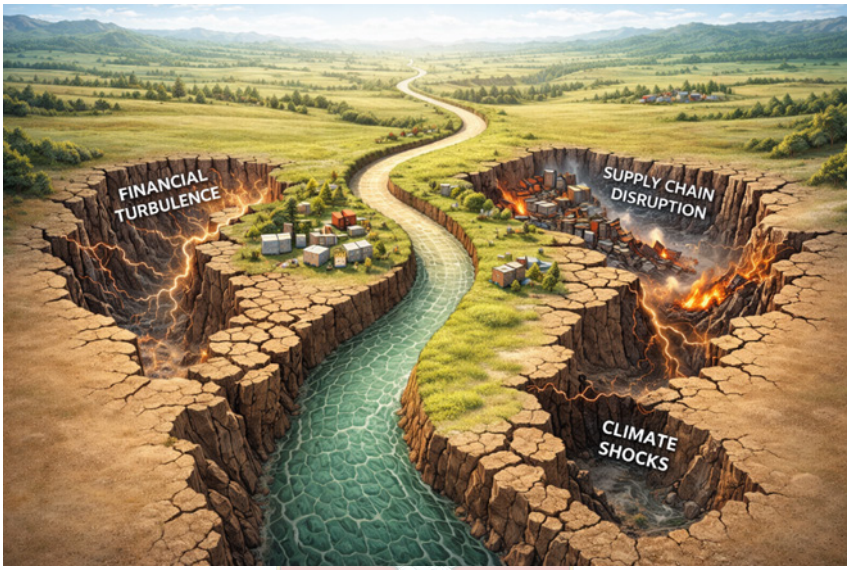
10.1. Conceptual Interpretation: Economic Catastrophes as Dynamic System Failures Along Structural Fault Lines

The proposed framework interprets the economy as a moving developmental path carved into a landscape of interacting pressures, where the depth, coherence, and direction of the path reflect the quality of structural transformation and governance (Image 1). Economic catastrophes do not appear as sudden breaks on a flat surface; they occur where this path becomes shallow, fragmented, or poorly coordinated, and where surrounding external pressures – represented as fault channels – intensify. In this sense, crises are not isolated events but moments when accumulated tensions exceed the structural depth of the system. This interpretation draws on systems thinking (Meadows, 2008) and the adaptive-cycle logic (Gunderson & Holling, 2002), where visible disruption is the outcome of long-term interactions between internal structure and external disturbance.

10.1.1. Hazard: The Pressure Flowing Through the Fault Channels

In the visual metaphor, hazards are not the cracks themselves but the forces flowing through the surrounding channels – financial volatility, geopolitical tensions, supply-chain disruptions, technological shifts, climate events. Their depth and width vary over time, reflecting the intensity of global turbulence. However, their destructive potential is relational: strong external pressure only becomes catastrophic where the economic path is shallow. This reflects the Minskian insight that instability is endogenously generated and revealed by shocks (Minsky, 1986), as well as the broader risk-society argument that modern hazards are systemic rather than exceptional (Beck, 1992). The same external wave may pass almost unnoticed along a deep and coherent path, yet overflow and collapse a shallow one.

Figures 1. Economic journey through turbulent challenges



Source: Author's illustration

10.1.2. Exposure: The Points Where the Path Meets the Channel

Exposure corresponds to the points of contact between the central economic path and the surrounding fault channels. These are the trade corridors, financial linkages, energy dependencies, and technological interfaces through which external pressures enter the system. In network terms, they represent the economy's positionality within global production and financial structures. Highly connected economies are not necessarily fragile; fragility arises when strong exposure is combined with insufficient structural depth. This is consistent with the global value chain perspective (Gereffi, 2018) and the new geography of production described in Baldwin's The Great Convergence (2016), where integration increases both opportunity and transmission speed of shocks. In the image 1, the wider the channels and the more directly they intersect the path, the stronger the transmission mechanism.

10.1.3. Vulnerability: The Structural Depth of the Economic Path

Vulnerability is the depth and compactness of the path itself. A deep path represents diversified production, institutional coherence, technological capability, social inclusion, and credible macroeconomic policy. A shallow path reflects structural dualism, weak institutions, narrow fiscal space, and

low productive complexity. This interpretation is closely aligned with the capability-based development approach in Development as Freedom (Sen, 1999) and with the economic complexity literature (Hidalgo & Hausmann, 2009), where development is understood as the accumulation of productive knowledge that increases adaptive capacity. Metaphorically, shallow segments are the zones where even modest external pressure causes erosion and fragmentation. These are the latent fault lines of the economy – long periods of apparently stable growth that conceal declining transformative capacity.

10.1.4. Conceptual Interpretation: Economic Catastrophes as Dynamic System Failures Along Structural Fault Lines

Resilience is not simply the ability to repair a damaged segment of the path; it is the capacity to deepen, redirect, and reinforce it while pressure is still present. This corresponds to the distinction between recovery and transformation in Resilience Thinking (Walker & Salt, 2006). A resilient economy uses disturbance to upgrade its productive structure, diversify its linkages, and reduce future exposure. Visually, resilient systems are those that progressively carve a deeper and more stable trajectory even where external channels remain active. By contrast, systems that repeatedly rebuild the same shallow segments remain locked into cycles of disruption, echoing the historical patterns of crisis and recovery described in Aliber & Kindleberger (2011) and Reinhart and Rogoff (2009).

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10.1.5. Governance: The Engineering Intelligence That Shapes the Entire Landscape

Governance is the meta-layer that determines how the path is constructed and how the surrounding channels are managed. It decides where to deepen the trajectory, where to build protective buffers, how to redirect flows, and how to transform exposure into strategic integration rather than dependency. In evolutionary political economy, policy is not a corrective intervention but a continuous process of coordination and learning (Rodrik, 2007; Acemoglu & Robinson, 2012). Metaphorically, governance is the invisible but decisive force that shapes the terrain itself: without it, the path follows the easiest short-term route and remains shallow; with it, the path becomes a long-term developmental corridor capable of withstanding external pressure.

10.2. Cross-Sector Applicability of the Systemic Resilience Workflow

The systemic resilience workflow proposed in this paper is not confined to a single policy domain; rather, it provides a transferable analytical architecture for tracing how hazards interact with exposure, vulnerability, and resilience across structurally different but functionally interconnected sectors. By translating the dynamic function of catastrophe formation into sector-specific configurations, the framework enables a comparative reading of risk accumulation and buffering capacity within trade, finance, energy, and security systems. This cross-sector perspective reflects the growing recognition in complex systems and global risk literature that contemporary crises propagate through tightly coupled networks rather than within isolated institutional silos (Helbing, 2013; WEF, 2023). In this context, resilience becomes a relational and governance-dependent property: the same external disturbance produces divergent outcomes depending on the depth of institutional capacity, the diversification of structures, and the degree of strategic coordination, as emphasized in recent European Union approaches to open strategic autonomy and integrated risk management (European Commission, 2021a, 2022). The table that follows operationalizes this logic by mapping the four-layer model across the selected sectors, demonstrating how the common workflow can support continuous monitoring, policy prioritization, and anticipatory economic governance.

Table 1. Applicability Across Domains

Sector	Hazard	Exposure	Vulnerability	Resilience
Trade	Supply-chain disruptions, protectionist shocks, logistics breakdowns, maritime chokepoints	High trade openness, import dependency in strategic goods, concentration of partners and routes	Low diversification, weak domestic value chains, limited storage and buffering capacity	Supplier diversification, nearshoring/friendshoring, strategic reserves, adaptive trade policy
Finance	Sudden capital outflows, liquidity freezes, asset price volatility, banking contagion	Financial openness, external debt, foreign currency lending, cross-border banking linkages	Shallow domestic capital markets, currency mismatch, regulatory gaps, high leverage	Macroprudential frameworks, capital buffers, lender-of-last-resort capacity, financial supervision integration

Energy	Price spikes, physical supply disruption, infrastructure attacks, technology lock-in	Import dependence, centralized generation, fossil fuel reliance, grid interconnection asymmetry	Lack of diversification in energy mix, aging infrastructure, slow permitting, limited storage	Renewable diversification, smart grids, storage capacity, demand-side flexibility, regional interconnectors
Security	Hybrid threats, cyber-attacks, disinformation, critical infrastructure sabotage, geopolitical spillovers	Digitalized governance systems, external technology dependence, open data and infrastructure networks	Institutional fragmentation, interoperability gaps, legacy ICT systems, cyber skills shortages	System redundancy, coordinated crisis response, secure digital architecture, strategic technological autonomy

Source: Author's elaboration

References: Systemic risk & complex adaptive systems – Arthur (1994), Helbing (2013), WEF (2023); Financial exposure & resilience – Brunermeier & Oehmke (2013), Tooze (2019); Trade & strategic autonomy – Baldwin & Evenett (2020), Rodrik (2011), European Commission (2021a); Energy transition & security – IEA (2021) European Commission (2022); Security & cyber resilience – European Commission (2021c), European Council (2022); Conceptual shift from risk → resilience governance – Knight (1921), Taleb (2007), Mazzucato (2021)

The table operationalizes the paper's central proposition that economic catastrophes are not single events but systemic failures emerging from the interaction between structural exposure and institutional capacity.

Across all four sectors, hazards represent external or endogenous triggers, but they do not by themselves produce systemic breakdowns. Their transformative impact depends on the configuration of exposure – the structural openness, interdependence, and concentration patterns embedded in the system.

Vulnerability is interpreted as a governance and development variable, not merely a risk condition. It reflects coordination failures, technological asymmetries, and regulatory fragmentation. In this way, vulnerability becomes the key transmission channel through which shocks evolve into economic disasters.

Resilience, in the proposed workflow, is not limited to recovery capacity. It captures redundancy, diversification, adaptive policy capability, and institutional learning. This confirms the shift from traditional risk management toward continuous systemic monitoring and resilience governance, which is the core analytical contribution of the model.

Most importantly, the unified structure demonstrates that the same algorithmic logic can be applied across sectors, making the framework: scalable, comparable, and operational for policymaking without reducing complexity to a single composite indicator.

In the context of the European Union, the four-dimensional structure closely corresponds to the policy logic embedded in the European Commission frameworks on resilience, particularly the Recovery and Resilience Facility (European Commission, 2021b), the Strategic Compass (European Council, 2022)., and the REPowerEU agenda (European Commission, 2022). Hazard aligns with the EU concept of shocks and stressors; exposure corresponds to open strategic autonomy and interdependence mapping; vulnerability reflects structural reform needs; while resilience mirrors the EU understanding of adaptive capacity, diversification, and coordinated crisis response. This semantic convergence strengthens the framework's direct applicability within EU resilience governance and cohesion-policy programming.

10.3. Synthesis: Catastrophes as Ruptures of Shallow Developmental Trajectories

When the five components are observed together, the visual landscape becomes a dynamic representation of modern capitalism. External pressures are constant and often intensifying, but catastrophic rupture occurs only where they intersect with insufficient structural depth and weak adaptive coordination. The analytical focus therefore shifts from predicting the arrival of shocks to mapping the topology of the path – its depth, continuity, and capacity to evolve. This interpretation transforms crisis analysis into the study of how economic systems carve their long-term trajectories within an environment of permanent turbulence, consistent with the complexity view of the economy as an evolving system (Arthur, 2015) and with the uneven-development tradition (Smith, 2008).

In this sense, the integrated algorithm provides more than a functional model: it offers a spatial and dynamic language for understanding economic disasters as the outcome of interactions between structural quality, network position, and governance effectiveness. The central research implication is clear and directly aligned with the visual metaphor: modern economic catastrophes do not originate in the shock itself, but in the shallow segments of the developmental path where accumulated structural weaknesses meet intensified external pressure.

11. Conclusions

This paper has argued that modern economic catastrophes can no longer be adequately understood as the consequence of isolated exogenous shocks. Rather, they emerge as systemic ruptures along slow-forming structural fault lines produced by the interaction of endogenous policy depth, institutional capacity, and evolving external pressures. The central contribution of the paper is therefore not a predictive model in the conventional sense, but a process-oriented algorithmic framework that enables the continuous monitoring, interpretation, and management of these dynamics.

By conceptualizing the economy as a winding developmental path whose depth reflects the quality of governance and structural resilience, and by representing external disturbances as lateral pressures that penetrate the system only where this depth is insufficient, the paper offers a new operational language for integrated risk management. Economic catastrophe appears not as an unexpected event, but as the visible moment in which accumulated vulnerabilities intersect with intensified external stress. In this sense, resilience is not a buffer applied after the shock, but a structural property built through the long-term deepening of the path itself.

The proposed formulation $C_t=F(H_t,E_t,V_t,R_t\|G)$ repositions risk analysis from outcome measurement to dynamic governance architecture. It enables simultaneous observation of hazards, exposure, vulnerability, and resilience as co-evolving layers and transforms crisis management into a continuous policy function rather than an episodic response. Such an approach is consistent with insights from complexity economics, systemic risk theory, and resilience thinking (Walker, & Salt, 2006), yet it advances the literature by providing a clear methodological flow for their integration.

Beyond its economic application, the framework has potential relevance for other domains characterized by cascading risks and structural fragilities – including environmental governance, energy transitions, regional development, and public health systems – thereby opening space for a broader interdisciplinary research agenda.

For policy, the implications are direct: the primary task is not to eliminate shocks, but to increase the structural depth of the economic path so that external pressures remain lateral rather than disruptive. Economies that invest in institutional quality, diversification, technological upgrading, and adaptive governance reduce the probability that stress will translate into rupture.

Future research will operationalize the algorithm through empirical indicators, comparative regional applications, and simulation modeling, allowing the transition from conceptual architecture to measurable systemic

diagnostics. In doing so, the framework presented here can evolve from a conference model into a scalable analytical tool for understanding and managing the economic catastrophes of the twenty-first century.

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Article

Management of the Extreme Situation in the Climate Change Zone (Republic of Serbia): Criticism, Political-Ecological Perspective, and *Complexitas Rerum*

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Abstract

This paper analyzes the perception of climate-related risks and emergency management capacities in the Toplica District (Republic of Serbia) through a critical political-ecological lens, drawing on the concept of complexitas rerum as a heuristic framework for understanding the interdependent relations among environmental processes, social structures, and institutional configurations of power. Extreme climate-related phenomena, particularly forest fires, are not treated as isolated natural events, but as socially mediated outcomes of interacting climatic, economic, and institutional factors that shape local vulnerability and adaptive capacity. The study employs a mixed-methods approach, combining a survey of 180 respondents with qualitative insights from a contextual analysis of the regional socio-ecological setting. Empirical findings indicate a high perceived increase in forest fire frequency, strong awareness of climate change impacts, and widespread perceptions of insufficient institutional preparedness and response capacity. At the same time, results highlight the coexistence of individual adaptive strategies and a relatively weak reliance on formal institutional protection mechanisms, particularly in rural and peripheral communities. The paper critically engages with

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technocratic and depoliticized approaches to disaster and risk management, emphasizing the gap between formal institutional frameworks (de iure) and their practical implementation (de facto) in the context of available resources and capacities. It also highlights how climate risks are socially distributed, with marginalized rural populations experiencing higher exposure and lower access to institutional support. By integrating empirical survey data, regional contextual analysis, and political-ecological theory, the study demonstrates that climate change in the Toplica District is not merely an environmental phenomenon, but a complex socio-political process that reinforces existing inequalities. In this sense, the framework of political ecology, grounded in *complexitas rerum*, contributes to a more nuanced understanding of emergency management and supports the development of more equitable and locally grounded adaptation strategies amid increasing climate uncertainty.

Keywords

Emergency management, climate change, complexitas rerum, social inequality.

1. Introduction

Political ecology, as an interdisciplinary field grounded in academic research and engaged in political practice at the global level, has experienced intense expansion in the second half of the 20th century.[1] This development has been dynamic but uneven, often accompanied by resistance from traditionally constituted scientific disciplines. With the growth of its epistemological visibility and analytical influence, there has been a marked diversification within the field itself, as a result of which political ecology is now applied to a broad and heterogeneous body of research problems that encompass complex interactions between power relations, social processes, and the natural (physical) environment. This corpus includes both individual subdisciplines within geography—such as land use and land cover change analysis, ecological history, cultural ecology, and risk and vulnerability studies—and related fields outside geography, such as ecological anthropology, ecological sociology, sustainable development studies, and the circular economy.

Research within political ecology is characterized by a pronounced theoretical pluralism, with conceptual foundations in Marxist political economy and significant influences from poststructuralist, postcolonial, and feminist theoretical approaches. In this sense, political ecology is firmly connected to a critical and radical scientific tradition that problematizes and rejects reduc-

1 The term "political ecology" was first used in 1935 in a work by Ton entitled "Wandering through Nature: Fighting for Grass". The anthropologist Wolf popularized the term again in his 1972 work "Property and Political Ecology" (Scoones 1999, pp.45-47).

tionist and positivist interpretations of social-ecological relations (Tomic & Kesic, 2025).

In the context of contemporary global challenges, research on climate change is gaining particular importance within political ecology, as it is not viewed solely as a biophysical phenomenon, but as a deeply political and economically mediated process. Climate change is interpreted as a product of historically conditioned patterns of capital accumulation, unequal distribution of resources, and asymmetric power relations at the global level, with its consequences disproportionately affecting marginalized communities and countries of the global South. This perspective enables a critical examination of issues of climate justice, adaptation, and resilience, as well as the roles of state and non-state actors in shaping responses to the climate crisis.

The aim of this paper is to affirm political ecology as a relevant theoretical and analytical framework for the critical study of contemporary socio-ecological problems, with a particular emphasis on examining how unequal distribution of power, access to natural resources, and political and economic structures shape environmental risks and generate conflicts. The paper aims to analyze key concepts of political ecology, demonstrate the application of different methodological approaches, and assess the role of local communities and civil society actors in articulating resistance to dominant models of resource exploitation, with a particular focus on countries of the Global South and the Balkan region, including the Republic of Serbia.

Although political ecology emerged relatively late as an autonomous research direction, its literary corpus is characterized by exceptional breadth, conceptual sophistication, and an emphasis on interdisciplinarity, encompassing fields such as geography, ecology, anthropology, environmental sciences, and agrarian studies. The thematic spectrum of research encompasses key contemporary environmental problems, from climate change, deforestation, and soil erosion to issues of environmental justice and liberation ecology, in which these phenomena are not treated as isolated natural processes but as the result of historically and socially constructed relations between society and nature.

Within this theoretical horizon, actor-oriented approaches are of particular importance, as they enable a more subtle understanding of the dynamics of power, interests, and practices of action of different actors in ecological contexts. These approaches assume that social reality is not given, but is continuously produced through interactions, negotiations, and conflicts, thus opening up space for the analysis of how actors shape their own existential strategies, articulate resistance, and develop adaptive mechanisms in relation to structural constraints and dominant forms of power (Turner, 2012; Cvetkovic, 2024).

The philosophical foundation of such approaches can be recognized in the broader corpus of critical theory, which questions the dualistic separation of nature and society, as well as in post-structuralist conceptions that emphasize contingency, relationality, and the discursive construction of reality. In this sense, political ecology not only analyzes the material aspects of ecological processes but also problematizes the epistemological and ontological assumptions underlying dominant models of understanding nature, pointing to their rootedness in certain regimes of knowledge and power (Tomic & Kesic, 2025).

Viewed through this prism, climate change ceases to be exclusively a question of physical transformations of the climate system and emerges as a paradigmatic example of global inequality and asymmetric power relations. Its causes and consequences are inextricably linked to the history of capitalist accumulation, the colonial legacy, and the uneven distribution of resources, while the capacities for adaptation and resilience are deeply conditioned by the social, political, and economic positions of the actors (Blaikie & Brookfield, 1987, p. 17). In this way, political ecology enables not only the analysis of environmental crises but also a critical examination of the ways in which they are conceptualized, managed, and potentially transformed towards more sustainable and just social relations (Blaikie et al., 2002).

2. Methods

Building on the aforementioned theoretical framework, this research is conceived as a qualitative case study focused on the analysis of socio-ecological dynamics in the context of climate change and natural resource management in the Republic of Serbia. This design was chosen due to its analytical suitability for a deeper understanding of contextually conditioned power relations, institutional practices, and local adaptation strategies. The research was conducted from 2022 to 2024, using both primary and secondary data sources, including strategic documents, legal acts, reports from relevant institutions, and data from international organizations.

Primary data collection was conducted through semi-structured interviews with representatives of local communities, civil society organizations, and relevant institutions, as well as through analysis of publicly available documents and media content. The research instruments had been piloted, and special attention was paid to ensuring validity and reliability through the triangulation of data sources and methods. Key analytical constructs include access to resources, perception of environmental risks, adaptation strategies, and forms of social resistance.

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The sample was selected using purposive sampling to include relevant stakeholders with specific knowledge and experience in natural resource management and climate policy. Inclusion criteria included active involvement in the observed processes, while stakeholders without direct experience in the analyzed area were excluded. The research was conducted in accordance with ethical standards, with informed consent from all participants and guarantees of anonymity and data confidentiality. Data analysis was based on thematic coding and interpretive analysis, using software tools for qualitative data processing, thereby enabling a systematic, transparent, and reproducible research process.

The spatial framework of this research covers the Toplica District in the Republic of Serbia, located in the southern part of the country, and administratively includes the municipalities of Prokuplje, Kuršumlija, Blace, and Žitorađa. This region is characterized by pronounced socio-economic specificities, including a peripheral position relative to the main development centers, demographic decline, and structural challenges in economic development and infrastructure.

From a socio-ecological perspective, the Toplica District represents a significant research context due to diverse land uses, including agricultural areas, forest ecosystems, and rural settlements, which are to varying degrees exposed to the impacts of climate change and ecological degradation. Of particular note is the sensitivity of this area to extreme weather events, including droughts, floods, and increased frequency of forest fires, which represent one of the key ecological risks in the region.

The choice of the Toplica District as a research area is based precisely on its pronounced vulnerability to forest fires, which have been increasing in intensity and frequency in recent decades, partly as a consequence of climate change and partly due to changes in land-use patterns and reduced institutional capacity for prevention and response. This specificity enables an analytical examination of the relationship among environmental risks, local adaptive capacities, and institutional risk management frameworks.

The sample was formed as a combined (mixed) sample, which includes elements of random and purposive sampling, with the aim of ensuring the representativeness of different social groups within the observed local community. The total sample comprises 200 respondents, aged 18 to 75, who have permanent residence in the territory covered by the research. The sample was stratified by basic sociodemographic characteristics, including gender, age, level of education, and occupation, to enable a comparable view of perceptions across different social groups. The criterion for inclusion in the sample was adulthood and at least 5 years of residence in the local communi-

ty, while respondents who lacked direct experience of living in the observed territory during the specified period were excluded.

The response rate was approximately 78%, with some of the initially contacted respondents refusing to participate or not fully completing the survey. After removing incomplete questionnaires, the final sample comprised 180 valid responses, which were included in the final analysis. The sample defined in this way provides a relatively reliable insight into the perceptions of the local population, while accounting for limitations related to sample size and potential bias in voluntary participation.

3. Results

The results of a survey conducted among 180 respondents in the Toplica District indicate a strong perception of environmental risks in the local community, with forest fires standing out as the dominant form of environmental threat (Table 1). The majority of respondents (74%) reported an increase in the frequency and intensity of forest fires in the last few years, especially in rural and mountainous areas of the municipalities of Kuršumlija and Prokuplje. Respondents most often associated this trend with prolonged dry periods and increased summer temperatures, indicating a strong local perception of the connection between climate conditions and fire occurrence.

In terms of the broader perception of climate change, 68% of respondents believe that climate change has already significantly affected living conditions in the local community, while 21% take a neutral position, and 11% do not notice any clear changes (Figure 1).



Figure 1. Perception of the impact of climate change (in %)

The most common indicators of climate change are rising temperatures, decreasing precipitation, and declining agricultural yields. When it comes to the causes of forest fires, 62% of respondents point to a combination of climate factors and human activities, 24% emphasize the dominant influence of climate change, and 14% attribute the causes primarily to insufficient institutional prevention and control.

The results also indicate relatively limited trust in institutional capacities to manage environmental risks, with only 31% of respondents believing that the relevant services are adequately prepared for fire prevention and

response, while 56% express dissatisfaction with their efficiency. In the domain of adaptive practices, 57% of respondents report undertaking self-protection measures, 29% rely on institutional support, and 14% do not conduct preventive activities. Additionally, the analysis of open-ended responses indicates a perception of spatial and social inequality in exposure to risks, suggesting elements of environmental injustice in the Toplica District.

Table 1. Respondents' perceptions of key environmental indicators (N = 180)

Variable	Response category	Percentage (%)
Perception of forest fires	Increase observed	74%
Climate change - impact on local conditions	Significant impact	68%
Climate change – impact	Neutral	21%
Climate change – impact	No clear impact	11%
Causes of forest fires	Climatic + human factors	62%
Causes of forest fires	Mostly climatic factors	24%
Causes of forest fires	Institutional factors	14%
Institutional trust	Low trust	56%
Institutional trust	High trust	31%
Population adaptive measures	Measures taken	57%
Population adaptive measures	Reliance on institutions	29%
Population adaptive measures	Without measures	14%

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All observed response distributions and empirically obtained survey results, relating to the perception of forest fires, climate change, risk causes, institutional trust, and adaptive practices, are presented in Table 1 and Figure 1, which together form the basis for further quantitative interpretation and qualitative research.

4. Discussion

The results indicate a high perception of environmental risks in the Toplica District, especially regarding forest fires and climate change, which aligns with contemporary research in political ecology, which emphasizes that climate risks are most often experienced through direct, visible local impacts.

The observed connection between temperature increases, dry periods, and fire frequency confirms the thesis of the localization of global climate processes, i.e., their transformation into concrete, existentially relevant phenomena in local communities.

When compared with the existing literature, the findings of relatively low institutional trust and the perception of the competent services in fire risk management as insufficiently efficient are in line with results from studies in peripheral and rural areas, which indicate a gap between formally defined policies and their practical implementation. At the same time, the prominent role of the combination of climatic and human factors in explaining fire occurrence aligns with modern socio-ecological approaches that reject single-factor interpretations. A deviation from the literature is the relatively high share of respondents who primarily emphasize climatic factors, which may indicate growing climate awareness, but also limited recognition of the institutional dimensions of risk.

The implications of these findings are reflected in both the theoretical and practical domains. From a theoretical perspective, the results confirm the analytical framework of political ecology, which emphasizes the mutual conditionality between natural processes and social power relations. From a practical point of view, it points to the need to strengthen institutional capacities for prevention and response, as well as the importance of developing local adaptation strategies and environmental education of the population. At the same time, the limitations of the research include the relatively small spatial coverage, potential bias in self-reported data, and the inability to fully generalize the results, which opens space for future comparative research and in-depth qualitative analyses in other regions.

5. Conclusions

This research has shown that the population of the Toplica District perceives environmental risks as present and intensifying, especially in the context of forest fires and climate change. The results indicate that the majority of respondents observe an increase in fire frequency and attribute it to a combination of climate factors and human activities, while at the same time, there is a significant presence of the perception of insufficient efficiency of the institutional response.

The significance of this research is reflected in its contribution to understanding how local communities in peripheral rural areas perceive climate change and environmental risks, as well as in its confirmation of the relevance of the political ecology approach to the analysis of socio-ecological

relations. The observed findings indicate a complex intertwining of natural, social, and institutional factors, which can be understood through the idea of complexitas rerum, i.e., the essential complexity of reality, in which ecological processes can never be reduced to a single cause or dimension.

The practical implications of the research relate to the need to strengthen institutional capacities for forest fire prevention and response, as well as to improving local adaptive strategies and environmental education for the population. Future research should include a wider spatial sample, comparative analyses with other regions, and in-depth qualitative approaches to enable a more detailed understanding of the mechanisms underlying the formation of ecological perceptions and adaptation strategies.

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Analysis of Physical and Psychological Safety Strategies in Schools and their Impact on the Protection and Safety of Students

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Abstract

Safety in schools is a key factor for a successful educational process, and includes both physical and psychological dimensions of student protection. Physical security includes measures related to the control of access to the facility, monitoring of the school premises, security protocols and clearly defined procedures for responding to crisis situations (eg evacuation, handling in the event of a threat, violence or accident). These measures have a preventive function because they reduce the possibility of incidents, but at the same time they are an operational mechanism that enables a quick and coordinated reaction of employees. However, physical protection in itself is not enough if a culture of safety is not built and if students do not feel belonging, supported and trusted in the school environment. The aim of this paper was to analyze physical security strategies in schools and their impact on the protection of students, as well as psychological strategies that contribute to the prevention of emotional risks and the reduction of violence. The methodology used included an analysis of relevant literature and the application of authoritative school climate theory, which emphasizes the importance of a combination of clear rules, consistent discipline, and supportive relationships between teachers and students. Special emphasis is placed on the psychological aspects of safety, such as developing social-emotional competencies, strengthening communication, resolving conflicts in a non-violent way and creating a stim-

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ulating atmosphere in which students feel seen and respected. The results show that schools with strong physical safety strategies reduce violence and risky behaviors, while psychological strategies, such as healthier interpersonal relationships and emotional safety, have a significant impact on academic achievement and a reduction in mental health problems. The conclusion suggests that the most effective is an integrated approach that connects organizational and technical measures with pedagogical-psychological interventions. In practice, this means that security protocols and infrastructural solutions should be supplemented with systematic violence prevention programs, peer mediation, team work of professional services, as well as continuous education of teachers to recognize early signs of risky behavior and provide support to students. Also, the involvement of parents and the local community in security initiatives further strengthens the school's resistance to various forms of threats. A comprehensive model that simultaneously builds a safe infrastructure and a positive school climate contributes to a safer, healthier and more stimulating school environment, and thus to better education of students.

Keywords

Student safety, physical protection, psychological safety, school, school climate.

1. Introduction

Safety in schools today represents one of the most important issues of modern education systems, since it directly affects not only the physical protection of students, but also the quality of their overall development and educational achievements. In the context of increasingly frequent discussions about violence, crisis situations and mental health of young people, school safety goes beyond the traditional understanding of protection from physical threats and grows into a complex, multidimensional construct. Modern education systems face the challenge of simultaneously ensuring the infrastructural security of facilities and developing a supportive psychological environment that fosters a sense of belonging and trust. It is this dual nature of security – physical and psychological – that requires an integrated approach that goes beyond partial and fragmented solutions. In the literature, it is increasingly emphasized that school safety cannot be reduced solely to the absence of violence or crime, because such a reductionist understanding ignores the emotional and social dimensions of school life. Traditional strategies, focused on access control, supervision and disciplinary procedures, although they have a preventive function, cannot by themselves ensure long-term stability and a sense of security among students. At the same time, neglecting the physical aspects of protection can lead to serious risks in situations of natural disasters, traffic

incidents or intentional acts of violence. Therefore, there is a need for a theoretical and empirical review of the existing models of safety in schools. The fact that there is no unique and universally accepted definition of school safety in the professional literature makes it difficult to compare research results and create coherent policies. Starting from the aforementioned theoretical and empirical findings, the goal of this paper is to analyze physical and psychological safety strategies in schools, as well as to consider their mutual relationship and impact on the protection of students. The paper tries to examine to what extent individual strategies contribute to the reduction of violence and risky behaviors, but also to point out the need to integrate them into a single, coherent model. Special emphasis was placed on considering the limitations of existing measures and the need for empirically based approaches in the creation of educational policiesity.

2. Conceptual definition and multidimensional structure of school safety

Different definitions of the concept of school safety, which appear in the professional literature, seriously complicate the comparison of scientific results and the establishment of a unique approach to the management of safety in the educational environment. Although everyone admits that safety in schools is a key social issue today, there is no common understanding of what the term exactly means, so this lack of consensus creates obstacles not only in the theoretical understanding of the term, but also in the practical solution of safety problems during the educational process (Bradshaw et al., 2021). Early definitions of school safety mainly concentrated on reducing crime and physical violence within the school environment. The biggest challenge in defining lies precisely in the fact that personal beliefs are often mixed with the results of empirical research, which is why it is extremely difficult to separate empty rhetoric from real, evidence-supported facts in discussions about school safety (Lewno-Dumdie et al., 2020). The school environment today requires security that is not limited to physical protection, but also includes organizational mechanisms, social relationships, and the emotional and psychological stability of students and teachers. It is precisely this multidimensionality that makes the notion of safety in schools extremely complex and comprehensive. Unlike earlier approaches that focused exclusively on the prevention of violence and crime, modern definitions introduce a wider range of elements that affect the overall sense of security. Therefore, today's understanding of school safety differs in that it actively includes psychological, social and emotional factors, thus creating a holistic framework for creating a supportive environment (Cvetković, Nikolić & Lukić, 2024;

Metić, 2025b). School climate is understood as a broad and multi-layered construct that includes numerous interconnected elements, among which safety occupies a key, unavoidable place. Although there is still no universally accepted definition for either school climate or school safety, most authors agree that the two concepts are deeply intertwined (Metić, 2025a). Three key elements stand out in most definitions of school safety, although there is still no universally accepted definition or full consensus on its basic components. Special emphasis is placed on the perception of the actors themselves within the school - primarily students and teachers - which includes their subjective views on the actual level of security in that environment. This category also includes feelings of fear of possible victimization or, conversely, the experience of personal safety while at school. In the broadest sense, perception includes overall attitudes about how physically and emotionally safe the school is for all its members (Anderson, 2022; Baumsteiger et al., 2022). Another key element relates precisely to the physical and social environment of the school, which must be free from any form of violence, criminal acts, intimidation, threats or permanent fear. In the definitions from this category, emphasis is placed on creating an atmosphere in which students, teachers and other actors feel protected and motivated to learn.

Thus, safety is not only reduced to the absence of danger, but also to the active creation of conditions that support emotional health and the successful execution of the educational mission (Tadić, 2022). Effective, consistent, and fairly applied disciplinary procedures and practices constitute the third key element in definitions of school safety. They enable the rules to be respected equally by all participants, thus building trust and stability within the school system. It is the presence of such structures that prevents chaos, reduces the unpredictability of behavior and contributes to the overall feeling of protection, which is why modern approaches emphasize that without systematically implemented and impartial discipline, security remains incomplete and vulnerable (Klevan, 2021). In research (Bauerline, 2022) on school safety, two overlapping, yet mutually distinguishable dimensions are clearly outlined - one related to physical protection, and the other to a psychological sense of safety. Those two planes constantly intersect in practice, but their separation allows for a more precise understanding of the problem and better targeting of interventions.

3. Protection in schools through the physical and psychological dimensions of safety

3.1. Ensuring physical safety in the school environment: risk prevention and protection from danger

Protection from external dangers such as natural disasters or traffic risks in the immediate vicinity of the school is as important as preventing internal threats, among which the inappropriate behavior of students, crime and various forms of violence stand out. At the very core of physical safety lies the creation of such a school space where all risks of physical injury, damage or violence are minimized. This means that students, teachers, other staff and all visitors are simultaneously protected through carefully designed conditions and structures that guarantee their well-being. Physical safety, therefore, does not mean only the absence of immediate danger, but the active formation of a safe environment that enables the unhindered presence and work of all actors in the school (Mubita, 2021). Distinguishing disasters from related terms such as hazards, crises and risks is a fundamental need behind any attempt to formulate a concise and clear definition. Precisely because of this need for a precise separation, the theoretical determination of the content and scope of disasters remains one of the most persistent and topical research questions in this field. Without such a clear demarcation, it is impossible to establish a common language, compare cases or develop effective prevention and response strategies. Therefore, the authors constantly return to this problem, trying to single out disasters through precise definitions as a special phenomenon that is significantly different from other threatening situations (Cvetković, 2015).

In the distant past, people interpreted natural disasters as the work of "higher forces", because they represented inexplicable and destructive forces that go beyond human power. Such an understanding arose from the fact that disasters always meant the most severe possible consequences for people's lives, nature, property, the economy and the entire society. They were not just single incidents, but often a series of connected events with a long-term and deep negative impact (Metić, 2024). The classification of natural disasters is done primarily according to the place and sphere of their occurrence, thus distinguishing between geophysical, meteorological, hydrological, biological and those of extraterrestrial origin. All natural disasters are characterized as harmful events that threaten people's lives, destroy their material goods and cause serious damage to the environment. Therefore, their origin and action are analyzed through the prism of the specific natural spheres in which they take place, which enables a better understanding of the mechanisms and possibilities of prevention (Cvetković, 2020). The activ-

ities, distribution, possession or consumption of illegal substances, as well as the possession or use of weapons in the school environment are among the most serious internal security risks. In addition, student disciplinary infractions that result in injury or create a threat to others often present a direct threat within the community. Violent and non-violent crimes, including murders and suicides, represent the most serious forms of endangerment stemming from school behavior itself. All these risks have a common origin in the intentional acts or negligence of members of the school community, which makes them particularly dangerous because they come from within and directly threaten the safety of individuals (Fredrick et al., 2021). School physical security measures against internal risks usually rely on a combination of technological solutions, strictly defined procedures and the presence of specialized personnel. Restricted access to certain rooms, along with clearly established protocols for dealing with crisis situations, form the backbone of the security procedures that the school puts in place. The presence of security personnel, from school resource officers, through private security, to stationed police officers, is a key human factor in minimizing threats and protecting all persons within the school (Lazarus & Sulkowski, 2024). Providing emergency resources as well as first aid equipment is a necessary part of schools' responsibility in dealing with disasters. In addition, clearly defined evacuation routes and regularly rehearsed emergency procedures enable quick and organized evacuation of the facility in moments of crisis. Schools are required to design and regularly maintain buildings so that they are resistant to various types of natural and other disasters. It all stems from a deep ethical and operational obligation to create an environment that actively protects the life and safety of students, teachers and everyone present (Khan et al., 2020).

In developed countries, especially in urban areas, measures to improve traffic safety around schools sometimes cause unexpected negative effects despite good intentions. Conversely, in many developing countries, school-related traffic incidents remain among the most common causes of serious injury and death among school-age children. Inadequately organized school transport, lack of basic safety standards and weak regulation of traffic near schools significantly increase the risk of accidents. Therefore, in those societies, the traffic safety of students on the way to school and back is highlighted as a priority problem that requires urgent systemic changes (Zacharia & Yablon, 2021). Well-intentioned road safety initiatives often end up keeping students off the road without providing real protection while walking, cycling or traveling as a passenger. Such an approach limits their mobility without effectively addressing the key risks they are exposed to as pedestrians, cyclists or passengers.

3.2. Ensuring psychological safety in the school environment: prevention of emotional risks and protection from psychological threats

School must be a place where students' social and emotional needs are met without any threat or insecurity - this is one of the basic expectations that define psychological safety in a broader sense. At the same time, the quality of interpersonal relationships among all participants - from students to teachers to parents - directly affects the degree of satisfaction with those interactions and the sense of belonging. Psychological safety, therefore, consists of two closely related aspects: the nature of social contacts that take place at school and the belief that the environment will remain safe for emotional and social fulfillment. Due to its two-layered nature, it cannot be reduced to individual incidents, but represents a continuous state of support and trust that enables the free development of personality within the school environment (Edwards, 2021). Trust, respect and emotional support are common pillars on which a positive school climate and psychological safety are built, because they are deeply rooted in the same theoretical framework. In order to turn this construct into something practically useful in everyday school life, it needs to be broken down into clearly defined, observable and measurable components. Those parts then become a concrete framework that enables the creation of an atmosphere in which both students and teachers feel emotionally protected and accepted. At its very core, psychological safety is focused on the quality of interpersonal relationships, where the school functions as a space with constantly available caring and supportive adults - primarily teachers who actively contribute to the sense of safety of all participants (Bradshaw et al., 2021). Closeness, affection, friendship and the constant availability of caring, supportive adults (most often teachers) are the main characteristics of positive teacher-student relationships that are built through continuous and meaningful interaction. Those relationships form the first key element of psychological safety that can be clearly operationalized in the everyday school environment. Therefore, overlapping factors such as trust, emotional support and mutual respect emphasize that psychological safety must be built as an integral, inseparable component of the overall school atmosphere (Daily et al., 2020; Longobardi et al., 2021). Social acceptance among peers, perceived popularity and general preference within the group are among the most significant indicators of social positioning that are closely related to the quality of relationships among peers. Positive relationships among children of the same age also strongly correlate with the depth of friendship and the quality of emotional attachment to peers, which contributes to their psychosocial development. Unlike the teacher-student relationship, these peer relationships are characterized by voluntariness and fundamental equality, without any hierarchical dimen-

sion. Another key element of psychological safety rests precisely on those egalitarian, freely chosen relationships among peers, because they directly affect the sense of belonging, emotional support and safety within the school social environment (Portt et al., 2020). Finally, that construct includes three main levels: rational judgments about real risks, emotional waves like fear or anxiety, and deep-rooted value attitudes that determine how significant a threat really is to someone. Because of this complexity, feelings of safety are a dynamic, internal process that shapes how students and teachers perceive and experience their own protection within the school environment.

4. Physical and psychological safety strategies in schools and their impact on protecting students and reducing violence

4.1. Physical security strategies in schools and their impact on student protection

Deliberately strengthening a school building and other facilities to make them more resistant to potential attacks is at the heart of a concept known as "target hardening". Collectively, all these measures, procedures and the engagement of specialized personnel make up the physical security strategies that the school is actively implementing. The goal of these strategies is to simultaneously protect students and staff from any threats and significantly reduce the occurrence of crime and inappropriate behavior within the school space (Kim et al., 2021).

The personal importance that an individual attaches to various security threats, fear as a dominant affective reaction, and cognitive assessments of the seriousness or frequency of crime - all these layers together build a multidimensional construct known as feelings of security. The subjective feeling of safety at school does not arise in isolation, but as an emotional response to a wide range of contextual factors surrounding the individual. Finally, that construct includes three main levels: rational judgments about real risks, emotional waves like fear or anxiety, and deep-rooted value attitudes that determine how significant a threat is to someone (Lamoreaux & Sulkowski, 2021). The media and the academic community often harshly criticize policy makers for proposing measures that seem attractive to the public, but do not have a solid scientific basis or proven effectiveness. Another function of physical security strategies is highly symbolic – it serves to send a strong message to the public that the school is still a safe place for students. When a serious incident of violence occurs, the school must quickly demonstrate

its power and authority, reassuring parents and the wider community that the situation is still under control. (Mann & Brock, 2020). Widespread school safety practices often enjoy great popularity and acceptance despite lacking serious empirical support and being based on limited or poor quality research. Leading experts in this field point out that the total quantity and quality of scientific works on school safety is extremely uneven, with large differences between individual topics.

Therefore, it is concluded that most current approaches suffer from a lack of rigorous, analytically deep and methodologically impeccably performed studies, which limits the possibility of making reliable, evidence-based decisions in this area (Lamoreaux & Sulkowski, 2020). Most of the problems related to school violence, crime and victimization remain intact even when multiple security measures are implemented in schools at the same time, and the only noticeable effect appeared in the reduction of exposure to property crime, but only in secondary schools. In primary schools, as in most cases in secondary schools, such combinations of measures have proven to be completely ineffective in solving most security challenges. Despite these limitations and the lack of evidence, it can be clearly concluded that the mentioned strategies do not bring the expected results in preventing or suppressing safety problems in schools (Sorensen et al., 2023). In secondary schools in Serbia, as in numerous other studies, the increased presence of school resource officers did not show any impact on the prevention of peer bullying or on the reduction of incidents related to weapons. On the other hand, studies indicate that their presence contributes to greater detection and arrest of drug-related offenses, which is one of the positive effects. Increased visibility of SROs has also been associated with decreases in some forms of non-gun violence, such as physical assaults, as well as fewer incidents of gun ownership among students. Nevertheless, when all the results are considered, the effectiveness of SRO engagement remains limited and selective, it acts on certain types of offenses, while on others, especially the most serious and widespread ones, it leaves no measurable trace (Grmuša, 2024). Students often perceive increased physical security measures not as protection, but as an additional instrument by which school personnel reinforce their control, assert authority, or even abuse power over them.

Such a perception leads to a serious negative outcome: strategies that should ensure safety lose credibility and cease to be seen as relevant for personal protection. In addition, an overemphasis on rules, procedures and their strict enforcement can shift the focus from teaching and learning to the routine enforcement of discipline and supervision. Therefore, the implementation of these strategies carries the risk of turning the school environment into a place where safety is measured by the amount of restrictions and not by the quality of support for student growth and development (Curran et al., 2022).

Many schools that adopt a "zero-tolerance" policy toward any inappropriate student behavior use SROs as the primary mechanism for enforcing discipline, even for minor infractions. This results in school resource officers becoming regular participants in day-to-day policing, rather than being engaged only for serious crimes or violence. This practice becomes particularly problematic as SROs become involved in standard disciplinary procedures for minor incidents, which changes their role from security guards to routine enforcers of school rules. Because of this, SRO engagement is highlighted as a critical point, as overuse for minor offenses can erode student confidence and turn the school into a place of heightened surveillance instead of support and development (Fisher et al., 2020).

The vast financial resources invested in physical security strategies require policymakers to insist on conducting rigorous, methodologically sound studies that would ultimately provide justification for such expenditures. Schools today find themselves in a difficult dilemma: how to maintain a high level of physical protection of the environment without turning it into a closed fortress full of surveillance and restrictions. Quantitative data clearly show that the presence of school resource officers (SROs) leads to a sharp increase in standard disciplinary sanctions against students, often for minor infractions. Therefore, it is necessary for policy makers to insist on rigorous studies in order to justify huge financial investments in the implementation of physical security strategies (Lazarus & Sulkowski, 2024). Lack of in-depth knowledge of disaster preparedness procedures among teachers is one of the biggest problems, despite their extremely positive attitudes during training. Training is mostly reduced to post-event reactions rather than proactive preparation, while evacuation exercises and simulations are often conducted as a mere formality without a serious approach and the necessary visual aids. Even in developed countries that have been repeatedly hit by devastating earthquakes, the preparedness of school facilities still remains inadequate, although in some US states it has reached a medium to high level. In developing countries, the situation is even worse, which shows that the problem of inadequate preparedness for disasters extends globally and requires a fundamental change in the approach to training, materials and the severity of exercises (Sonmez & Gokmenoglu, 2023; Khan et al., 2020).

The only study conducted in Serbia on the safety of schools from natural disasters revealed a worrying fact where more than half of the students do not feel safe inside school buildings when they think about the possible consequences of an earthquake or other disasters. Those findings are based solely on the perceptions of the students themselves, because objective data on the condition of school facilities in the context of natural disasters in Serbia is almost non-existent. This clearly shows that realistic insights into the degree of preparedness of Serbian schools for natural disasters are extremely

limited and come down to the subjective feeling of students. Therefore, it remains completely unclear whether school buildings really provide adequate protection or whether the feeling of insecurity among students is completely justified by the actual situation (Cvetković, Janković and Milojević, 2016). Therefore, preparedness does not automatically extend to other types of crises; people and institutions most often remain vulnerable to disasters that differ from the one they recently experienced, so such a selective effect emphasizes the need for systematic, comprehensive planning, because past experience alone cannot be relied upon as a universal protection mechanism.

4.2. Improving interpersonal relationships and reducing violence through psychological safety strategies in schools

A large number of studies have confirmed that the feeling of security and the quality of interpersonal relationships significantly influence academic results and psychosocial outcomes in education, as well as the reduction and prevention of problematic student behavior. This means that a stronger sense of security at school leads to more positive academic achievements and a better psychosocial state of students. Exposure to violence and victimization, regardless of whether it is personally experienced, observed or committed violence, predicts a significantly weaker sense of safety in the school environment (Adzkiya et al., 2023). In schools where peer bullying is widespread, students most often feel insecure, which was also found in schools in Serbia. The quality of relationships at school, both between teachers and students, and among students, is crucial for the emergence of various unacceptable behaviors, such as social maladjustment, criminal activities, violence and aggression, which manifest both within the educational institution and in the wider social context (Tadić and Kordić, 2024). When relationships between teachers and students are of high quality and supportive, students less often exhibit risky and problematic behaviors, while their exposure to violence and the risk of becoming victims of peer bullying is significantly reduced, which is true both in schools in Serbia and in the international context. Students who fail to build good social relationships with their peers belong to a group with an increased risk for behavior problems, emotional difficulties and academic difficulties in future years (Milićević et al., 2022).). A recent large-scale meta-analysis found a clear link between better teacher-student relationship quality and less occurrence of peer bullying, regardless of whether the student is in the role of perpetrator or victim.

Interpersonal relationships at school proved to be a particularly important factor when it comes to peer bullying, both among those who perpetrate it and among those who suffer from it. Therefore, encouraging healthy and

reducing bad teacher-student relationships can be an effective way to reduce the problem of bullying among children in school. Such an approach not only helps to resolve specific incidents, but also builds a long-term atmosphere of trust and respect in the entire school community (Bokkel et al., 2022). One of the strongest protective factors against victimization by peer bullying, according to another meta-analysis, is warm, caring, and supportive peer relationships in the classroom. Empirically validated strategies that both increase feelings of safety and improve the quality of interpersonal relationships are limited to those that shape an authoritative school climate. Authoritative school climate theory - a conceptual framework for understanding the connection between school climate and school safety, is derived from the literature on authoritative parenting in developmental psychology. The essence of that theory lies in the combination of high expectations and emotional support towards children (Kloo et al., 2023). In schools that foster an authoritative approach, there is a balance between high standards and continuous support, which has a positive impact on students.

Such environments ensure better engagement, greater academic success, but also reduce the occurrence of mental health problems, reduce absenteeism and reduce peer violence. An authoritative school atmosphere is associated with higher levels of academic success, including better achievement, higher educational goals, and greater motivation to progress. In addition, research shows that students in such schools feel a higher level of security. Also, in schools that provide clear discipline and fair measures, there is less chance of later behavior problems, while schools with an authoritative approach tend to have lower levels of violence and bullying among students (Kloo et al., 2023). Schools that implement authoritative approaches have a lower incidence of risky activities, such as drug use, suicidal thoughts, association with criminal groups and carrying weapons. In such institutions, students are less exposed to behaviors that threaten their safety and well-being. In contrast, the results of multilevel analyzes show that in educational institutions with a less authoritative approach, there is a higher frequency of violent behavior and more frequent victims of these same negative phenomena.

5. Conclusion

Safety in schools is a complex and multidimensional construct that cannot be reduced to the mere application of technical protection measures or formal safety protocols. Its essence is reflected in the simultaneous provision of physical protection and the construction of a psychologically stable and supportive environment. Any unilateral approach, whether based solely on control and surveillance or solely on declarative support, remains insufficient to

achieve lasting and sustainable security. Safety implies the existence of clear, consistently applied rules, but also an atmosphere of trust in which students do not feel the fear of humiliation, stigmatization or unfair treatment. If the school is organized predominantly through the logic of repression and sanctions, an environment of formal order can be created, but without a true sense of security among the students. On the other hand, the absence of clear norms and structure can produce unpredictability and destabilize the school environment. Therefore, it is necessary to establish a balance between organizational strength and emotional support, so that safety becomes part of everyday school practice, and not just a normative requirement. The subjective experience of safety occupies a central place in shaping the school experience, because it affects the motivation, engagement and readiness of students to actively participate in the teaching process. When students perceive the school as a place of fairness, consistency and respect, their trust in the institution grows and their sense of belonging to the community strengthens. In such an environment, discipline does not function as a mechanism of coercion, but as a framework that enables stability and predictability of relations. The quality of interpersonal relationships is of particular importance, since it is through daily interactions that students shape their sense of personal and social security. Relationships based on respect, support and open communication contribute to the creation of an atmosphere in which conflicts are resolved constructively and differences are accepted without violence. Security, therefore, is not built exclusively through infrastructure and formal procedures, but through a culture of shared responsibility and mutual understanding. An integrated approach, which connects the physical and psychological dimensions of safety, allows overcoming partial solutions and creates a foundation for the long-term stability of the school system. Such a model implies that protection is seen not only as a response to a threat, but as a continuous process of building trust and institutional consistency. Finally, a school that manages to harmonize the organizational structure with emotional support becomes a space where safety is not only the absence of danger, but the foundation for the complete development of students and the realization of the educational mission.

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Operationalizing the Resilience of Local Communities to Flood Risk: A Capital Approach and Assessment Model

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Abstract

Floods are among the most widespread and devastating natural hazards in Serbia, causing significant human, material, and environmental losses and slowing long-term local and national development. The consequences of floods do not arise only from the characteristics of the natural event. However, they are largely conditioned by the human factor, i.e., the way space is used, the degree of urbanization, planning, infrastructure quality, and institutional readiness to manage risk before, during, and after the event. Based

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on modern approaches to disaster risk management, the paper focuses on resilience, reflected in the local community's ability to preserve key functions, reduce losses, adapt to changing conditions, and ensure rapid and sustainable recovery. However, experiences following the major floods of 2014, as well as numerous studies, have shown systemic weaknesses and highlighted that existing solutions are often insufficiently coordinated. In addition, local capacities are uneven, and preventive measures remain insufficiently developed to meet the needs of risk-exposed areas. For this reason, strengthening local governments and building resilient communities are considered strategic priorities. This is because risks are identified more quickly, resources are coordinated effectively, and safety measures that impact citizens are implemented more directly at the local level. Based on this, the paper specifically emphasizes that local governments have a dual role: as the bearer of planning and regulation (spatial planning, urban measures, risk assessment) and as the coordinator of operational activities (preparation, alerting, evacuation, care, and recovery). The paper aims to offer a practically usable framework for strengthening local communities' resilience to floods by conceptualizing and analyzing relevant normative and institutional frameworks. Special attention is paid to the integration of investment (infrastructural) and non-investment measures (organizational, educational, planning, and communication), as well as to their coordination across different levels of governance, with clear division of responsibilities and cooperation mechanisms. The focus is also on harmonizing local policies with modern legislative and strategic solutions of the Republic of Serbia, including the Law on Disaster Risk Reduction and Emergency Management (2018), which encourages more systematic risk management and strengthening prevention. The paper shows that flood risk management cannot be based solely on the traditional "flood defense" model. Still, it requires a shift towards an adaptation approach and the concept of "living with floods", which implies continuous reductions in vulnerability and improvements in capacity. In this context, in addition to classic protection measures, the systematic strengthening of community resources and capacities — natural, economic, infrastructural, human, social, and institutional — is crucial, because it is precisely their quality that determines how ready a community will be to prevent damage, respond to an event, and recover without long-term disruption. Additionally, the paper highlights the importance of partnerships among local governments, public enterprises, the civil sector, and business to pool resources and implement measures more quickly and efficiently.

Keywords

Integrated risk management, economic disasters, systemic risk, resilience, vulnerability, trade fragmentation, economic risk management.

1. Introduction

Floods are among the most frequent, extensive, and destructive natural hazards worldwide, causing severe human, material, economic, and environmental consequences (Kljajić, Popović, & Grujić, 2016; Ćuzović, 2019). Their effects extend well beyond the immediate physical impact of inundation, as they disrupt social functioning, damage critical infrastructure, weaken local economies, degrade ecosystems, and slow long-term development processes (Cvetković, 2017a; Cvetković, 2017b; Cvetković et al., 2016; Cvetković et al., 2018; Cvetković et al., 2017). In many countries, especially in flood-prone regions, the severity of flood impacts is shaped not only by the intensity of the hydrological event itself, but also by patterns of exposure, the degree of vulnerability, the quality of spatial planning, the condition of infrastructure, and the preparedness of institutions and communities to manage risk effectively (Kron, 2005; Bekić & McKeogh, 2013).

The Republic of Serbia is particularly exposed to flood risk due to its geographical position, hydrological characteristics, and the growing influence of climate-related extremes (Sekulić, Dimović, Krnajski-Jović, & Todorović, 2012; Milović, 2018). Floods have long been among the most significant natural hazards in the country, repeatedly threatening human safety, property, agriculture, infrastructure, and the environment (Đorđević, 2017; Gavrilović, Milanović-Pešić, & Urošev, 2012). Although floods were historically treated as unavoidable natural phenomena and often interpreted as an "act of God," contemporary research and disaster risk reduction practice increasingly emphasize that their consequences are strongly conditioned by human decisions, land use patterns, urbanization, environmental degradation, institutional capacity, and the extent to which prevention and preparedness are integrated into public policy (Ndini, 2020; Milović, 2018). In this respect, flood risk cannot be understood solely as a product of nature; it is also a consequence of insufficient adaptation, uneven development, and weaknesses in risk governance (Mančić, 2025; Elkheir et al., 2025; Iftikhar & Iqbal, 2023; Iftikhar & Iqbal, 2024; Rebouh et al., 2024; Kron, 2005; Stefanović, Gavrilović, & Bajčetić, 2014).

The catastrophic floods of 2014 represented a turning point in Serbia's understanding of flood risk and disaster management. In addition to causing extensive human suffering and enormous economic losses, they exposed serious weaknesses in prevention, preparedness, interinstitutional coordination, and post-disaster recovery (Bjelić & Lazarević, 2016; Izveštaj o svrsishodnosti revizije – Prevencija poplava u Republici Srbiji, 2019). These events clearly demonstrated that reactive approaches are insufficient and that local communities must be strengthened as the first and most immedi-

ate arena of disaster risk reduction. Since risks are identified most quickly, resources are organized most directly, and protective measures are implemented most concretely at the local level, local self-government units occupy a central position in flood risk management (Ahmed, 2025a; Ahmed, 2025b; Paudel et al., 2025; Rahman et al., 2025; Inusa et al., 2025; Stefanović et al., 2014; Milosavljević, 2012). Their role is not limited to formal administration. Rather, they function simultaneously as planners, regulators, coordinators, and operational actors responsible for risk assessment, spatial and urban planning, preparedness, warning, evacuation, assistance, and recovery (Ljuboja, 2013; Zakon o smanjenju rizika od katastrofa i upravljanju vanrednim situacijama, 2018).

For this reason, strengthening the resilience of local communities has become one of the key priorities of contemporary disaster risk management (Cvetković, 2026; Milenković, 2025; Cvetković et al., 2026a; Cvetković et al., 2026b; Cvetković & Radonjić, 2022; Sendai Framework for Disaster Risk Reduction 2015–2030, 2015; Tierney & Bruneau, 2007). In this context, resilience does not refer only to the ability to resist and absorb flood impacts, but also to the capacity of a community to preserve essential functions, reduce losses, adapt to changing conditions, and ensure timely and sustainable recovery (Pavićević, 2016; Tiernan, Drennan, Nalau, Onyango, Morrissey, & Mackey, 2019). Such an understanding requires a departure from the traditional model of "flood defense," which relies predominantly on technical protection measures, and a shift toward a broader and more adaptive framework based on the concept of "living with floods" (Kljajić et al., 2016; Tozier de la Poterie & Baudoin, 2015). This approach assumes that the complete elimination of flood risk is neither possible nor realistic and that long-term safety depends on the continuous reduction of vulnerability, the strengthening of capacities, institutional learning, and social adaptation (UNISDR, 2009; Sendai Framework for Disaster Risk Reduction 2015–2030, 2015).

A particularly useful framework for understanding local resilience is the capital-based approach, which views resilience as the result of the interaction of several key community resources (Mayunga, 2007). These resources include natural, economic, physical, human, social, and institutional capital, the quality and availability of which largely determine how effectively a local community can prevent damage, prepare for a hazard, respond under pressure, and recover without prolonged disruption (Mayunga, 2007; Anđelković & Kovač, 2016). Natural capital affects environmental stability and the ability of ecosystems to mitigate the impacts of hazards. Economic capital determines the availability of resources for prevention, emergency response, and reconstruction. Physical capital includes critical infrastructure and facilities necessary for protecting the population and ensuring service continuity. Human capital reflects the knowledge, skills, health, and adaptive capacities of

the population. In contrast, social and institutional capital shape trust, participation, cooperation, and the quality of governance, all of which are essential in crises (Al-Maruf, 2017; Husted, Opper, & Park, 2022; Sanyal & Routray, 2016). Considered together, these dimensions provide a more comprehensive basis for assessing resilience than approaches focused only on infrastructure or legal regulation (Mayunga, 2007; Nikolić, Galjak, & Taradi, 2020).

In Serbia, the importance of strengthening local resilience has increasingly been recognized within the normative and strategic framework of disaster risk reduction. The adoption of the Law on Disaster Risk Reduction and Emergency Management in 2018 marked an important step toward a more systematic and prevention-oriented approach (Zakon o smanjenju rizika od katastrofa i upravljanju vanrednim situacijama, 2018). This legal framework, together with the relevant provisions of the Law on Waters, the National Strategy for Protection and Rescue in Emergency Situations, and the National Programme for Disaster Risk Management, created the basis for a more integrated understanding of local responsibilities in the field of flood risk reduction (Zakon o vodama, 2010/2012/2016/2018; Nacionalna strategija zaštite i spasavanja u vanrednim situacijama, 2011; Nacionalni program upravljanja rizikom od elementarnih nepogoda, 2014). Nevertheless, despite these normative advances, important challenges remain. Preventive capacities are unevenly developed, local resources differ significantly across municipalities, and the practical coordination among institutions, public enterprises, civil society actors, and the private sector is often insufficient (Anđelković & Kovač, 2016; Nikolić et al., 2020). Consequently, there remains a need for analytically grounded and practically applicable models that can assist local governments in identifying weaknesses, setting priorities, and strengthening resilience in a more coherent, operational way.

Starting from these considerations, this paper seeks to contribute to the conceptualization and operationalization of local community resilience to flood risk by applying a capital-based approach and developing an assessment model relevant to local self-government units. The paper is based on the assumption that resilience cannot be strengthened through isolated measures alone, nor through exclusive reliance on emergency response mechanisms. Instead, it requires the coordinated development of normative, institutional, infrastructural, social, economic, and human capacities, supported by clear planning, intersectoral cooperation, and alignment between local and national disaster risk reduction policies (Mayunga, 2007; Sendai Framework for Disaster Risk Reduction 2015–2030, 2015). In that regard, the paper aims to offer a practically applicable framework for understanding and strengthening local resilience to floods, while also contributing to the broader discussion on integrated disaster risk management in Serbia and similar contexts.

The significance of this research lies in bringing together two perspectives that are too often treated separately in practice: the institutional and legal perspective on local disaster governance, and the community-capacity perspective grounded in resilience resources. By linking these dimensions, the paper provides a broader basis for assessing the readiness of local self-government units to address flood risk and for identifying those areas in which additional investment, reform, education, or coordination is needed (Barik et al., 2025; Dada et al., 2025; Janković et al., 2025; Popović Mančević, 2025; Renner & Mayr-Veselinovic, 2025). In doing so, it also supports the transition from a narrowly reactive model of disaster management toward a more preventive, adaptive, and resilience-oriented framework better suited to contemporary flood risk conditions (Tiernan et al., 2019; UNISDR, 2009).

This paper aims to conceptualize and operationalize the resilience of local self-government units to flood risk in the Republic of Serbia through a capital-based approach and to develop an assessment model applicable at the local level. More specifically, the study seeks to identify the key normative, institutional, infrastructural, economic, human, natural, and social factors that shape local flood resilience and to examine how their interactions influence communities' capacity to prevent, prepare for, respond to, and recover from flood events. In doing so, the paper contributes both theoretically and practically: theoretically, by linking the resilience literature with the governance and disaster risk reduction framework; and practically, by offering a structured basis for assessing local capacities, identifying weaknesses, and supporting more integrated and preventive flood risk management policies in Serbia and comparable contexts.

2. Flood risk in the Republic of Serbia

Among natural hazards affecting the Republic of Serbia, floods have consistently attracted the greatest attention, primarily because of their frequency, intensity, and the scale of the damage they produce. They stand out as the most significant natural hazard in the country and one of the most serious threats to the safety of the population, the stability of infrastructure, and the continuity of social and economic life. Although floods have accompanied human societies throughout history and were once interpreted as unavoidable natural events or even as an "act of God," their destructive potential has become far more evident in recent decades. This growing severity is closely related to the adverse effects of human activity on the environment. Intensified climate change, disturbances in the hydrological cycle, inappropriate land use, and increasingly frequent heavy precipitation have all contributed to an increase in flood risk across the region. This trend is also supported by

data indicating that since 1980, Europe has recorded 325 flood events, 200 of which occurred after 2000 (Kljajić et al., 2016, p. 586). In Serbia itself, between 2016 and the first half of 2019, the Government declared a state of natural disaster six times, while both fluvial and flash floods have become increasingly common and destructive (Performance Audit Report, 2019).

The effects of floods reach virtually every segment of society. Their consequences include the loss of human lives, damage to public health, destruction of residential and other buildings, displacement of the affected population, degradation of the natural environment, damage to cultural heritage, and the disruption of everyday economic and social activities. These effects are not limited to immediate destruction alone. In many cases, indirect consequences are even more demanding, since their elimination requires more time, resources, coordination, and institutional effort than the initial emergency response.

This chapter, therefore, examines several closely related issues. It first addresses the distinction between hazard and risk, concepts that are often misused as if they have the same meaning. It then explains the concept of flood risk and how it is assessed and managed. After that, attention is directed toward defining floods, identifying their main characteristics and types, and explaining the transition from the traditional perception of floods as an uncontrollable force of nature toward the contemporary adaptive concept of "living with floods." In the second part of the chapter, special emphasis is placed on the influence of climate change on the growing intensity of floods, on the available means of flood defense through structural and non-structural measures, and on the seriousness of the harmful consequences that this hazard may produce.

2.1. Flood hazard, flood risk, and flood risk assessment

A general definition of hazard is provided in the UNISDR terminology, according to which hazard refers to "a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage" (UNISDR, 2009, p. 17). Building on this understanding, Stefanović and colleagues (Stefanović, Gavrilović, & Bajčetić, 2014) describe flood hazard as a qualitative and dimensionless fact, meaning that danger exists. However, it is not yet expressed through measurable quantitative characteristics. In simpler terms, a flood hazard is the possibility that a harmful event could occur, regardless of whether it ultimately happens.

Since hazards may be classified by origin, floods are categorized as climatic hazards, alongside tornadoes, cyclones, droughts, hurricanes, storms, and snowstorms (Stefanović, Gavrilović, & Bajčetić, 2014, p. 60). Over the last several decades, the number of factors contributing to increased flood hazard has evidently grown, while the intensity and frequency of this natural hazard have also increased. A significant share of these developments can be linked to human activities that intensify climate change, alter hydrological regimes, and thereby increase the likelihood of flooding (Kron, 2005, p. 58). Bekić and McKeogh define flood risk as the combined effect of the probability that a flood event will occur and the possible harmful consequences it may have for human life and health, property, cultural heritage, and the environment. In that sense, probability is the estimated likelihood that a flood of a given magnitude will occur in the future. At the same time, the severity of consequences depends on the characteristics of the flood itself, such as flow velocity, water depth, speed of onset, and duration, as well as on the vulnerability of the exposed population, infrastructure, and environment, including factors such as the average age of the population, the resilience of buildings, and the organization of flood defense (Bekić, & McKeogh, 2013).

To manage flood risks effectively, it is necessary to prepare a preliminary flood risk assessment, flood hazard maps, flood risk maps, and a flood risk management plan. In the Republic of Serbia, the preliminary flood risk assessment is prepared by the Ministry of Agriculture, Forestry and Water Management – Republic Water Directorate, in accordance with the Law on Waters, for a period of six years. This assessment must include floods caused by river overflow (external waters) and by excessive groundwater (internal waters). It is required to contain maps of the water area with topographic features, river basin and sub-basin boundaries, and land use patterns, a description of historical floods that significantly affected human life and health, the environment, economic activity, and cultural heritage, together with an assessment of the likelihood of similar events occurring again in the future, and an evaluation of the potential harmful effects of future floods, taking into account the location of watercourses, their hydrological and geomorphological features, the condition of flood defense structures, the location of settlements, and topographical characteristics ("Official Gazette of the RS," Nos. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018, Art. 45).

The key purpose of the preliminary flood risk assessment is to identify areas that are particularly exposed to flooding and in which the likelihood of severe, harmful consequences is increased. According to the 2019 assessment, which analyzed floods from 2012 to 2019, the number of identified significant flood-prone areas rose slightly compared with the 2012 assessment. While the earlier assessment identified 99 such areas, the later one identified 101 areas as being significantly threatened by flooding. These water areas

and significant flood-prone zones are presented on the map published by the Ministry of Agriculture, Forestry, and Water Management (Retrieved from the Ministry of Agriculture, Forestry, and Water Management website: https://www.rdvode.gov.rs/uredjenje-vodotoka.php).

2.2. The concept and types of floods in Serbia

According to Sekulić and colleagues, Southeastern Europe is regarded as a region particularly vulnerable to natural disasters, not only because of its geographical position and climatic characteristics, but also because of the unstable economic circumstances in many of its countries, which further intensify the effects of natural hazards. In the case of the Republic of Serbia, a long-standing exposure to the harmful effects of disasters is especially evident, and the country is particularly prone to floods (Sekulić, Dimović, Krnajski-Jović, & Todorović, 2012). Since the earliest stages of human settlement, floods have been among the greatest threats to people and the environment. Historically, communities were established near rivers because such locations offered fertile land and high agricultural productivity (Ćuzović, 2019, p. 22). However, as Ndini emphasizes, areas exposed to flooding are characterized by a dual reality: they offer substantial benefits but also involve considerable risk. This remains true today, although it is also clear that flood risk is continuously increasing, partly as a consequence of intensified climate change and partly due to human activities that alter natural conditions (Ndini, 2020, p. 53).

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Floods have been defined in different ways in the literature. One definition describes a flood as a natural phenomenon involving an unusually high water level in rivers and lakes, resulting in water overflows from the river channel or lake basin that cross the banks and inundate adjacent land (Đorđević, 2017, p. 153). According to Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks, which has been incorporated into the Serbian Law on Waters, a flood is understood as the temporary covering of land that is not normally submerged by water. Such flooding may result from external or internal waters. At the same time, a flood area is defined as an area periodically inundated due to river overflow or excess internal waters ("Official Gazette of the RS," Nos. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018, Art. 3).

The causes of floods may vary considerably, but for analytical clarity, they are commonly divided into direct and indirect causes. Direct causes include precipitation in the form of rain or snow, ice formation on rivers, water-level conditions at the time of rising waters, channel meandering, landslides, and coincident high waters. Indirect causes include the size and shape of

the catchment area, the density of the river network, relief characteristics, soil saturation, the degree of afforestation and agricultural use in the basin, groundwater levels, fires that endanger flora and fauna, human influence, inadequate sediment removal from rivers, climate change, and insufficient embankment systems (Đorđević, 2017, pp. 154–155). Taken together, these causes show that floods are shaped not only by hydrological processes, but also by broader environmental and human factors.

For a better understanding of flood danger, it is also necessary to distinguish between different types of floods. Ndini notes that floods may be classified by their origin, the consequences they produce, the geography of the affected area, the underlying cause, or the speed at which they develop (Ndini, 2020, p. 54). Gavrilović and colleagues distinguish six main types of floods: floods caused by precipitation or snowmelt, floods caused by the coincidence of high waters, ice floods, torrential floods, floods caused by landslides, and floods caused by dam failure (Gavrilović, Milanović-Pešić, & Urošev, 2012, p. 108). In Serbia, the first two types occur most frequently, while ice floods were more common in the past, especially in the valleys of the Velika and Južna Morava rivers. Torrential floods are also relatively frequent, particularly in the basin of the Južna Morava, where they occur as a result of inadequate regulation of mountain watercourses. The last two categories are rare in Serbia, although historical cases show that they can cause catastrophic consequences when they do occur (Gavrilović, Milanović-Pešić, & Urošev, 2012: 108).

Floods can also be classified according to their frequency of occurrence. In that respect, they may be described as semi-annual, annual, hundred-year, thousand-year, and rare "mega" floods (Ćuzović, 2019: 23). In addition, Directive 2007/60/EC distinguishes floods of low probability or extreme events, floods of medium probability, and floods of high probability when flood hazard maps are being prepared. When the timing of flood wave formation is taken into account, floods may also be categorized as slow floods, which are typical of plains and generally require more than ten hours for the formation of a flood wave, torrential floods, which are characteristic of mountainous terrain and develop in less than ten hours, and accidental floods, which result from failures of water management or hydropower facilities and may develop almost instantaneously (Đorđević, 2017, p. 155).

Floods in the Republic of Serbia pose a potential threat to 1.6 million hectares of land, which amounts to 18% of the national territory (Gavrilović et al., 2012, p. 108). At the same time, 2.5 million inhabitants, or approximately 42% of the population, together with 32% of the country's GDP, are exposed to flood risk (Ćuzović, 2019, p. 25). The most endangered regions include Vojvodina, Posavina, and Pomoravlje, while the areas most often flooded

are located in the valleys of the Tisa, Sava, Velika Morava, and Danube rivers (Gavrilović et al., 2012, p. 108). Although floods may occur at any time of year, they are most common in Serbia in spring and autumn. In spring, a combination of rainfall and snowmelt in mountainous areas creates favorable conditions for flooding, as was the case in May 2014, while autumn is often marked by short but intense rainfall events that arise suddenly and produce flooding in riparian zones (Anđelković, Kovač, 2016, p. 23).

Serbia has had to contend with floods for many decades. One of the most significant floods of the twentieth century occurred in 1965, when the Danube overflowed and affected all river courses, inundating 150,000 hectares of land, destroying 16,000 houses, and damaging 214 kilometers of road infrastructure. In the twenty-first century, 2005 was marked by severe floods in Central Banat. The damage from these floods was estimated at 12.6 million euros, while an additional 3 million euros were spent on reconstruction and on improving flood protection systems (Nadlanu, 2014). Nevertheless, despite experience, Serbia was unprepared for the floods of May 2014, which remain remembered for their catastrophic impact. These floods are regarded as the most severe in the previous 120 years. A total of 1.6 million inhabitants were affected, more than two-thirds of municipalities experienced consequences, and the total financial damage was estimated at 1.7 billion euros (Bjelić & Lazarević, 2016, p. 6).

2.3. The impact of climate change on increasing flood risk at the local level

Climate change is increasingly recognized as one of the greatest threats to humanity in the twenty-first century, and such an assessment is well-founded. Rising average temperatures, expanding urbanization, the disappearance of agricultural land, glacier melt, sea-level rise, increasing ocean acidity, shifts in precipitation patterns, and growing threats to biodiversity all represent direct consequences of climate change whose effects have become more pronounced in recent years and have produced serious repercussions for both people and the environment (Milović, 2018).

To understand climate change more clearly, it is first necessary to consider the greenhouse effect. When solar energy reaches the Earth's surface, one portion is reflected toward the atmosphere. Greenhouse gases such as water vapor, carbon dioxide, and methane absorb and reflect part of this radiation, thereby warming the Earth's surface. Under natural conditions, this process is necessary for maintaining temperatures suitable for life. In practice, however, the ever-growing concentration of these gases in the atmosphere has led to rising global temperatures. This phenomenon is commonly described as global warming or climate change (Milović, 2018).

Among greenhouse gases, carbon dioxide has the strongest influence on temperature increase, and its concentration is directly associated with human activity. Over the last 250 years, the concentration of carbon dioxide in the atmosphere has risen by 35%, or approximately 100 ppm, while between 1995 and 2005 alone it increased by 19 ppm, which represents the highest recorded increase in such a short period. These alarming developments contributed to the organization of the 1992 Rio de Janeiro Summit, where the United Nations Framework Convention on Climate Change was adopted, thereby formally marking the beginning of a more coordinated global response to climate change (Sekulić et al., 2012, p. 14).

By 2015, the average global temperature had increased by 1.5°C, while the latest report of the Intergovernmental Panel on Climate Change indicates that temperatures may rise by as much as 4.5°C during the period from 2021 to 2050 (IPCC, 2022). Such warming affects both land and ocean surfaces. It accelerates water evaporation, which is then transported through the atmosphere and eventually returns to the ground as rain or snow (Trenberth, 2005). In this way, climatic changes directly affect the quantity and intensity of precipitation, thereby increasing flood risk (Milović, 2018). Although monitoring the precise impact of climate change on precipitation remains complex and regionally variable, current knowledge suggests that already dry regions will tend to become even drier due to reduced rainfall. In contrast, wet regions are likely to experience shorter but more intense rainfall events (Milović, 2018).

Researchers associated with the World Weather Attribution initiative have also examined the relationship between precipitation and flood occurrence, particularly in the context of how intensified climate change produces increasingly visible year-to-year differences in rainfall. Their research focused on Western Europe, including eastern France, western Germany, eastern Belgium, Luxembourg, and northern Switzerland. They concluded that rising temperatures increase the likelihood of catastrophic rainfall and that human activity is the principal driver of climate change that intensifies precipitation and creates favorable conditions for devastating floods (Mekgaret, 2021).

In response to these developments, many international organizations, institutions, regional bodies, and states have sought to identify ways of reducing the harmful consequences of climate change through panels, platforms, negotiations, and summits. In that context, the European Commission prepared a legislative proposal to reduce greenhouse gas emissions, with the overarching goal of achieving carbon neutrality by 2050. To pursue this goal, states are expected to prepare and adopt long-term greenhouse gas emission reduction strategies, such as Serbia's Low Carbon Development Strategy, as

well as medium-term greenhouse gas reduction plans known as Nationally Determined Contributions (Danas, 2022).

By ratifying the 2015 Paris Agreement, the Republic of Serbia assumed an obligation to prepare and submit these documents to the international community. However, Serbia has made only limited progress in this regard. Although a draft of the Low Carbon Development Strategy exists, it has not yet been formally submitted. The Nationally Determined Contribution was presented publicly in 2020, but likewise not submitted to the international community. At present, the principal normative documents regulating this field remain the Law on Climate Change and the Law on Energy (Danas, 2022).

2.4. Flood defense at the local level

Because the consequences of floods are so extensive and multidimensional, it is necessary to establish an adequate protection system against them. Effective flood defense requires institutional bodies responsible for disaster risk reduction and the coordination of response, recovery, and rehabilitation, as well as an appropriate legal and strategic framework comprising laws, strategies, plans, and decrees related to disaster risk reduction and flood protection. These formal elements must also be accompanied by practical implementation, public education, and continuous dissemination of information to the population if flood defense is to function effectively at all levels.

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Contemporary flood defense is based on three basic principles. The first is sustainable development, which implies awareness that absolute protection against floods does not exist and that the focus must therefore shift toward understanding floods as a phenomenon with which societies must learn to live. The second is integration, meaning that structural and non-structural measures must be combined in order to provide an appropriate degree of protection. The third is coordination, which requires harmonized action among authorized bodies at the local, national, and international levels (Kljajić, Popović, & Grujić, 2016, p. 597).

According to the Law on Waters, flood defense refers to protection against high external and internal waters, as well as against ice accumulation. It may take the form of regular or extraordinary defense. The Law provides that flood defense is declared on a river section when the water level reaches elevations prescribed by the operational flood defense plan and a further rise in water level is expected, when the conditions for the formation, movement, and accumulation of ice meet the criteria prescribed by the operational plan, or when flood protection structures are endangered due to prolonged high

water levels. Flood defense may also be declared within a hydromelioration system when the conditions and criteria defined in the operational plan are fulfilled ("Official Gazette of the RS," Nos. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018, Art. 53).

In the Republic of Serbia, waters are classified into Class I and Class II categories. A special decision determines which class of waters include interstate waters. Flood protection structures on Class I waters are managed by the public water management company responsible for the relevant territory, while structures regulating watercourses on Class II waters are managed by the local self-government unit on whose territory they are located. In order to manage the risks arising from the harmful effects of water effectively, it is necessary to prepare a preliminary flood risk assessment, a general and operational flood defense plan, a flood risk management plan, and to implement regular and extraordinary flood defense measures, as well as erosion and torrent control ("Official Gazette of the RS," Nos. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018, Art. 45).

The General Flood Defense Plan is adopted for both Class I and Class II waters. It is prepared by the ministry responsible for water management and adopted by the Government for a period of six years. The Operational Plan is likewise adopted for Class I and Class II waters, as well as internal waters. The public water management company prepares it in accordance with the General Plan. It is adopted by the competent ministry no later than 31 December of the current year for the following year ("Official Gazette of the RS," Nos. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018, Art. 55).

Regarding specific flood-protection activities, Kljajić and colleagues distinguish between structural and non-structural measures. Structural measures include both active and passive forms of protection. Active measures are aimed at reducing the adverse characteristics of high waters and addressing downstream problems along watercourses. These measures include the construction of reservoirs and retention basins, river regulation designed to increase discharge capacity, diversion channels, and catchment area regulation to ensure more even runoff. Passive measures are intended to prevent the direct overflow of high waters from river channels and include the construction of embankments, diversion channels, and protective walls that prevent water from entering protected areas.

By contrast, non-structural measures include preventive and operational actions, regulatory and institutional measures, solidarity-based measures, and information and education. Preventive and operational measures are directed at reducing the harmful effects of floods in all phases of defense and include the adoption of regulations and flood defense plans, as well as the forecasting of flood waves and the transmission of information to all relevant

levels. Regulatory and institutional measures consist of legal rules and decrees that define how flood-prone areas may be used. Solidarity measures are mechanisms aimed at reducing the negative effects of floods on social and economic systems during and after inundation. Information and education are also indispensable, as both the population and the personnel involved in flood defense must continually update and expand their knowledge in this field (Kljajić et al., 2016, pp. 594–595).

Protection against the harmful effects of water falls within the competencies of the Republic of Serbia, the autonomous provinces, local self-government, households, and the population more broadly. At the local level, self-governing units are obliged to adopt protection and rescue plans in accordance with the general and operational plans. However, several additional activities are particularly important for improving the protection of people and property and for strengthening local self-government's resilience to flood risk. One of these is land use management. Local communities are required to adopt valid planning and spatial planning documentation, since inappropriate land use in flood-prone areas significantly increases flood risk and the potential threat to people and the environment. To prepare such documentation properly, it is necessary to determine flood zones and potentially flood-prone zones within the community's broader zoning plans. It is also important to regulate the relocation of building and regulatory lines where technically feasible, and to define recommendations regarding the use of ground floors and basements, including prohibiting basement construction and specifying appropriate construction materials in flood-prone areas.

Another essential activity is flood preparedness, which includes implementing local preventive measures to reduce flood risk. Financing preparedness is equally important, since it provides the financial basis for reducing potential losses and protecting both individuals and communities. For example, insurance of buildings and property may represent one form of preparedness consistent with the principle of "living with floods." Raising public awareness about floods is also indispensable. This includes ensuring that information about flood risks, harmful consequences, evacuation procedures, first aid for affected persons, and related issues is widely available. It also implies the maximum possible use of media channels to inform as many people as possible about how to act before, during, and after floods (Stefanović, Gavrilović, & Bajčetić, 2014, pp. 57–58).

2.5. Consequences of floods and recovery at the local level

Because floods are both the most frequent and the most destructive natural hazard in the Republic of Serbia, they represent one of the greatest dan-

gers to human communities and have a particularly strong negative impact on the country's social and economic development.

The harmful effects and damage caused by floods may be classified in several ways. One common distinction is between material and non-material damage. Material damage includes losses that can be compensated, repaired, reconstructed, or replaced. In contrast, non-material damage refers to physically irreparable losses, such as human lives or parts of ecosystems whose usability has been destroyed by pollution (Messner & Meyer, 2006).

Another distinction concerns the difference between direct and indirect effects. Direct effects are those that arise from immediate contact between water and people, property, or the environment. These include fatalities, building damage, ecosystem destruction, livestock losses, contamination of agricultural land, and similar consequences. Indirect effects arise from floods' influence on broader social and economic processes. These include production interruptions due to building or facility damage, power outages and communication breakdowns, disruptions to the delivery of essential goods because of damaged transport infrastructure, and the inability to access public services such as health care and education (Messner & Meyer, 2006).

The floods of 2014 provide a particularly clear example of both direct and indirect consequences. They affected 1.6 million inhabitants, representing 22% of the population, while 51 people lost their lives. A total of 38 local self-government units suffered consequences, mainly in central and southern Serbia, and 32,000 people were evacuated. At the same time, serious indirect effects also emerged. Health institutions encountered difficulties because many of them suffered physical damage. At the same time, a large number of schools ceased functioning either because they were damaged or because they had to be used as temporary shelters for evacuated persons. An additional risk arose from the possible spillage of hazardous waste, as high groundwater levels threatened industrial zones. At the same time, large areas of agricultural land became unusable due to the deposition of harmful substances (Bjelić & Lazarević, 2016: 13). Although such consequences should ideally be prevented through adequate risk assessments and well-developed protection and rescue plans, where they nevertheless occur it is essential to have clear normative regulation and competent institutional bodies capable of coordinating recovery and assistance.

Following a natural disaster, the recovery and assistance process begins to restore normal life as quickly as possible. In the Republic of Serbia, the 2014 floods were followed by certain institutional and normative changes. An operational body of the Government, originally called the Office for Reconstruction and Assistance and today known as the Office for Public Investment Management, was established to perform professional and ad-

ministrative tasks related to assistance and post-disaster reconstruction. Its competences include coordinating the work of government bodies, donors, creditors, and other interested actors to support affected households and businesses (Bjelić & Lazarević, 2016, p. 15).

At the normative level, the Law on the Elimination of the Consequences of Floods in the Republic of Serbia was adopted, which has since been renamed the Law on Recovery after a Natural and Other Hazard. This law regulates the procedure of recovery and assistance provided to citizens and business entities that have suffered material damage as a consequence of a natural hazard (Vujičić, Maksimović, Stanimirović, 2020, p. 6).

The recovery and assistance procedure in the Republic of Serbia functions through several interconnected stages. Once a natural disaster has been declared, the Government adopts state recovery and assistance programs, after which local self-government units establish damage assessment commissions and issue public calls inviting citizens to report their losses. Once the reporting procedure has begun, the commissions assess and verify the damage. Local self-government units then conduct the procedure for determining entitlement to state aid and adopt decisions recognizing the right to such assistance. After the appeals procedure has been completed, state aid is paid to the affected parties. In cases involving the reconstruction of publicly owned facilities, the local self-government unit submits a request to the Office for Reconstruction and Assistance, and state recovery and assistance programs may also be applied to such facilities. The procedure differs somewhat depending on whether the matter involves new construction or rehabilitation. If a new facility has to be built, technical documentation must be prepared and location and construction permits obtained. In contrast, for rehabilitation, a permit to carry out works is required. The funds used for reconstruction and rehabilitation are secured from the Republic of Serbia's budget, donations, contributions, gifts, borrowing, and revenues from the sale of financial assets. At the same time, special importance is attached to financing transport infrastructure, public buildings, and facilities used for the production and distribution of electricity (Vujičić et al., 2020, p. 3).

3. Building local self-government resilience to flood risk

Resilience may be understood as the capacity of a system to absorb disturbance, respond to adverse conditions, and restore its key functions after disruption (Cutter et al., 2008). In the field of disaster studies, this concept is particularly relevant for analyzing local communities' ability to cope with flood hazards and recover from their consequences. For that reason, this chapter focuses on how local self-government units can enhance their re-

silience to flood risk and strengthen their institutional, social, and developmental capacities. A fundamental precondition for strengthening resilience is the existence of an adequate normative and institutional framework in disaster risk reduction, and its harmonization with international policy documents and strategic directions. In the Republic of Serbia, a major step in this regard was made in 2018 through the adoption of the Law on Disaster Risk Reduction and Emergency Management, which is aligned with the priorities of the Sendai Framework and places special emphasis on strengthening the role of local self-government in disaster risk reduction (Official Gazette of the Republic of Serbia, No. 87/2018). The adoption of this law represented an important shift from a predominantly reactive approach toward a more preventive and integrated understanding of disaster management. It also created a clearer legal basis for defining the obligations of local authorities in relation to preparedness, prevention, response, and recovery.

At the same time, the Law on Waters is also of considerable importance because it regulates flood-related issues in more detail, including the definition of institutional responsibilities and the organization of flood protection measures. In addition, this law prescribes the adoption of the Water Management Strategy for the Territory of the Republic of Serbia as one of the key planning documents in this area. Alongside these legal and strategic acts, it is also necessary to highlight the National Programme for Disaster Risk Management, which was adopted after the 2014 floods to improve the mobilization, distribution, and coordination of financial and institutional resources for more effective disaster risk management (Official Gazette of the Republic of Serbia, Nos. 30/2010, 93/2012, 101/2016, 95/2018, 95/2018; National Programme for Disaster Risk Management, 2014). Together, these documents form the basis of Serbia's normative framework for flood risk reduction and indicate that resilience cannot be strengthened without clearly defined responsibilities, long-term planning, and coordinated action.

In addition to the official documents that govern the role of local self-government in reducing flood risk, academic literature has developed approaches to assess community resilience across different forms of capital. This perspective includes natural, economic, physical, human, and social or institutional capital, all of which are essential for decreasing vulnerability and improving preparedness for future flood events (Mayunga, 2007). Such an approach makes it possible to understand resilience as a multidimensional phenomenon, rather than reducing it solely to legal capacity or physical protection. Therefore, this chapter aims to demonstrate that the resilience of local self-government units to flood risk in the Republic of Serbia can be strengthened not only through laws and strategies, which provide the formal framework, but also through the development of different forms of cap-

ital that directly shape the actual capacities of communities (Mayunga, 2007; Anđelković & Kovač, 2016).

3.1. Normative and legal foundations of local self-government resilience to flood risk

When international standards in disaster risk reduction, climate-related recommendations, and the experience of catastrophic events such as the 2014 floods are taken into account, it becomes evident that Serbia's adoption of the Law on Disaster Risk Reduction and Emergency Management in 2018 marked a major step toward strengthening resilience to flood risk (Official Gazette of the Republic of Serbia, No. 87/2018). This law introduced a more comprehensive legal basis for disaster governance. It emphasized that risk reduction must be approached as a continuous, planned process rather than as a response limited to emergencies. It also confirmed that local self-government units have a central role in translating national policies into concrete local action.

The law establishes the general principles governing disaster risk reduction and emergency management and explicitly identifies these matters as priorities at the local level. In addition, it recognizes local communities as key actors in implementing disaster risk management measures. According to Article 29, local self-government units are responsible for preparing risk assessments, drafting local disaster risk reduction plans and protection and rescue plans, organizing and establishing civil protection systems within their territory, forming emergency management headquarters, planning and securing budgetary resources, identifying business entities of special importance for protection and rescue, establishing civil protection units, and carrying out all necessary preventive and urgent measures aimed at reducing disaster risk (Official Gazette of the Republic of Serbia, No. 87/2018). Through these obligations, local self-government is positioned not merely as an administrative level, but as a crucial operational and strategic actor in the management of flood risk. This is especially important because the effectiveness of local action often determines the scope and severity of disaster consequences.

A more detailed regulation of water-related activities, including water management and flood protection, is provided by the Law on Waters. Integrated water management in Serbia falls under the jurisdiction of the Republic of Serbia. It is implemented through the ministry responsible for water management, the authorities of the autonomous province, local self-government units, and public water management enterprises. In order to ensure adequate flood risk management and protection from the harmful effects of

water, and in accordance with broader international approaches, the Law prescribes the adoption of preliminary flood risk assessments, flood risk management plans, general and operational flood defense plans, regular and emergency flood protection measures, as well as erosion and torrent control measures. One of the especially important obligations of local self-government in this field is the identification and designation of flood-prone zones within its territory so that adequate preventive action may be undertaken promptly. Furthermore, Article 29 of the Law defines water management planning documents, among which the Water Management Strategy for the Territory of the Republic of Serbia holds the most important place (Official Gazette of the Republic of Serbia, Nos. 30/2010, 93/2012, 101/2016, 95/2018, 95/2018). This confirms that flood resilience depends not only on emergency response capacity, but also on the quality of long-term planning and governance in the water sector.

The Water Management Strategy for the Territory of the Republic of Serbia until 2034, adopted in 2017, is a long-term planning document that determines the strategic direction of water management in the country. To be effective, it must be harmonized with other legal, strategic, and planning documents in related fields, especially spatial planning, environmental protection, and sustainable development. Based on this strategy, numerous activities are implemented in the water sector to improve the overall system and strengthen institutional and professional capacities at the national, regional, and local levels. The Strategy is adopted by the Government, upon the proposal of the competent ministry, for a period of ten years. It is reviewed every six years, as necessary, revised, or supplemented to improve water governance. During the drafting process, it is necessary to determine the existing state of water management, define its objectives and guidelines, project its future development, and identify the measures required to achieve the established goals (Official Gazette of the Republic of Serbia, Nos. 30/2010, 93/2012, 101/2016, 95/2018, 95/2018). This strategic orientation is important because it connects flood protection to broader development priorities and demonstrates that water governance is not solely a technical issue but also one of institutional coordination and sustainability.

Alongside these legal and strategic documents, which provide the basis for a systematic approach to prevention and risk management, it is also necessary to mention the National Programme for Disaster Risk Management, adopted in 2014 after the devastating floods that affected Serbia. Its main purpose is to strengthen resilience at all levels through appropriate coordination, targeted allocation of resources, and the implementation of activities aimed at reducing disaster risk and improving emergency management. The Programme is structured around six major components implemented through annual plans: institution building, risk identification and monitor-

ing, structural and non-structural risk reduction measures, early warning and preparedness, risk financing, and efficient recovery and reconstruction (National Programme for Disaster Risk Management, 2014). The importance of this Programme lies in the fact that it links prevention, preparedness, response, and recovery into a single policy framework, thereby providing the broader national context within which local self-government units can shape their own resilience-building measures.

3.2. Natural capital as a basis for flood resilience

To assess the resilience of local communities, a framework based on different forms of capital has been adopted. From this perspective, capital represents a community's ability to absorb the impacts of disasters, respond effectively, mitigate their consequences, and strengthen long-term resilience. From this perspective, resilience may be analyzed in terms of natural, economic, physical, human, social, and institutional capital (Mayunga, 2007). This model is particularly useful because it broadens the understanding of resilience beyond institutions and infrastructure, enabling observation of how different community resources interact during crises. It also highlights the fact that vulnerability is usually the result of several interconnected weaknesses rather than a single deficiency.

Natural capital includes resources such as arable land, meadows, forests, biodiversity, minerals, oil, and water, whose availability, quality, and structure strongly influence both a community's vulnerability to disasters and its overall potential for sustainable development. These resources may be grouped into two broad categories. The first includes basic resources essential for life and the functioning of ecosystems, such as land, surface and groundwater, oceans, and the atmosphere. The second comprises resources necessary for the development of culture and civilization, namely those whose exploitation and processing provide the material basis for human life, such as timber, metals, non-metals, and energy resources (Aktiviranje kapitala zajednice u svrhu vitalnog lokalnog razvoja, 2017). The condition of these resources affects not only the environmental quality of an area, but also its social stability and economic security. Therefore, natural capital should be viewed as one of the central pillars of resilience rather than as a passive environmental background.

In strengthening local resilience to floods, preserving and improving natural capital is particularly significant. Vegetation can help reduce the risk of excessive overflow in riparian areas, while forest cover may lessen erosion and contribute to greater environmental stability. Research conducted by Anđelković and Kovač shows that natural capital in Serbia is relative-

ly weak, particularly regarding agricultural land, which is among the first resources affected during floods. At the same time, agriculture itself is directly endangered. In addition, human activity, industrial development, and the intensification of the greenhouse effect represent serious pressures on natural capital (Anđelković & Kovač, 2016). This indicates that resilience to floods cannot be strengthened solely through technical or engineering measures, but must also include environmental preservation and more responsible management of natural resources.

3.3. Economic capital and the capacity for recovery

Economic stability is one of the most important indicators of a country's condition and the quality of life of its population. A stronger and more stable economy generally contributes to higher resilience to floods, whereas economic decline is commonly associated with greater vulnerability. Research conducted in Serbia has shown that economically stronger local self-government units, characterized by a higher number of business entities, stronger employment, and higher gross product, tend to recover more rapidly from disasters and possess greater capacity to cope with the consequences of floods (Anđelković & Kovač, 2016). Economic strength enables local communities to mobilize resources faster, invest more in prevention, and reduce their dependence on external assistance during recovery. In that sense, economic capital functions not only as a background condition but as an active factor in resilience-building.

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According to Al-Maruf, financial capital can directly reduce local vulnerability to floods through mechanisms such as insurance schemes and the construction of safer residential and commercial facilities. Investment in financial capital at different stages of recovery can also improve community infrastructure by supporting the construction or rehabilitation of roads, bridges, and embankments, while strengthening human capital through expenditures in education and health care. Financial capital may further contribute to resilience through access to financial services, including microfinance, and through support for small and medium-sized enterprises during periods of social and economic disruption. Previous studies have suggested that economic or financial capital may be measured through indicators such as household income, property value, employment, investment, average wages, the number of companies operating within a local community, loans, and related variables. Strengthening economic capital, therefore, enhances the capacity of individuals, groups, and communities not only to absorb the impacts of disasters but also to adapt more effectively and recover more quickly (Al-Maruf, 2017). Communities with stronger economic resources

are typically better positioned to implement both preventive and post-disaster measures.

As emphasized by Anđelković and Kovač, one of the most important directions for improving economic capital is to educate companies on preventive and reactive disaster protection measures and to raise awareness of the importance of property insurance, particularly in municipalities such as Smederevska Palanka and Loznica, where flood vulnerability is especially pronounced. In contrast to economically stronger municipalities such as Kladovo and Obrenovac, less resilient municipalities such as Mali Zvornik and Negotin remain much more dependent on external assistance and donations (Anđelković & Kovač, 2016). This difference clearly illustrates that disparities in local development are directly reflected in unequal disaster recovery capacities. For that reason, any long-term resilience policy should also include measures to reduce local economic inequalities and strengthen local development potential.

3.4. Physical capital and critical infrastructure

Physical capital includes essential infrastructure such as transport systems, shelters, communication networks, water supply systems, health institutions, and markets, as well as production equipment and other tangible assets that help people maintain safety and a certain level of well-being. It is one of the most important resources available to communities because it provides households and groups with the material basis necessary for survival and recovery during and after both natural and human-induced disasters. However, access to physical capital is not distributed equally, especially in poorer rural communities, so not all communities are in a position to control the physical resources available to them directly (Al-Maruf, 2017). Unequal access to infrastructure often results in unequal exposure to disaster impacts, which is why the quality and accessibility of physical capital must be regarded as fundamental dimensions of local resilience.

There is no doubt that critical facilities and infrastructure play a decisive role in ensuring access to resources and support during crises. Conversely, the absence of physical infrastructure or critical facilities can significantly weaken households' and communities' capacity to cope with disasters (Al-Maruf, 2017). For this reason, physical capital may be assessed based on access to educational institutions, housing, mass media such as television, newspapers, and computers, the quality of water supply and sewage systems, distance from regional centers, and the level of road infrastructure development (Anđelković & Kovač, 2016). These indicators show that physical resilience depends not only on major infrastructure, but also on the availa-

bility of everyday services and facilities that become critically important in emergencies.

To improve physical capital in municipalities across the Republic of Serbia, it is necessary to plan the efficient use of available facilities that could serve as emergency reception centers. In contrast, continuous investment in road infrastructure can improve connectivity and facilitate the delivery of assistance during disasters (Anđelković & Kovač, 2016). Additional attention should also be given to maintaining and modernizing infrastructure in areas exposed to repeated flooding, because without sustained investment, even previously adequate infrastructure may become a source of vulnerability rather than protection.

3.5. Human capital and community adaptive potential

Human capital is generally understood as the stock of knowledge, skills, and abilities possessed by the labor force. Historically, this concept was first used to support the view that a country could achieve economic growth if its workforce became larger, healthier, and better educated, even without a simultaneous increase in physical capital (Husted et al., 2022). Over time, however, the concept has taken on broader significance and has become highly relevant in disaster studies. Today, human capital is increasingly recognized as a key determinant of a community's ability to prepare for, respond to, and recover from disasters.

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From a disaster resilience perspective, people represent the greatest potential to strengthen local community resilience. Human capital may therefore be understood as the development of population capacities through formal and informal education, as well as through the acquisition of practical skills that indirectly reinforce other forms of capital. In addition, experience gained from previous flood events enables people to accumulate knowledge, refine their response patterns, and strengthen local adaptive capacities (Al-Maruf, 2017; Husted et al., 2022). In that sense, human capital operates both as a direct and an indirect resource for resilience, shaping not only individual preparedness but also the community's collective ability to learn, organize, and adapt over time.

In Serbia, a large share of older adults, children, ill persons, and social welfare beneficiaries contributes to greater vulnerability during disasters, complicating responses and necessitating the inclusion of these groups more systematically in local disaster risk reduction plans. Research has also shown that insufficient protective measures and the absence of economic support for welfare recipients contribute to the growth of poverty during emergen-

cies in municipalities such as Nova Crnja and Mali Zvornik. For this reason, measures aimed at protecting social welfare beneficiaries should be incorporated into local response and recovery policies (Anđelković & Kovač, 2016). This issue is especially important because disaster vulnerability is not distributed equally across the population. A resilience-oriented policy must therefore devote particular attention to those groups whose capacities for self-protection are more limited.

A useful example of good practice in the integration of disaster risk reduction into education can be found in Armenia, where a programme was implemented within the framework of the European Commission Humanitarian Aid Department's Disaster Preparedness Programme, in cooperation with UNICEF, UNDP, Save the Children, Oxfam, and the Armenian Red Cross Society. The purpose of the programme was to provide disaster risk reduction education, strengthen institutional capacities, improve the technical preparedness of emergency management bodies, and include children with disabilities in the national disaster risk reduction strategy. Among the concrete measures introduced were a new warning system for persons with visual or hearing impairments, special fire safety measures, and adapted elevators for wheelchair users (Palonka & Evidente, 2022). Such examples demonstrate that human capital can be strengthened most effectively when education, inclusion, and practical preparedness are approached in an integrated manner. They also confirm that resilience-building measures should be adapted to the needs of different social groups.

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3.6. Social and institutional capital in local flood risk reduction

When discussing communities in hazard-prone areas, especially those exposed to flooding, it is necessary to focus not only on structural measures but also on non-structural approaches to disaster risk reduction. In this context, the social dimension of a community becomes one of the most important elements of disaster management at the local self-government level. It is evident that social capital plays a major role in different phases of the disaster risk management cycle, both before and after disasters, and may therefore be used as an important collective resource for strengthening local resilience (Sanyala & Routray, 2016). Strong communities are defined not only by their infrastructure and institutions, but also by the quality of relationships among their members. For that reason, social ties should be understood as a practical resource in times of crisis rather than merely as a background social characteristic.

One definition of social capital presents it as a feature of social organization that includes networks, norms, and trust. At the same time, in the

context of community resilience, it reflects the quality and scope of social cooperation. Drawing on previous disaster experience, some authors argue that the most resilient communities are precisely those that can mobilize all available capacities and unite around a common goal (Mayunga, 2007, p. 7). This interpretation makes it clear that resilience is not exclusively technical or institutional, but also deeply relational and collective. Communities characterized by stronger cooperation and trust are usually better prepared to respond to disruptive events and recover more effectively from their consequences.

Among the most important determinants of resistance and response to natural disasters is the social dimension itself, including population cohesion, the quality of interpersonal relations, information exchange, and mutual trust (UNDP). Indicators of social capital used in measuring community resilience include political participation at the municipal level, the number of telephone subscribers, the number of school dropouts, and the level of computer literacy (Anđelković i Kovač, 2016, p. 64). These indicators show that social capital may be observed through both formal participation and everyday capacities for communication, inclusion, and access to information. In practical terms, this means that resilience depends as much on social connectivity as on formal institutional preparedness.

Research in the field of disasters has produced strong evidence regarding the importance of social cohesion during and after disasters, demonstrating that social networks provide not only financial assistance, such as loans and gifts for repairing damaged property, but also non-financial support, including search and rescue, debris removal, childcare during recovery, emotional support, shelter, and information. In contrast, isolated individuals with few social ties are less likely to receive first aid or support during evacuation and sheltering (Aldrich & Meyer, 2014, p. 3). This confirms that social isolation may substantially deepen disaster vulnerability. It also explains why the strengthening of local social ties should be regarded as an important element of flood risk reduction policy.

In the Republic of Serbia, the principal indicator of social and institutional capital is citizens' participation in political decision-making. Thus, in cities such as Šid, Novi Pazar, Smederevska Palanka, Kragujevac, and Kraljevo, where political engagement among citizens is relatively high, residents may advocate for the inclusion of informal groups within the local disaster risk reduction system. By contrast, in municipalities with low political participation, cooperation between citizens and local self-government tends to remain confined to the formal disaster risk reduction framework. The development of local policies and procedures for disaster risk reduction should therefore be based on the inclusion of vulnerable groups for the purpose of strength-

ening their resilience in emergencies, the education of children and youth at all levels of schooling, and the adequate use of social networks for disseminating information on prevention measures, protection, and response in disaster situations (Anđelković i Kovač, 2016, p. 101). In that respect, institutional openness and citizen participation should be understood as mutually reinforcing components of resilience. The stronger the cooperation between institutions and the community, the greater the likelihood of effective disaster risk reduction and successful recovery.

4. Conclusion

Undoubtedly, natural hazards are among the greatest threats facing humanity in the twenty-first century. Owing to their characteristics, such as sudden onset and intensity, they continuously pose a threat not only to human life and health, but also to critical infrastructure and the environment. The region of Southeastern Europe, due to its geographical position and climatic characteristics, is known to be highly susceptible to natural hazards. At the same time, the Republic of Serbia, in particular, has long been marked by floods. This phenomenon has always accompanied it and continues to pose a major threat to protected values.

Although floods have long been an integral part of human life and were even explained as an "act of God," in recent decades, their frequency, intensity, and speed of onset have changed significantly, and we are witnessing increasingly frequent and destructive flood events with clearly identifiable causes. One of those causes is certainly ongoing climate change, the rapid intensification of which is driven by human activity and harmful impacts on nature. This results in ozone depletion, an increase in average annual temperatures, the destruction of biodiversity, an increase in precipitation, and similar processes, all of which together create favorable conditions for floods.

Efforts to align legal and strategic documentation with the recommendations and regulations of international organizations in the field of disaster risk reduction and emergency management, together with the timely and adequate implementation of preventive activities such as hazard-source mapping, monitoring, and risk assessment, respect for urban planning regulations and land management to avoid constructing houses and other facilities in flood-prone areas, as well as the provision of financial resources for maintaining protection systems, are essential measures for ensuring the proper functioning of the risk reduction system and strengthening resilience at the local, national, and regional levels.

After the 2014 floods, which caused catastrophic consequences and revealed numerous shortcomings and weaknesses in the risk reduction system, the key role of local self-government in risk management was recognized. Accordingly, local self-government has a primary role in undertaking both preventive and reactive measures in addressing flood risk within the territory of the local self-government unit. In the context of risk reduction, local self-government is obliged to adopt a risk assessment, designate flood-prone zones within its territory, implement flood defense plans, establish civil protection units, and organize fire and rescue units in order to ensure a more effective response in the event of floods and to reduce and eliminate their consequences.

In addition to specific normative and planning measures aimed at building resilience at the local level, an unavoidable new concept of resilience assessment is the capital-based approach—natural, physical, economic, human, and social and institutional capital—through which capacities for response to and recovery from floods are strengthened at both the local and national levels. Based on measuring the resilience capital index, that is, by analyzing each form of capital and its indicators, it is possible to determine the degree of resilience of a particular local self-government unit, while also identifying the need to improve certain capacities and resources in order to provide more adequate protection and response in the event of natural disasters.

Within the context of capital, in addition to infrastructure improvement, afforestation, and economic stability, the importance of human and social capital in disaster risk reduction has also been recognized. The main means of combating disasters lies in building the resilience of people, that is, members of the community, and equipping them to understand risk, undertake proactive measures, respond promptly, and adapt to the consequences. None of this can be achieved without non-formal educational programs that teach the local population how to act before, during, and after a disaster. This form of education not only benefits each individual but also strengthens the cohesion of a local community to confront change collectively and, in that way, supports competent services in eliminating consequences and restoring normal life.

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Article

Continuity of State Functions and Protection of Classified Information in Disaster Conditions: Theoretical Framework and Strategies of Digital Resilience

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Abstract

Contemporary integrated disaster risk management requires a holistic approach that encompasses not only the physical protection of people and material assets, but also the preservation of the continuity of key state institutions and protected information systems. This paper analyzes strategies and mechanisms for ensuring the continuity of state functions and the protection of classified information under conditions of complete or partial collapse of infrastructure and information systems caused by disasters of natural, technological, or hybrid origin. Through a comparative analysis of Switzerland's system (territorial

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decentralization model), Finland's system (total defense model), and Israel's system (constant operational readiness model), key principles of successful frameworks are identified. These include: decentralization and redundancy of critical infrastructure, a unified and functional legal-institutional framework, integration of cyber security into crisis management systems, and an institutionalized culture of regular capability testing. Based on these observed experiences, concrete recommendations are formulated for improving the system in the Republic of Serbia, including the development of a National Strategy for the Continuity of State Functions, the construction of a hierarchically organized network of backup centers following the Primary–Alternate–Contingency–Emergency (PACE) model, and the establishment of a mandatory exercise program for relevant institutions. The paper contributes to the theoretical framework of national resilience by pointing to the necessity of establishing a balance between physical and digital resilience as a key prerequisite for preserving the sovereignty and functionality of the state in conditions of deep and complex crises.

Keywords

National security, classified information protection, continuity of state functions, disasters, backup centers, digital resilience.

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1. Introduction

In the contemporary, globalized, and digitally interdependent world, the concept of national security has been significantly expanded beyond traditional military-political frameworks. Today, it also encompasses the resilience of state systems under conditions of complete or partial collapse caused by natural disasters, technological failures, or deliberate hybrid actions. This paper is based on the assumption that a state's ability, in times of extreme crisis, to ensure the continuity of its key functions while simultaneously protecting its most sensitive information represents the ultimate test of its sovereignty and functional maturity—particularly for candidate countries whose access to European security mechanisms is conditioned by harmonization with requirements, such as Decision 2013/488/EU (Council of the European Union, 2013)[1] and the protection of classified information and the Critical Entities Resilience Directive (European Parliament & Council of the European Union, 2022)[2].

The aim of this paper is to analyze the strategic, legal, organizational, and technical aspects of ensuring the continuity of state functions and the

protection of classified information in disaster conditions, with particular emphasis on the synergy of four interdependent dimensions: (1) a unified strategic framework, (2) an operational plan for the protection of classified information in emergency situations, (3) a hierarchical network of backup centers based on the PACE model, and (4) an institutionalized culture of regular testing through national exercises. Through a comparative analysis of the systems of Switzerland (territorial decentralization model), Finland (total defense model), and Israel (permanent operational readiness model), the paper seeks to formulate applicable and contextually adapted recommendations for improving the domestic normative and institutional framework, with an explicit link to European standards of institutional resilience.

Operationalization of Key Concepts

In this paper, the following terms are used in a precisely defined sense:

- *Continuity of Government (COG):* the ability of state institutions to maintain key functions of decision-making, command, and governance under conditions of extreme crises, including scenarios of partial or complete collapse of primary infrastructure.
- *Digital resilience:* the ability of information systems to maintain the integrity, availability, and confidentiality of data even under conditions of degradation or loss of primary technological resources.
- *Classified information in emergency conditions*: information whose disclosure would endanger national security, as stated in Article 4 of the Law on Classified Information (Republic of Serbia, 2009)[3], with particular emphasis on the minimal set of data necessary for the functioning of the state in crisis ("state minimum").
- *Unified continuity system:* an integrated framework that connects the strategic, normative, infrastructural, and procedural levels into a single functional whole, where each element enhances the effectiveness of the others, and the absence of any element compromises the overall preparedness of the state.

Research Gap and Contribution of the Paper

The existing literature primarily addresses the continuity of government functions through the lens of crisis management and the physical resilience of infrastructure (Boin & McConnell, 2007)[4], while the protection of classified information is analyzed within the frameworks of information security and cyber defense (Dunn Cavelty & Suter, 2009)[5]. However, there is a lack of a theoretical framework that integrally connects institutional continuity and the protection of the most sensitive data as synergistic components of

national resilience under conditions of total collapse. Furthermore, current research neglects the Euro-integration dimension of this issue—namely, the fact that for candidate countries, the development of continuity systems is a prerequisite for security cooperation with the EU and for access to classified information within the framework of the Common Foreign and Security Policy.

This paper fills the identified gap through a holistic model of "physical-digital resilience," which: (a) conceptually integrates the maintenance of decision-making functions and the protection of classified information as inseparable elements of state sovereignty; (b) offers a comparative analysis that simultaneously encompasses legal, technological, institutional, and procedural aspects; (c) formulates a mechanism for transposition into the domestic context through the synergy of four system dimensions; and (d) explicitly connects the domestic solution with the European framework, with a direct link to Article 87, paragraph 1, item 9 of the Serbian Law on Classified Information and its European parallel in Article 15 of the previously cited Decision 2013/488/EU.

2. Theoretical Framework: Resilience as an Existential Prerequisite of Sovereignty

The concept of national resilience today requires a theoretical rearticulation that goes beyond its traditional definition as the ability of a system to 'recover after disruption' (Hollnagel, 2011)[6]. In the context of hybrid threats and cascading crises, resilience must be understood as an existential prerequisite of sovereignty—the ability of the state to preserve its functional identity amid total or partial collapse of physical and digital infrastructure. This theoretical framework is built upon three interrelated foundations:

First, the theory of Complex Adaptive Systems (CAS) enables the conceptualization of the state not as a static bureaucratic structure, but as a dynamic system that must preserve its functional integrity even when its physical carriers disintegrate (Comfort et al., 2010)[7]. In this sense, continuity of government functions is not a matter of maintaining buildings or servers, but of safeguarding the network of decision-making, legitimacy, and control that constitutes the state as a political entity. When primary infrastructure is compromised, the state must be able to 'shift' to alternative carriers of that network—requiring predefined protocols, redundant systems, and a culture of institutional adaptation.

Second, the theory of sovereignty in the digital age requires a revision of the classical Weberian definition of the state as the monopoly on legitimate physical force (Weber, 1919)[8]. In the era of cyber and information warfare, control over key information becomes an equally important component of sovereignty as control over territory (Kello, 2017)[9]. The loss of access to classified data on critical infrastructure, military capabilities, or diplomatic communications in times of crisis does not represent merely a technical obstacle—it constitutes an existential threat to sovereignty, as it prevents the state from making informed decisions about its own survival. In this context, the protection of classified information under emergency conditions is not a subdomain of information security, but the very core of the concept of state survival.

Third, the concept of the "state minimum"—the minimal set of functions and information necessary to preserve the state as a political entity under conditions of total crisis—requires theoretical grounding in Schmitt's understanding of sovereignty as "the ability to decide on the state of exception" (Schmitt, 1922)[10]. In a state of exception caused by disaster, the state must be able to maintain three elements of the "state minimum": (a) the chain of decision-making and command; (b) access to key information on security and critical infrastructure; and (c) the ability to communicate among the holders of sovereignty.

The loss of any of these three elements leads to the disintegration of the state as a functional entity—even if its territory and population physically survive the disaster.

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On the basis of this threefold theoretical foundation, a holistic model of "physical-digital resilience" has been developed, which represents the key contribution of this paper. The model assumes that physical resilience (protected locations, redundant infrastructure) and digital resilience (data protection, continuity of information flows) are not additive dimensions, but synergistically conditioned: physical infrastructure loses its meaning without access to key information, while data becomes powerless without functional institutions capable of using it for decision-making. Therefore, the development of a continuity system for state functions is possible only through the integration of four interdependent dimensions—strategic framework, operational plan, infrastructure, and testing culture—into a unified system whose integrity is greater than the sum of its parts.

Finally, for candidate countries, such as Serbia, this theoretical framework acquires an additional dimension through the theory of regulatory harmonization. The European Union has developed the concept of collective resilience as the foundation of its security architecture, where the ability of each member state to maintain functionality in crisis is a prerequisite for

the security of the entire bloc (European Commission & High Representative of the Union for Foreign Affairs and Security Policy, 2016,[11]; European Commission & High Representative of the Union for Foreign Affairs and Security Policy, 2022,[12]; Council of the European Union, 2022[13]). In this sense, the development of continuity systems is not merely an internal security imperative, but also a theoretical condition for integration into the European security space—adding normative weight to the theoretical framework presented in this chapter.

3. Methodological Approach: An Integrated Methodology for Analyzing the Unified Continuity System

This paper applies an integrated methodological approach that combines four interrelated methods in accordance with the theoretical framework of "physical-digital resilience":

1. Normative-legal analysis of the domestic framework;
2. Comparative case study with theoretical sampling;
3. Doctrinal analysis of European standards;
4. Synthetic method for constructing the model of the "unified continuity system".

The comparative method is not the primary research instrument, but rather an analytical intermediary that enables the identification of universal structural principles from different national contexts, while avoiding the mechanical transplantation of solutions.

4. Comparative Analysis: Structural Principles of Continuity from the Experience of Three Models

The comparative analysis in this chapter is not aimed at identifying "the best model" that could be mechanically adopted and implemented in the domestic context, but rather at extracting the structural principles underlying functional and sustainable systems of continuity of state functions. Each of the three models analyzed — Swiss, Finnish, and Israeli — was developed within a specific geostrategic, historical, and institutional environment, shaped by different threats, resources, and political-legal traditions. Nevertheless, despite these differences, all three models demonstrate a shared capacity to preserve the so-called "state minimum" in conditions of extreme crises, that is, the continuity of key functions necessary for the survival of the state as a functional and sovereign political entity.

The analysis is structured through the prism of four interconnected dimensions of the "unified continuity system" — strategic, normative, infrastructural, and procedural — which together enable a comprehensive understanding of how states institutionalize resilience in times of crisis. The purpose of this analytical approach is not to identify specific technical solutions, but to recognize conceptual and organizational patterns that have demonstrated functional sustainability and that, with critical adaptation, can be adjusted to the Serbian context. Particular emphasis is placed on their compatibility with the normative requirements of Decision 2013/488/EU, as a key European standard in the field of classified information protection and continuity of decision-making under crisis conditions.

The selection of the three states for comparative analysis is based on theoretical sampling, in line with the concept of the "state minimum" and the need to cover three key organizational-institutional models:

Table 1. Comparative analysis of three organizational-institutional models

State	Theoretical relevance	"State minimum" model	Relevance for Serbia
Switzerland	It tests the hypothesis that territorial decentralization and physical redundancy can compensate for a less developed cybernetic infrastructure	Physical dimension: underground infrastructure as a guarantee of continuity, even in the event of the loss of digital systems	Relevant for a state with pronounced regional autonomy and the need for geographical dispersion of key functions
Finland	It tests the hypothesis that legal coherence and the total integration of civilian and military resources create resilience event in a state with an exposed geostrategic position	Institutional dimension: chain of deputies, as a legal mechanism for maintaining the decision-making chain	Relevant as a model for a state that is confronted with hybrid threats and demands a unified legal framework
Israel	It tests the hypothesis that permanent operational readiness and cyber-physical integration can compensate for the lack of strategic depth	Digital dimension: automated protocols for switching to backup systems in real time	Relevant for a state exposed to continuous hybrid threats in the digital domain

Source: Author's compilation

The analysis is conducted through four analytical dimensions that directly correspond to the four components of the "unified continuity system" from the theoretical framework:

- **Strategic dimension** — analysis of the existence and quality of a unified strategic document that defines the principles of continuity of state functions;

- **Normative dimension** — analysis of the legal foundations for the protection of classified information under emergency conditions (e.g., Article 87, paragraph 1, item 9 of the earlier mentioned Serbian Law on Classified Information and Article 15 of Decision 2013/488/EU);
- **Infrastructural dimension** — analysis of the hierarchical organization of backup centers and mechanisms for offline archiving of key data;
- **Procedural dimension** — analysis of the testing culture through regular exercises simulating communication collapse and incapacitation of leadership.

As an additional methodological instrument, doctrinal analysis of European security standards (set out in the previously cited EU Strategy for Countering Hybrid Threats, Critical Entities Resilience Directive, NIS2 Directive (European Parliament & Council of the European Union, 2022) [14], and the earlier discussed Decision 2013/488/EU) was applied with the aim of identifying regulatory requirements that will become mandatory for Serbia in the process of EU accession. This analysis enables the transformation of comparative insights into European-contextualized recommendations, avoiding a "Western-centric" approach in favor of a "European-harmonized" model.

The sources used include: a) primary legal sources (laws, strategies, decisions); b) secondary sources (academic literature in the fields of security studies, resilience theory, and crisis management); c) official presentations and reports of international organizations (EU, NATO, OSCE); d) a limited number of expert interviews with representatives of competent institutions within permitted security protocols.

Research limitations — The study is subject to four significant methodological limitations that require explicit acknowledgment**:**

1. Access to classified operational protocols and technical details of continuity systems is restricted due to the nature of national security. The analysis therefore relies exclusively on publicly available sources (national strategies, laws, official reports), which limits the depth of examination of technical and operational aspects—particularly in the case of Israel, where most protocols are classified. This limitation is partially compensated through the analysis of publicly available academic works written in cooperation with security structures and through comparative triangulation of sources.
2. The scope of analysis of the domestic system is limited by the fact that many operational plans and protocols for the protection of classified information under emergency conditions (including the implementation of Article 87, paragraph 1, item 9 of the Law on Classified Information) are classified or not publicly available. This limitation is

methodologically compensated through the analysis of the normative framework and institutional capacities, with explicit acknowledgment that operational implementation may differ from formal provisions.

3. Contextual differences between the analyzed states—including geopolitical position, territorial size, demographic structure, and historical experiences with existential threats—require critical adaptation of the identified models. The Swiss model of underground infrastructure, for example, is not directly transferable to Serbia due to differing geological and financial conditions. Instead of direct adoption, the study focuses on extracting structural principles (e.g., "redundancy by design," "chains of deputies") that can be contextually implemented.
4. The dynamic nature of European regulation in the domain of critical entities' resilience means that some standards (e.g., earlier mentioned the NIS2 Directive) are still in the process of being transposed into the national legal systems of member states. This limits the possibility of precisely assessing their operational effectiveness, but does not diminish their normative relevance for candidate countries, which must harmonize their legislation prior to accession.

Despite these limitations, the applied methodological approach enables the identification of structural gaps in the domestic system and the formulation of recommendations that are theoretically grounded, comparatively verified, and European-harmonized—representing a significant methodological contribution to research under conditions of restricted access to classified operational details.

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4.1. Switzerland: Decentralization and Physical Resilience

The Swiss system of continuity of state functions is based on the principles of strict decentralization and systemic duplication of key state capacities. Federal administrative centers, archives, and server resources are housed in protected underground facilities (*Schutzbauten*), which are geographically dispersed throughout the country's territory. This spatial organization aims to minimize the risk of centralized system failure in conditions of armed conflict, natural disasters, or prolonged infrastructural disruptions.

The key structural principle of this model is *redundancy by design,* whereby every critical state function has at least one physically separate and operationally independent backup location. Continuity, therefore, does not rely on improvisation under crisis conditions but is instead embedded in the very architecture of the state.

The protection of data relevant to national security is regulated by the Federal Act on Official Secrecy (*Bundesgesetz über das Öffentlichkeitsprinzip der Verwaltung – BGÖ*), as well as by special military protocols that mandate offline archiving of the most sensitive information on physically secured media. This practice reflects an awareness of the limitations of digital security in conditions of total crisis and represents a deliberate departure from complete digital dependency (Federal Council of Switzerland, 2021)[15].

4.2. Finland: Legal Coherence and Total Defense Concept

The Finnish model of *total defense* (*kokonaispuolustus*) represents a highly integrated approach to national security that unites civil, military, economic, and social resources into a single system. This model is not limited to the institutional level but rests on a deeply rooted culture of collective defense and societal preparedness, in which security is viewed as a shared responsibility of the state, the economy, and the citizens.

The Crisis Management Act 741/2011 (Finnish Parliament, 2011) [16] obliges all ministries, local government bodies, and critical infrastructure operators to develop, update, and regularly test continuity plans. These plans are verified through national exercises, such as "Operation Total Defense," which are held annually and simulate scenarios of prolonged and multidimensional crises.

The protection of classified information in the Finnish system is based on the complementary jurisdiction of two key authorities.

- **SUPO** *(Suojelupoliisi*), as Finland's security and intelligence service, is responsible for the protection of classified information in the context of national security, counterintelligence, and conducting security clearances for individuals with access to classified data.
- **Traficom** (*Liikenne- ja viestintävirasto*) - Finnish Transport and Communications Agency, on the other hand, oversees the technical security of information and communication systems, including the protection of critical digital infrastructure and the implementation of information security standards.

A particularly significant element of the Finnish model is the precise legal regulation of the transfer of authority through the *substituutti-ketju* ("chain of deputies"), which establishes a clear and predetermined hierarchical order for assuming the powers of the President of the Republic, the Prime Minister, and ministers in the event of their incapacity. This mechanism, regulated by the Act on the Exercise of the Powers of the President of the Republic

(751/1999) (Finland, 1999) [17], and the Government Act (751/2003) (Finland, 2003)[18] ensures "continuity of decision-making and governance even under conditions of extreme crisis" (Finnish Ministry of Defense, 2022)[19].

Note on terminology: The Finnish term *substituutti-ketju* is most accurately translated as "chain of deputies" in the Serbian legal context, since it refers to a predefined sequence of individuals who assume authority according to hierarchy, rather than succession in the sense of inheritance law.

4.3. Israel: operational continuity and cyber-physical integration.

The Israeli approach to the continuity of state functions is characterized by a permanent state of operational readiness, serving as an institutional response to ongoing security, hybrid, and cyber threats. The National Emergency Management Authority (*Rashut HaHatzala HaLeumit – RAHEL*), operating within the Ministry of Defense, functions on a 24/7 basis and coordinates civilian, military, and security resources across all phases of a crisis.

The protected communications system of the state leadership, referred to in public sources by the general term "protected communications system," enables continuous, confidential, and resilient communication at all levels of government, even under conditions of intense cyberattacks and hybrid operations. This ensures the operational continuity of command and decision-making, regardless of the state of public communication networks.

Integration of cyber defense into the continuity system has been achieved through the National Cyber Directorate, which operates directly within the Prime Minister's Office and coordinates both civilian (NCSA) and military cyber capabilities. This model enables predefined protocols for the immediate transfer to backup digital infrastructures in the event of a compromise of primary systems, thereby ensuring continuity of governance and command even under conditions of partial collapse of key information systems (Government of Israel National Cyber Directorate, 2023).[20]

Note: Due to the nature of national security, details regarding the technical characteristics of protected communication systems and the locations of backup centers are not publicly available; therefore, the analysis is based solely on officially published strategic and doctrinal documents.

4.4. Synthesis: universal principles and their transferability

Although the analyzed models differ significantly in institutional structure and technical solutions, it is possible to extract from them four universal

principles that form the core of a functional system of continuity of state functions.

The first principle is ***redundancy by design,*** which means that critical functions and data must have at least one physically and logically independent backup location in order to avoid a single point of failure. The Swiss model achieves this through underground infrastructure, the Finnish model through a legally regulated mechanism of a chain of substitutes, and the Israeli model through digital duplication of systems. The first principle is *redundancy by design*, which means that critical functions and data must have at least one physically and logically independent backup location, in order to avoid a single point of failure. The Swiss model achieves this through underground infrastructure, the Finnish model through a legally regulated mechanism of a chain of substitutes, and the Israeli model through digital duplication of systems.

Another principle relates to *a unique and coherent legal framework*, which excludes fragmentation of competences and ensures clear protocols for the transfer of authority in crisis conditions. The Finnish model in this regard represents the highest standard and directly corresponds to the requirements of Article 15 of Decision 2013/488/EU.

The third principle is **cyber-physical integration**, which stems from the fact that under conditions of hybrid threats, physical and digital resilience cannot be treated as separate spheres. The Israeli model demonstrates that cyber defense must be integrated into the very architecture of continuity systems, rather than organized as a parallel or secondary domain.

The fourth principle represents **a culture of testing as an institutional norm**. Without regular, realistic, and critically oriented exercises, even the most developed plans and infrastructure lose practical value. All three models show that exercises are not treated as a formality, but as a key mechanism for identifying weaknesses and continuously adapting the system.

These principles are not tied to a specific national context and can be contextually implemented in the Republic of Serbia through the development of a unified continuity system that integrates a strategic framework, operational plans for the protection of classified information, a hierarchical network of backup centers, and a program of national exercises. The key challenge in this process is not technical feasibility, but rather the political will to overcome institutional fragmentation and to accept continuity of state functions as a permanent security priority, in line with European resilience standards that will become mandatory during the process of accession to the European Union.

Table 2. Comparative Analysis of Models for Continuity of State Functions and Protection of Classified Information

Dimensions	Switzerland	Finland	Israel
Strategic	Federal Strategy for Critical Infrastructure Protection with Emphasis on Territorial Decentralization and Resilience of State Functions	*Total defence* as a Social and Security Pact; Integration of Continuity into All Sectors of Society and the State	Permanent Operational Readiness as a Response to Continuous Hybrid and Security Threats
Normative	Federal Law on Official Secrets (BGÖ) and Special Military Protocols; Decentralized Jurisdiction at the Cantonal and Federal Levels	Crisis Management Act (741/2011); Precisely Regulated *Substituutti-ketju* (Chain of Deputies) and Clear Division of Competences between *SUPO* and *Traficom*	Continuous Operational Protocols in Emergency Situations; Integration of Cyber Defense into the Normative and Managerial Crisis Framework
Infrastructural	Underground Protected Facilities (*Schutzbauten*); *Redundancy by Design*; Offline Archiving on Physically Secured Media	Government ICT Network (*Valtioneuvoston tietoturvaverkko*), Physically and Logically Separated from the Public Internet	Protected Communications System; Automatic Switching to Backup Digital Infrastructures in Real Time
Procedural	Regular Exercises at the Local and Federal Levels; Simulations of Scenarios of Total Institutional Collapse	Annual National Exercises within the Concept of Total Defense (*Yhteiskunnallinen Turvallisuus*)	Continuous Simulations of Hybrid and Cyber Threats; Permanent Operational Readiness of the System

Source: Author's compilation

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Methodological note – The table Does Not Represent a Ranking of Models, but Rather an Analytical Tool for Identifying Structural Principles of Continuity of State Functions Across Four Key Dimensions of a Unified Continuity System.

5. Analysis of the Situation in the Republic of Serbia: Existing Framework and Challenges

The Republic of Serbia has, over the past decade, established a relatively developed legal and institutional framework for emergency management, primarily through the Law on Emergency Situations (Republic of Serbia, 2009)[21] and the National Security Strategy (Republic of Serbia, 2019)[22]. However, a more detailed analysis points to pronounced fragmentation in terms of an integrated approach to the continuity of state functions under disaster conditions, as well as the absence of a clearly articulated and normatively

consolidated concept of *Continuity of Government* within the domestic legal and institutional system. This gap is particularly evident in the domain of systemic protection of classified information, where continuity of control over sensitive data is a crucial element of state sovereignty.

5.1. Framework for the Protection of Classified Information and the Role of the Office of the National Security Council and Classified Information Protection

By the already discussed Serbian Law on Classified Information, a unified system was established for the designation and protection of classified information relevant to national and public security, defense, and the internal and external affairs of the Republic of Serbia. The central institutional actor in this system is the Office of the National Security Council and Classified Information Protection (hereinafter: the Council Office), which functions as a professional service of the Government of the Republic of Serbia with the status of a legal entity, responsible for implementing and overseeing the application of the law.

Article 87, Paragraph 1, Item 9 of that law stipulates that the Council Office "*proposes to the Government of the Republic of Serbia a plan for the protection of classified information for emergency and urgent situations*." This provision serves as the legal basis for integrating the protection of classified information into the disaster and crisis management system. However, in practice, no unified, comprehensive, and operationally applicable plan has been adopted that would encompass scenarios of complete or partial collapse of infrastructural, communication, and information systems.

Article 88 of the same law regulates the handling of classified information belonging to public authorities that have ceased to exist without a legal successor, stipulating that "*the Council Office shall take over the classified information of public authorities that have ceased to exist and have no legal successor, or assign another public authority to store and use such information*." Although this provision is significant for long-term archival protection, it operates *ex post* and does not address the continuity of access to and operational use of classified information during an active crisis, when uninterrupted and authorized access to information is crucial for making strategic and operational decisions.

5.2. Law on Information Security and Protection of Critical Infrastructure

The Law on Information Security (Republic of Serbia, 2025)[23] regulates measures for protecting information and communication systems from security risks, as well as the obligations of critical infrastructure operators. Particularly significant are Articles 5–25, which prescribe the obligation to develop incident management plans and measures for enhancing the technical and organizational resilience of systems.

Nevertheless, the aforementioned law does not contain explicit provisions concerning the continuity of state functions as an integral concept, nor does it define the hierarchy of backup systems and the priorities of state authorities' functioning under a wide spectrum of disasters. The integration of information security into the emergency management system remains at the level of general principles and sectoral obligations, without precise operational protocols that would ensure synchronized action by the Office for Information Technologies and e-Government, the Security-Information Agency, and the Ministry of Interior in conditions of systemic crisis.

5.3. Law on the Foundations of the Organization of Security Services and the Crisis Management System

By the Law on the Foundations of the Organization of Security Services (Republic of Serbia, 2007)[24], the national security system is defined as "*a set of institutions, organizations, resources, and activities carried out for the realization of national security*." The National Security Council, as the highest political body, has the role of coordination and guidance, but the law does not provide for a unified mechanism for assuming functions, ensuring continuity of command and decision-making in conditions of collapse or serious dysfunction of existing governing and managerial structures.

The Law on Disaster Risk Reduction and Emergency Management (Republic of Serbia, 2018)[25] regulates crisis management primarily through the activities of a special organizational unit of the Ministry of Interior and other protection and rescue entities. The normative focus is directed toward the protection of people, property, and the environment, while the preservation of the functionality of state institutions, continuity of decision-making, and protection of information systems handling classified data as elements of state sovereignty remain outside its primary scope.

5.4. Strategic Framework and Identified Institutional Gaps

The previously noted 2019 National Security Strategy of the Republic of the Republic of Serbia recognizes societal resilience as a key element of modern security architecture and highlights the importance of hybrid threats. However, the strategic document lacks a dedicated and systematized chapter focused on the continuity of state functions *(Continuity of Government*), as well as clearly defined indicators of institutional and digital resilience under conditions of extreme crises.

The key gaps in the domestic system can be summarized as follows:

- Lack of a unified strategy for the continuity of state functions that would integrally connect the protection of classified information, cybersecurity, and emergency management;
- Pronounced fragmentation of institutional competences, whereby the Council Office (classified information protection), the Office for Information Technologies and e-Government (infrastructure), the Security-Information Agency (security and counterintelligence protection), and the Ministry of Interior (crisis management) operate within their own mandates without a unified and pre-defined operational protocol for coordination in crisis conditions.
- Absence of a hierarchically organized network of backup centers for ensuring the continuity of state authorities' operations, including physically protected locations with offline reserves of classified information.
- Insufficiently developed culture of testing and exercises, since plans for the protection of classified information and cybersecurity are rarely verified through realistic scenarios that involve communication collapse, loss of access to key databases, and incapacitation of leadership structures.

A particular relevance for the Republic of Serbia, as a candidate for membership in the European Union, lies in the fact that the concept of resilience of state institutions—including the continuity of work with classified information in crisis conditions—is explicitly integrated into the European security architecture. The previously cited EU Strategy for Countering Hybrid Threats (2016, updated 2022) and the Joint Communication on Increasing Resilience and Bolstering Capabilities to Address Hybrid Threats (JOIN/2022/12) emphasize that a state's ability to maintain the functionality of key institutions under the pressure of hybrid threats represents a key indicator of societal resilience—one of the six fundamental pillars of the European security architecture.

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The key legal framework for the protection of classified information at the EU level is Council Decision 2013/488/EU of 23 September 2013 on the security rules for protecting EU classified information. This decision regulates not only classification and access procedures, but also obliges Member States to ensure the continuity of classified information protection under emergency conditions, including scenarios of partial collapse of information systems or incapacitation of competent authorities. Article 15 of this decision explicitly requires each Member State to establish *"security evacuation and continuity plans for classified information handling"* as part of its national system for the protection of classified information.

Additionally, the already mentioned Critical Entities Resilience Directive and the NIS2 Directive establish the obligation for operators of critical infrastructure—including public institutions managing sensitive data—to develop continuity plans. In this context, the development of a unified system for continuity of state functions in Serbia—with particular emphasis on the implementation of Article 87, paragraph 1, item 9 of the Law on the Protection of Classified Information—represents not only a domestic security priority, but also a preventive harmonization with the requirements of Council Decision 2013/488/EU. This harmonization is a prerequisite for security cooperation with the EU, access to classified information within the framework of the Common Foreign and Security Policy (CFSP), and the reduction of the regulatory gap in the final phase of accession.

Overall, the identified institutional, normative, and operational gaps point to systemic fragmentation in the domain of continuity of state functions in the Republic of Serbia. The absence of a unified strategic framework that would integrally connect the protection of classified information, cybersecurity, and crisis management makes the state vulnerable precisely in those scenarios of extreme crises where the continuity of decision-making and access to key information is most critical for the preservation of sovereignty.

6. Recommendations for Improving the System in the Republic of Serbia

Based on the conducted comparative analysis and the identified normative, institutional, and operational gaps in the domestic system, the following measures are proposed to improve the continuity of state functions in the Republic of Serbia. These recommendations are formulated as an interconnected set of measures at different levels—from strategic to operational—whose common purpose is to strengthen state resilience under conditions of extreme crises. The implementation of this framework requires prior or par-

allel regulation of cybersecurity as an integrated national-level concept, with clearly defined competences, technical standards, and operational protocols for the protection of critical information systems.

6.1. Strategic Level: National Strategy for the Continuity of State Functions

It is recommended to adopt a unified strategic document that would explicitly define the principles, objectives, and procedures for preserving the functionality of state institutions in conditions of disaster, systemic crises, and hybrid threats. This strategy would, for the first time in the domestic system, clearly articulate the concept of *Continuity of Government* as an integral part of national security.

The strategic document would integrally connect the provisions of the earlier stated Law on Classified Information (Article 87, paragraph 9), the Law on Information Security, and the Law on Disaster Risk Reduction and Emergency Management, thereby overcoming the existing sectoral fragmentation and establishing a unified framework for state action in crisis conditions. Special emphasis would be placed on preserving the continuity of decision-making, command, and control, as well as on protecting critical information and communication flows.

6.2. Normative Level: Operational Plan for the Protection of Classified Information in Emergency Situations

In accordance with Article 87, paragraph 9 of the Law on Classified Information, it is necessary to develop a unified and binding executive document—the Operational Plan for the Protection of Classified Information in Emergency and Crisis Situations. This plan would serve as a normative bridge between strategic commitments and concrete procedures for action in crisis conditions.

Such a document would include:

- A clearly defined procedure for the immediate transfer to backup systems for storing and accessing classified information;
- Protocols for offline archiving of key data in geographically dispersed and physically protected locations;
- Definition of the "state minimum" of data—a set of information essential for decision-making at the highest political and security levels under conditions of limited access to systems.

In this way, the protection of classified information, currently framed as a formal legal obligation, would be transformed into a functional instrument of state continuity.

6.3. Infrastructural Level: Hierarchical Network of Backup Centers

It is recommended to build a hierarchically organized network of backup state centers based on the PACE model *(Primary, Alternate, Contingency, Emergency).* The network would be geographically dispersed, functionally autonomous, and technically independent from the primary infrastructure, in order to avoid systemic vulnerability caused by a single point of failure.

The backup centers would be physically and technically protected in accordance with relevant national and international information security standards, equipped with integrated systems for storing, processing, and accessing classified information. Such infrastructure would provide the material foundation for the continuity of state functions under conditions of serious security and technological disruptions.

6.4. Procedural Level: Unified Operational Protocol and Exercise System

As the final but crucial element of the system, it is recommended to establish a unified operational protocol for crisis response, accompanied by a mandatory program of regular national exercises. These exercises could be conducted under the working title *"State Under Pressure"* and would focus on simulating scenarios of complete or partial communication collapse, loss of access to key databases, and incapacitation of leadership structures.

The exercise program would encompass all key institutional actors—the Council Office, the Office for IT and eGovernment, the Security Information Agency, and the Emergency Management Sector of the Ministry of Interior—in accordance with predefined coordination and synchronization protocols. In this way, a culture of testing would be developed, institutional interoperability enhanced, and the gap between formal plans and actual operational capabilities reduced.

7. Conclusion

In conditions of complex, multilayered, and cascading risks, the state's ability to preserve the functionality of its institutions and protect classified information during disasters is not a luxury, but the very foundation of state

sovereignty. This study has shown that success in this area does not primarily depend on the level of technological development or budgetary capacity, but rather on the degree of strategic planning, a clear and functional division of competences, an institutionalized culture of regular testing, and the adoption of a holistic approach that treats both the physical and digital resilience of the state.

The key contribution of this study is the conceptualization of a unified system for the continuity of state functions as a synergistic whole, whose elements—the strategic framework, the operational plan for the protection of classified information, the hierarchical network of backup centers based on the PACE model, and the program of regular exercises—function only through their interconnection. Without a strategic framework, the operational plan becomes a technical document without political legitimacy; without physical infrastructure, the plan remains theoretical; and without regular testing, neither the strategy nor the infrastructure guarantees actual readiness in times of crisis. Therefore, the development of a system for the continuity of state functions in the Republic of Serbia is possible only through the simultaneous and coordinated advancement of all four dimensions.

A special significance in this context lies in Article 87, paragraph 1, item 9 of the previously discussed Law on Classified Information, which explicitly enables the drafting of a plan for the protection of classified information in emergency and crisis situations and provides a clear legal basis for integrating the protection of classified information into the crisis management system. This provision, together with its European parallel in Article 15 of Decision 2013/488/EU, constitutes a key regulatory bridge between the domestic and European frameworks for the protection of classified information under crisis conditions.

Nevertheless, despite the existence of relevant normative prerequisites, the analysis has shown that the operational implementation of these solutions, as well as their institutional integration into a unified and functional system for the continuity of state functions, remains insufficiently developed.

The comparative analysis of the models of Switzerland, Finland, and Israel indicates that state resilience is not built through *ad hoc* reactions in moments of crisis, but through long-term institutional investments, systematic duplication of critical functions, and continuous testing of the readiness of the entire apparatus of government. In this sense, the implementation of the proposed framework in the Republic of Serbia will require strong political will, stable inter-institutional cooperation, and the acceptance of continuity of state functions as a permanent security priority—as well as a European integration imperative.

Institutional resilience, including the continuity of work with classified information, is explicitly required in the earlier mentioned EU Strategy for Countering Hybrid Threats, the Critical Entities Resilience Directive and the NIS2 Directive, and its absence represents a regulatory gap that will need to be overcome in the final phase of EU accession.

Although the costs of building and maintaining such a system are significant, the comparative experiences of the analyzed states show that investments in the continuity of state functions are investments whose true value is not measured in peacetime conditions, but is fully manifested only in moments of the deepest, systemic, and existential crisis—when that very continuity becomes the last line of defense of state sovereignty.

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List of Symbols

BGÖ – Bundesgesetz über das Öffentlichkeitsprinzip der Verwaltung [DE]; Federal Law on the Principle of Transparency in Administration [EN];

CAS – Complex Adaptive Systems

CFSP – Common Foreign and Security Policy

COG – Continuity of Government

EU – European Union

NATO – North Atlantic Treaty Organization

NIS2 – Network and Information Security Directive

OSCE – Organization for Security and Cooperation in Europe

PACE – Primary-Alternate-Contingency-Emergency

RAHEL – Rashut HaHatzala HaLeumit [HE]; Israeli National Emergency Management Authority [EN];

SUPO – Suojelupoliisi [FI]; Finland's Security and Intelligence Service [EN];

Traficom – Liikenne- ja viestintävirasto [FI]; Finnish Transport and Communications Agency [EN]

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Article

Experiences in Organizing and Implementing Evacuation Drills for People at Risk From Educational Facilities

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Abstract

Regular evacuation drills for individuals at risk in public facilities are of great importance for employees and visitors, as they improve efficiency and reduce the risk of consequences in real-life fire situations and other emergency events. They are particularly important in facilities used by educational institutions, as these environments, in addition to staff, accommodate a large number of children and young people. Well-prepared, organized, and implemented drills in such institutions enable the verification of alarm systems, evacuation plans and routes, as well as procedures and actions of both staff and students, while also helping to reduce fear and panic. When planning these drills, it is essential to ensure detailed preparation for all key participants involved in their implementation: the director, civil protection officers, teachers, professors, and administrative and technical staff. After the drill is conducted, it is also necessary to analyze all activities carried out during the exercise, identify areas for improvement, and derive lessons, conclusions, and measures for the future. The group of authors analyzed the implemented activities, with particular emphasis on the

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organizational aspects of the drills and on identifying critical points in the evacuation process. A total of 16 evacuation drills were organized and conducted in all primary and secondary schools within a local self-government unit over a previous period. This paper presents experiences related to the preparation of employees and teaching staff for conducting evacuation drills, potential shortcomings, difficulties, and threats encountered during their implementation, as well as lessons learned following the post-drill analysis involving all key stakeholders. The obtained results confirm that a systematic approach to planning, implementing, and analyzing evacuation drills is a key factor in reducing risks and increasing safety in educational institutions.

Keywords

Education, fire, emergency event, alerting, evacuation, panic, evacuation routes, safe place, analysis

1. Introduction

Evacuation from endangered environments is a key topic in disaster risk reduction and emergency management. The effectiveness of evacuation procedures significantly influences the outcome of any emergency event, whether it involves fire, earthquake, technological accidents, terrorist attacks, or similar hazards. Fires with catastrophic consequences and a high number of casualties continually emphasize the importance of evacuation, both from a preventive and operational perspective (Alexander, 2002).

Human behavior during evacuation is generally rational; however, instances of irrational individual or group behavior may occur, with serious consequences. Rational and composed behavior is more commonly observed among individuals who have prior experience, as well as those who have participated in training or evacuation drills. In situations where individuals are unfamiliar with the environment and evacuation routes, disorientation and confusion are more likely to arise, potentially hindering safe evacuation (Proulx, 2001; Gwynne et al., 1999).

Evacuation is particularly important in facilities where large numbers of people gather, especially children, such as educational institutions. In such environments, it is essential that responsible persons and all employees are adequately informed, trained, and prepared to ensure that endangered individuals can be safely evacuated at any time, without panic and within the shortest possible timeframe (NFPA, 2022).

Despite the recognized importance of evacuation planning and training, prior studies and practical experience indicate that challenges remain in the organization, preparedness, and consistent implementation of evacuation procedures, particularly in educational settings. This highlights the need for a systematic approach that integrates planning, training, and continuous evaluation of evacuation drills.

The objective of this study is to analyze experiences in organizing and conducting evacuation drills in educational institutions, focusing on identifying organizational aspects, potential shortcomings, and critical points in the evacuation process, and deriving lessons learned to improve future practice.

2. Methods

2.1. Study design and rationale

This study is designed as a qualitative case study with descriptive elements, combined with document analysis and field observations. The case study approach was selected because the research focuses on the real-life implementation of evacuation drills in schools within a specific municipality, enabling an in-depth understanding of procedures, challenges, and outcomes. The study aims to analyze the legal framework, current practices, and the implementation of evacuation exercises in schools, and to identify deficiencies and propose improvements.

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2.2. Setting and data sources

The study was conducted in 16 schools in the territory of the City of Sremska Mitrovica, including:

- Primary schools
- Secondary schools
- A music school
- A special education school

Data were collected during the implementation of evacuation drills organized as part of a joint project involving SITE d.o.o. and a partner institution, with support from the City Administration for Education.

2.3. The data sources included

- Legal and regulatory documents
- School internal documentation (plans and procedures)
- Interviews with school directors and municipal education authorities
- Direct observation during evacuation exercises
- Reports and analyses prepared after drills

2.4. Data collection procedures

Data collection involved multiple methods:

- Document analysis: Review of fire protection rules, evacuation plans, risk assessments, and protection and rescue plans.
- Interviews: Conducted with school directors and municipal education representatives to assess preparedness and organizational aspects.
- Direct observation: Monitoring of evacuation drills in real-time, including response to simulated fire scenarios.
- Training sessions: Two online training sessions were conducted via the Moodle platform for civil protection officers and school staff.

Evacuation drills were conducted using standardized scenarios simulating fire incidents, including the use of a smoke simulation device and the activation of alarm systems.

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To ensure consistency, detailed evacuation plans were prepared in advance for each school and shared with all relevant stakeholders.

2.5. Sampling and study units

The study used purposive sampling, selecting all schools included in the project within the municipality. The study units were:

- Schools as organizational entities
- School staff involved in evacuation procedures
- Students participating in evacuation drills

No exclusion criteria were applied, as all institutions involved in the project were included in the study.

2.6. Ethics and compliance

The study was conducted in accordance with applicable national regulations governing school safety and emergency preparedness. Participation in interviews and drills was coordinated with school administrations and municipal authorities.

Informed consent was obtained at the institutional level. Data were used in aggregated, anonymized form to ensure the confidentiality of participants and institutions. No personal sensitive data was collected.

2.7. Data processing and analysis

The analysis followed a qualitative descriptive approach:

- Data from documents, interviews, and observations were systematically reviewed.
- Key themes were identified, including legal compliance, organizational preparedness, execution of drills, and identified deficiencies.
- Comparative analysis was conducted across schools to identify common patterns and differences.
- Findings were synthesized into categories such as strengths, weaknesses, and recommendations.

No statistical testing was performed, as the study is qualitative in nature. Analysis was supported by structured note-taking and thematic categorization.

3. Results

3.1. Legal and regulatory framework

The analysis of legal documents shows that evacuation-related obligations in schools in Serbia are regulated through multiple laws and regulations. According to the Law on Fire Protection, schools as legal entities have clear obligations to ensure the safe evacuation of students and staff. Article 28 requires the adoption of Fire Protection Rules, which include instructions for action in the event of a fire and evacuation plans. These plans must be publicly displayed in visible locations. Article 53 defines the obligation to adopt a training program for employees in fire protection, including both theoretical and practical training. The Law on Disaster Risk Reduction and

Emergency Management requires schools to develop risk assessments and protection and rescue plans that include evacuation measures and assigned tasks for key actors.

The Rulebook on the Protocol for Action in Institutions in Response to Violence, Abuse, and Neglect (Ministry of Education, 2024) provides guidelines for strengthening school resilience to crisis events by upholding the principles of continuity, cooperation, accessibility, and efficiency. This rulebook obliges schools to form crisis teams, develop crisis response programs, and conduct evacuation drills and procedures at least once per year.

Only the aforementioned ministerial rulebook explicitly prescribes the obligation to conduct evacuation drills at least once per year, while other laws provide more indirect obligations.

Table 1. Legal basis for evacuation and evacuation drills

Topic	Law on Fire Protection	Law on Disaster Risk Reduction and Emergency Management	Rulebook on Protocol for Action in Institutions in Response to Violence, Abuse, and Neglect
Evacuation	YES	YES	YES
Training of employees in fire protection and practical training	YES	NO	NO
Disaster protection and rescue plan with evacuation measures and assigned tasks	NO	YES	NO
Evacuation plans and procedures	YES	YES	YES
Evacuation drills	NO	NO	YES (at least once per year)

Notes: Law on Fire Protection. (2009, 2015, 2018). Official Gazette of the Republic of Serbia, No. 111/2009, 20/2015, 87/2018; Law on Disaster Risk Reduction and Emergency Management. (2018). Official Gazette of the Republic of Serbia, No. 87/2018; Rulebook on the Protocol for Action in Institutions in Response to Violence, Abuse and Neglect. (2024). Official Gazette of the Republic of Serbia, No. 11/2024.

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3.2. Current state of evacuation practices

The findings indicate that evacuation drills are not implemented consistently across schools. There is a lack of standardized methodology for planning and executing drills, and the existing rulebook does not define detailed procedures for their organization. As a result, drills are performed irregularly and without a systematic approach. Post-drill analyses are rarely conducted systematically with all key actors, and lessons learned are not consistently documented or applied. This limits the continuous improvement of evacuation procedures. A thorough post-drill analysis with responsible persons must be integral to every evacuation exercise to identify deficiencies and enable progress.

3.3. Implementation of evacuation drills

All evacuation drills followed a structured scenario:

- Simulation of a fire using a smoke device
- Attempted initial suppression by school staff
- Activation of alarm systems
- Evacuation of students and staff
- Assembly at designated safe locations
- Verification of attendance
- Notification of fire and rescue services

All participants were required to follow predefined evacuation routes and procedures.

3.4. Identified deficiencies

The main deficiencies observed during drills included:

- Inadequate audibility of alarm systems in some parts of school buildings
- Limited visibility of students for teachers during evacuation
- Improperly located assembly points in certain schools
- Partial non-participation of some staff members due to operational duties

4. Discussion

The results indicate that although a legal framework exists, its implementation in practice is inconsistent. The lack of detailed procedural guidelines contributes to variability in how evacuation drills are conducted across schools. The absence of standardized post-drill evaluation limits the ability to identify weaknesses and improve procedures over time. This is consistent with findings in emergency management literature, which emphasize the importance of feedback loops and continuous training.

The study highlights the purpose of systematic evacuation drills: they educate all participants on individual and group procedures, improve coordination, raise safety awareness, and reduce fear and panic. Drills also allow verification of key parameters, such as evacuation plans and routes, alternative evacuation paths depending on the hazard, evacuation time (from alarm to assembly), and staff and student procedures.

Furthermore, post-drill analysis should follow the experiential learning cycle: concrete experience during the drill, reflective observation of actions taken, abstract conceptualization (interpretation of actions), and active experimentation (planning improved activities for the future). Without quality analysis, the experience is not effectively translated into learning at the individual or team level.

The identified deficiencies suggest that both technical infrastructure (e.g., alarm systems) and organizational readiness are critical factors influencing evacuation effectiveness.

Limitations of the study include: a focus on a single municipality, the lack of quantitative performance metrics (e.g., evacuation times), and reliance on observational and interview-based data. Future research could include comparative studies across regions and the integration of quantitative performance indicators.

5. Conclusions

The study demonstrates that evacuation preparedness in schools depends on both regulatory compliance and practical implementation.

Key conclusions:

- Legal regulations exist but are not uniformly operationalized in practice.

- Evacuation drills are essential but lack standardization and systematic evaluation.
- Post-drill analysis is a critical component that is often neglected and should become mandatory.
- Identified deficiencies point to both technical and organizational challenges.

Regular evacuation drills, combined with structured analysis and continuous improvement, significantly enhance the safety culture in schools.

Recommendations

- The school director is the responsible person for evacuation implementation.
- All students should be informed or reminded of evacuation procedures at the beginning of the school year.
- Carefully select and appoint civil protection officers, deputies, and members of the evacuation team.
- Periodically test the fire alarm system and verify siren audibility in all areas of the school.
- Prepare a backup alarm signal in case the siren fails.
- The assembly point must be adequately chosen, clearly defined, with an established layout for each class, and at a safe distance from the building.
- At the assembly point, every teacher must have full visibility and control over the presence of their students.
- Plan evacuation drills at least once per year using scenarios based on identified risks (fire, earthquake, terrorist attack, etc.).

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Review article

Organization of Emergency Response and Rescue Units in Emergencies Caused by Hazardous Materials

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Abstract

Industry has become inconceivable without the use of various hazardous materials in production processes. They are an inevitable companion of modern times, and science and technology further accelerate their development. The system of protection and rescue in emergencies caused by hazardous materials depends on knowledge of the characteristics of a large number of hazardous substances, which, during production, storage, distribution, transportation, and use, may cause serious consequences for people, property, and the environment. In addition to understanding their characteristics, it is necessary to examine their harmful effects and the technical and technological processes involved. Radioactive, explosive, flammable, toxic substances, and biological agents, by their very nature, represent hazardous materials and can easily be misused for malicious purposes, including terrorist attacks. The effective mitigation of consequences arising from such dis-

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asters largely depends on management and cooperation among emergency response and rescue units at the scene. No single emergency response unit can provide an adequate response on its own, relying solely on its own resources and capacities. Therefore, it is necessary to establish an organizational structure and management system capable of adequately responding to the situation. Based on domestic and international scientific literature, and using content analysis, the author will, in the introductory section, familiarize readers with the concepts and characteristics of hazardous materials, followed by rescue activities and the interdependence of emergency response services. In the final part, the operational and tactical levels of the management system for disasters caused by hazardous materials will be examined (the strategic level of management will not be addressed), using the "8-step" procedure.

Keywords

Hazardous materials; protection and rescue system; emergency; emergency response and rescue units; "8-step procedure".

1. Introduction

Hazardous substances and their harmful effects can cause major problems during production, transportation, processing, storage, and use. A large number of hazardous materials used in everyday life can be misused for terrorist purposes. Accordingly, it is necessary to undertake appropriate measures at the operational, tactical, and strategic levels. These measures include training and equipping emergency response and rescue services to enable effective intervention. Management of disasters caused by hazardous materials is highly complex, as it requires coordinated activities of all emergency response units within the shortest possible time, while ensuring the safety of all participants and the efficiency of consequence mitigation. Such situations demand that leaders be well prepared for highly stressful and complex tasks. Trained members of the police, fire, and rescue units, and emergency medical services must arrive at the scene as quickly as possible. Leaders and personnel of emergency response units must be aware that such situations can occur at any time and in any place. Personnel must be familiar with the characteristics of hazardous materials and be able to recognize when an incident involves a terrorist act. Effective management of emergencies caused by hazardous materials depends on the existence of response plans, the level of personnel training, and the use of specialized command structures (Cvetković, 2020).

Given the characteristics of such emergencies, all emergency response and rescue services share common objectives, as stated by Mlađan and Cvetković (2012, p. 535): saving and protecting human lives; alleviating suffering; controlling the emergency; warning the public and businesses, providing advice and information; protecting the health and safety of emergency response personnel; preserving the environment; protecting property (assets) as much as possible; maintaining or restoring critical activities; and sustaining normal services at an appropriate level, etc. In examining the organization of emergency response and rescue units in hazardous materials incidents, particular attention should be paid to studies on first responders' capacities, inter-agency coordination, institutional organization, industrial hazards, and the role of technology in disaster response. Research on first responders emphasizes the importance of strengthening operational capacities, preparedness, and resilience in order to ensure an effective response to complex emergencies (Cvetković, 2025). Closely related to this, studies on the collaboration between volunteer and professional fire units highlight the importance of interoperability, role differentiation, and coordinated action among rescue services (Molnár, 2024). The relevance of hazardous-material incidents is also supported by work focusing on hazardous chemical handling industries, where continuity planning and structured preparedness are essential for reducing response gaps and organizational failures (Kumar, 2024). In addition, broader analyses of industrial disasters underline the need for a holistic understanding of causes, consequences, and resilience-building mechanisms in technologically driven emergencies (Cvetković, Renner, & Jakovljević, 2024). From an organizational perspective, studies on disaster response coordination, network structures, and decentralized disaster management systems further demonstrate that effective emergency response depends on clear command arrangements, institutional integration, and cooperation across multiple actors (Masaba, Aryatwijuka, Ntayi, & Bagire, 2025; Mokhele, 2024; Ocal & Torun, 2025; Pandya, 2025). Finally, research on emerging and new technologies in disaster management shows that technological innovation can significantly improve situational awareness, communication, coordination, and operational efficiency during emergency interventions (Hanspal & Behera, 2024; Jovičić, Gostimirović, & Milašinović, 2024). Taken together, these references support the argument that the successful organization of emergency response and rescue units in hazardous materials emergencies depends on preparedness, coordination, institutional clarity, and technological support.

In emergencies caused by terrorist acts, reliance on established procedures ensures consistency in tactical operations, regardless of which emergency response and rescue services are involved (Cvetković, 2013a). Defining and implementing key steps in establishing an organizational structure

can significantly facilitate the work of emergency response units (Cvetković, 2014, p. 64; Kramer, 2009, p. 74). Studies on integrated disaster risk reduction systems, disaster response roles, critical infrastructure protection, fire protection, and psychosocial support in emergencies can support the organization of emergency response and rescue units for hazardous materials incidents. Milenković (2025) is particularly relevant because it examines the theoretical, institutional, and organizational aspects of an integrated disaster risk reduction system, which directly relates to structuring response units and defining responsibilities in complex emergencies. Popović Mančević (2025) is also useful because it analyzes the role of military actors in natural disaster response, offering broader insights into multi-actor emergency organization and support functions. Miletic and Stojanović (2025) contribute indirectly by addressing risks and threats to critical infrastructure, which is highly relevant since hazardous materials incidents often endanger key infrastructure systems. Jovanović Popović (2025) provides an additional connection through the topic of fire protection, which is closely associated with hazardous materials emergencies due to the frequent presence of flammable, explosive, or chemically reactive substances. Finally, Janković et al. (2025) broaden the perspective by emphasizing the role of psychosocial support in emergency and disaster management, reminding us that effective rescue organizations also include support functions beyond purely technical intervention.

The organizational structure must be established by the emergency service that first arrives at the scene and maintained so that, upon the arrival of additional services and units, effective coordination of all currently and subsequently available resources can be achieved, along with the necessary instructions for participants. It is essential to establish a unified organizational framework across key services and, depending on the nature of the emergency, to designate the lead service. A unified command post should be established. Any lapse in safety may result in casualties. Basic strategic objectives and priorities must be defined. Focus should be placed on patient triage, locating and identifying all victims, and establishing a priority system for treatment and transport. Control over victims, facilities, and responsible services must be carried out in a unified manner using standardized methods. No single service can effectively manage an emergency independently; therefore, training programs should be implemented at regional and broader levels. Organizational procedures and control mechanisms must be respected not only in emergencies but also in everyday operations (Cvetković, 2014, p. 64; FEMA, 2004, p. 29).

The eight-step procedure itself provides a flexible tactical management system that ensures consistent management structures regardless of the type of hazardous material involved. Essentially, eight fundamental steps must

be undertaken, typically following the timeline of a terrorist emergency. As stated by Cvetković (2013a), these steps include: incident management and control of the affected area; problem identification; hazard and risk assessment; selection of protective clothing and equipment; management of information and response resources; implementation of response strategies; decontamination and cleanup operations; and termination of the emergency.

According to the Emergency Response Guidebook (Vodič za odgovor na udes, 2024), hazardous materials are defined as substances which, during production, transportation, processing, storage, or use in technological processes, release or generate infectious, irritating, flammable, explosive, corrosive, asphyxiating, toxic, or other hazardous dusts, fumes, gases, mists, vapors, or fibers, as well as harmful radiation in quantities that may endanger human life and health, material assets, and the environment at varying distances from the facilities in which they are present. As noted by Cvetković (2012), hazardous materials can be classified into the following categories according to international classification standards: class 1 – explosive substances; class 2 – gases under pressure, liquefied gases, or gases dissolved under pressure; class 3 – flammable liquids; class 4 – flammable solids; class 5 – oxidizing substances; class 6 – toxic (poisonous) and infectious substances; class 7 – radioactive materials; class 8 – corrosive substances; and class 9 – miscellaneous hazardous materials.

2. Organization of rescue activities and interdependence of emergency response services

Mitigation of the consequences of emergencies involving hazardous materials depends on cooperation and coordination among emergency response and rescue services, given that their competencies overlap and complement one another. The adoption of appropriate laws and by-laws, which would serve as a fundamental basis for the development of adequate procedures, would enable the integration of responsibilities among multiple rescue services (Cvetković, Filipović, & Gačić, 2019; Cvetković, 2012).

As noted by Cvetković (2022), in emergencies involving hazardous materials, the organization of rescue operations depends on several factors: (a) the type of hazardous materials; (b) the manner of their use and release; (c) the affected area; (d) the number of people present; (e) the infrastructure; and (f) the level of equipment and availability of protective resources.

At the very beginning of organizing protection and rescue activities, it is necessary to conduct chemical reconnaissance in order to determine the type and concentration of hazardous substances, as well as the boundaries and dynamics of the contamination zone, the dimensions and characteristics

of the affected facility, the level of contamination, the quality of the terrain and air, and the least contaminated access routes to the site. Identifying the source of contamination is the initial phase of chemical reconnaissance. A comprehensive inspection of each room must be carried out, as well as of the surrounding area, territory, and community within the contaminated zone. Other responsibilities of chemical reconnaissance units include delineating the boundaries of contaminated zones, identifying and marking routes, determining deployment and assembly directions for response forces, enabling evacuation without exposure to contamination, and preventing further incidents (Cvetković, 2022; Cvetković, Popović, & Sadiah, 2014).

The most commonly used methods for recognizing and identifying hazardous materials include: (1) the location and extent of their effects; (2) the types and shapes of containers in which hazardous materials are stored; (3) labels and color codes; (4) hazard identification lists; (5) transport documentation; (6) detection instruments; and (7) symptoms of resulting illnesses. In addition to the above, special attention must be paid to preventing the spread of contamination and maintaining control of the affected site. Contaminated or exposed personnel must be isolated to prevent contamination from spreading beyond the controlled area. Therefore, reconnaissance is conducted first in order to assess the scale of the problem in such disasters (Cvetković, 2022).

Previous experience indicates that upon the arrival of emergency response and rescue units at the incident site, it is crucial to determine the physical extent of the emergency in order to avoid worsening the existing safety situation. Furthermore, emergencies of this type must be properly managed in their initial stage, as it becomes increasingly difficult to control the situation as it evolves. Effective and safe mitigation of harmful effects requires establishing control over the site itself (Cvetković, 2022).

Controlling the incident site itself is critical, as it significantly influences the development of tactics and the overall response to the situation. In mitigating the consequences of an emergency, the police, alongside fire and rescue units and emergency medical services, play a significant role. Police officers are typically the first to arrive at the scene. Such situations require the establishment of three cordons: an inner cordon, an outer cordon, and a traffic control cordon. Accordingly, the incident site is divided into three zones: the exclusion zone, the restricted access zone, and the safe zone (Cvetković, 2020; Cvetković, 2022).

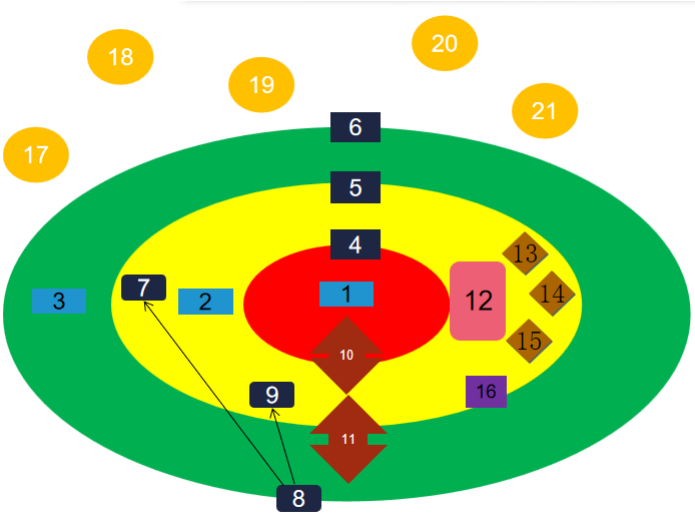


Figure 1. Organization of an incident site affected by an emergency involving hazardous materials and adapted from (Cvetković, 2022, p. 92).

forbidden zone (hot zone); 2. restricted access zone (warm zone); 3. safe zone (cold zone); 4. internal cordon; 5. outer cordon; 6. traffic cordon; 7. operational headquarters (joint control center); 8. control of access to the place of emergency; 9. assembly place; 10. control point of access to the internal cordon; 11. control point of access to the external cordon; 12. police district; 13th place for the media; 14. central bureau for victims; 15. place for decontamination; 16th place for logistics; 17. reception center for reception of friends and relatives; 18. reception center for survivors; 19. recreation center; 20. center for humanitarian aid; 21. mortuary.

The restrictive zone (red zone) represents the area surrounding the incident scene, extending far enough to prevent the harmful effects of the action (for police officers, it is the most dangerous contaminated part of the inner cordon). Access to the restricted zone is provided exclusively by emergency and rescue units equipped with special equipment. This zone has one entrance and one exit for access control, to prevent entry without personal protective equipment. It is marked with red and white tapes. Members of the intervention and rescue units deployed at the entry and exit points must know who is allowed to access the inner cordon. Personnel of emergency and rescue services entering this zone must be recorded, so that, in the event of an emergency evacuation from that area, their movements and positions are known. The area of the prohibited zone may become the responsibility of the fire-rescue unit that cooperates with the emergency medical service. Given the limited availability of personal protective equipment, it is necessary

to carry out planned replacements for police officers. After the end of the rescue phase, the police will take responsibility and transfer the deceased and mortal remains, perform a forensic examination, and collect evidence. The restricted access zone adjoins the restricted access zone, which represents a space where there is no harmful pollution from hazardous substances for people, but equipment and people leaving the restricted zone can be contaminated. Within the restricted access zone are an operational headquarters, a meeting place, a police area, decontamination centers, and the injured (Cvetković, 2022).

It is usual to set up three cordons in such situations. An internal cordon is placed around the restricted zone to ensure immediate security. The outer cordon closes a wide area around the inner cordon and thus provides a restricted access zone. To prevent unauthorized vehicle access to the area affected by the disaster, a traffic cordon is set up outside the outer cordon. The personnel who make up the external cordon must be warned of the possibility of unauthorized people attempting to gain access. This is especially true for remote sectors of the border area. Decontamination of people and equipment is carried out in this zone. Police in this zone control the crowd and provide aid and decontamination according to priorities. The outer cordon provides a limited access zone. The basic function of this cordon is to create conditions for a safe working environment for intervention and rescue units responding to a disaster (Cvetković, 2022).

An area with no pollution is a safe zone. It can be divided into two subzones. The first sub-zone is the area where the equipment and resources of all participating intervention-rescue units are located. The second subzone is part of the traffic cordon and refers to preventing access by unauthorized vehicles. In this subzone, there is also a space for the media (Cvetković, 2014; Cvetković, 2022).

All members of intervention and rescue units should be directed to a single gathering point. The meeting place should be safe and secure. The operational headquarters is the central location where the leaders of the intervention and rescue units make joint decisions on disaster management. The access control center must be under police control, clearly visible, and placed outside the outer cordon. It keeps records of all personnel of non-intervention services who requested access. After the check, the personnel are escorted to the meeting place or operational headquarters. The central authorities establish the holiday center, which is a gathering place for evacuees. These centers are open for up to 48 hours and staffed by medical personnel. These centers provide food, communication, and security. The reception center for survivors serves to identify and document survivors. Police officers carry this out. A reception center for friends and relatives opens at a

safe distance from the disaster site. Depending on the availability, it opens within 12 hours after the disaster. Friends and relatives can come here to get information about missing persons and victims. The local community should establish a Center for Humanitarian Aid within 48 hours after the disaster. This center assists persons directly or indirectly threatened by such a disaster (Cvetković, 2022).

No single emergency response and rescue unit can, on its own, using only its own capacities and resources, provide an adequate response to mitigate the consequences. Therefore, it is necessary to establish a management system that will adequately address all needs at the incident site (Cvetković, 2020; Cvetković & Miladinović, 2018).

3. Levels of management and the application of the operational and tactical levels of work organization, known as the eight-step procedure

The management of rescue operations implies a process that includes: collecting data on the status and progress of rescue operations; analyzing and assessing the situation and the course of rescue activities; preparing conclusions and proposals regarding the composition of emergency response and rescue services and the procedures for their deployment; communicating tasks to subordinate command structures; organizing the interaction of operational units; and ensuring the support of their activities (Cvetković, 2022, p. 80; Voronoi et al., 1995).

In emergencies, the initial response comes from emergency response and rescue units. In the initial stage of an emergency for which no prior warning was issued, the operational level of management is activated first. If there is a threat of further deterioration of the situation, the command is then escalated to a higher level of management, the tactical or strategic level (Cvetković, 2022; Đurđević, 2016).

According to Cvetković (2022:446; Cvetković, 2013), the operational level of management is the level at which work is carried out in the emergency area or its surrounding areas, and it represents day-to-day response to immediate lower-level hazards. Emergency response and rescue units involved in mitigating the consequences undertake appropriate measures and assess the scope of the problem. They retain full control over the resources and means they use within their area of responsibility. The operational-level commander directs resources toward specific tasks within their domain of responsibility and acts in accordance with prescribed duties until another command level is established. This level of management is appropriate for

the effective coordination and resolution of multiple immediate, small-scale hazards. A key role of the commander at this level is to decide whether circumstances warrant activating the tactical level of management.

If the commander of the operational level of management in emergencies involving hazardous materials assesses, or circumstances indicate, that this level of management cannot provide an effective response, the system transitions to the tactical level of management to ensure the execution of all activities and to provide a comprehensive response. At the tactical level of management, significantly more equipment, rescuers, and personnel trained for specific emergencies are deployed to implement protective and rescue measures in hazardous-material emergencies. Tactical-level commanders carry out priority actions, assign tasks, allocate resources, and make decisions regarding further activities. They are obliged to comply with occupational safety and health requirements and to implement appropriate measures to reduce risk. At all times, they must be aware of what is occurring at the operational level (Cvetković, 2012; Cvetković, 2019; Cvetković, 2022). One of the most serious security threats is an emergency caused by the use of hazardous materials for terrorist purposes (Bošković & Cvetković, 2017; Cvetković, 2012b, p. 58). Setting aside the strategic level of management, in such emergencies, the operational and tactical levels of work organization are applied, commonly known as the eight-step procedure.

In the following section, each step will be explained.

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3.1. Management and control of the area

In this step, it is necessary to (Cvetković, 2012b, p. 58): approach the location of the emergency and position emergency response and rescue services; establish control and activate the emergency management system (the first arriving emergency response unit activates the management system); coordinate other emergency response and rescue services; define danger zones (inner, outer, and traffic cordons; if the emergency area is not isolated, security will be compromised); and implement all measures aimed at protecting the population (evacuation or sheltering procedures). The objective of area management is to rapidly establish control over the emergency site and separate people from the incident, which is further assessed and evaluated in the next step. Management and control of the area are achieved by forming cordons.

3.2. Problem identification

The subject of identification is based on the recognition, identification, classification, and verification of hazardous materials (Cvetković, 2014; Thomas, 2008). Actions are carried out as follows: detection of the presence of hazardous materials; identification of the hazardous materials involved; if precise identification is not possible, an attempt is made to classify and determine the type of hazard (e.g., corrosive substance, toxic gas, etc.); upon arrival at the scene, any initially obtained information must always be confirmed. The initial information should never be assumed to be accurate without verification. Common methods for recognizing and identifying hazardous materials include (Cvetković, 2014; Paulun, 2003): the location and extent of the incident; the shape of containers in which substances are stored; markings and colors; placards, labels, and hazard lists; transport and other documentation; detection and measurement instruments; sensory indicators; symptoms of exposure and resulting illnesses, etc.

3.3. Risk and hazard evaluation

At this stage, absolutely no poor assessments must be made. During the risk assessment phase, it is necessary to determine both offensive and defensive measures to be taken and the tactical procedures to be applied at the incident site. In this context, hazard refers to a threat that may endanger human life. In emergencies, these elements are treated as constant; they do not vary by incident location and can be obtained from sources such as the Emergency Response Guidebook or material safety data sheets. Risk refers to the likelihood of suffering consequences or losses. Risks associated with hazardous materials are intangible variables that vary from incident to incident and must be assessed by qualified personnel (Cvetković, 2014). According to Heyer, factors influencing the level of risk include (Heyer, 2006): the type of hazard and the quantity of the material involved; the effects of exposure, including the scale of the incident, the size and degree of chemical contamination that may endanger responders, civilians, land, and the environment; and the availability of resources.

3.4. Selection of personal protective clothing and equipment

Personal protective equipment (PPE) refers to any clothing or device worn by emergency response and rescue personnel to protect them from hazards at the incident site. Protective measures for these personnel may vary depending on the tasks to be performed and the specific location of the emergency, and may change in accordance with on-site activities. PPE must

be considered a top priority. Protective equipment directly depends on the physical and chemical properties of the hazardous materials present at the scene. It is of primary importance that personnel involved in the intervention are equipped with appropriate protective clothing and adequate equipment for the expected tasks. When selecting protective clothing, the type of hazardous material must be taken into account, as well as the response strategy to be implemented. Protective suits will vary depending on several factors, most commonly according to the task, i.e., whether police officers will perform offensive or defensive operations, or carry out certain measures and actions in the absence of direct intervention (Cvetković, 2014, p. 68; Law Enforcement Officers Guide, 2003:51).

3.5. Control of information flow and coordination of resources

Control of information flow and coordination of resources refer to the process of determining the timely and effective management, coordination, and dissemination of all available data, information, and resources among all stakeholders (National Fire Protection Association, 1994). The effectiveness of coordination is directly related to the implementation of the emergency management system and its procedures. If the elements of command established at the incident site are not properly implemented, it will be very difficult for all personnel present at the scene to operate safely and effectively (Cvetković, 2014). The basic guidelines to be considered include (Cashman, 2008): confirming emergency orders and monitoring developments to ensure that they are properly received and executed; maintaining strict control of the situation; ensuring continuous progress toward resolving the problem within the established timeframe, and requesting additional assistance without delay in case of escalation; ensuring that all key actors understand the action plan and the decision-making process; recognizing that bad news does not improve with time; and preventing external factors from interfering with the unified command structure.

3.6. Implementation of priority actions

During the implementation phase, emergency response and rescue services operate in accordance with the adopted strategies governing this field. Specific tasks include (Cvetković, 2013a, p. 59): initial entry to the site and continuous monitoring in order to determine the current level of danger; assessment of the incident scene to identify evidence that may be used in reconstructing the event; identification of factors that caused the emergency;

interviewing personnel present at the scene and witnesses to establish obtained information and opinions formed based on available data; and documentation of preliminary findings. In essence, when such an emergency occurs, the incident commander may choose one of three models (Combs, 2003, p. 76): the offensive model (attack model), which aims to direct resources toward suppressing the spread of harmful effects of hazardous materials; the defensive model (protection model), which directs resources (personnel, equipment, and materials) toward less aggressive objectives. The defensive approach may require marking certain areas as closed and contaminated. At the same time, the response focuses on limiting further effects of the hazardous substance, and the non-intervention model, which implies no action is taken. The basic principle of non-intervention is that authorities allow the emergency to follow its natural course until the risk of intervention is reduced to an acceptable level (Cvetković, 2014, p. 69).

3.7. Decontamination and terrain cleaning

Decontamination is a process in which equipment, personnel, and supplies are freed from the influence of hazardous materials present during entry into or work within contaminated areas. At the incident site, decontamination must be carried out to ensure the safety of emergency response and rescue services and the public by reducing contamination on individuals, equipment, and in the environment. Decontamination itself must be coordinated with tactical police operations and properly established. In emergencies, decontamination should be integral to every response plan. Its implementation on a large number of people represents a significant challenge for emergency response personnel. One of the most important decontamination methods is removing clothing. Removing outer garments eliminates up to 80% of contaminating substances (Bellany, 2007, p. 101). On the other hand, washing with water for approximately three minutes also provides highly effective removal of contaminants and must be carried out promptly. In certain cases, decontamination of clothing may be complex, requiring disposal of contaminated items. Decontamination is performed by fire and rescue services or other designated agencies assigned to this task. Decontamination aims to enhance and ensure safety at the emergency site by minimizing the potential for secondary contamination outside the incident area. The decontamination zone is usually located within the restricted access area, preferably upwind of the incident site, and must be clearly marked and identified. Decontamination methods can be divided into physical and chemical methods (Cvetković, 2014). According to Carus (2002), physical methods include brushing and scraping, dilution, absorption, heating, and the use of low or

high air pressure (pressurized air may cause contaminants to detach from surfaces and pose inhalation and further spread risks). Chemical methods include chemical degradation, neutralization, solidification, disinfection, and sterilization.

3.8. Termination of the emergency

In the phase of terminating the emergency, command is transferred to the appropriate service responsible for coordination and activities following the emergency. Emergency response and rescue services must check their personnel and equipment, conduct an investigation related to the emergency, and transfer command to the lead service responsible for post-incident operations. According to Levy (2010), activities undertaken after the completion of an emergency situation can be divided into three groups: submission of the incident report, analysis of the emergency, and critique of the emergency. In the final phase of termination, or after the personnel of these services are released, an emergency report is submitted. The submission of the emergency report is most effective when a designated individual is appointed to lead it. Such a report should be concise, covering only the main aspects of the emergency, and should not exceed 30 minutes. Recommended topics include (Cvetković, 2013a, p. 51): health information; issues requiring immediate action (procedure failures, major personnel problems, and legal involvement in recovery operations); and highlighting correctly performed activities as well as recognition from the incident commander for well-executed work. The objectives of the report should include (Cvetković, 2012c, p. 105): informing emergency response personnel about possible exposure to toxic substances and associated signs and symptoms; identifying equipment failures requiring immediate attention or isolation for further analysis; defining responsibilities for data collection for the analysis and critique of the emergency; summarizing the actions taken by each department or sector within the emergency management system; and emphasizing positive aspects of the emergency response. The analysis should focus on five relevant areas: the emergency management system; tactical operations; plans and planning; support services; and resource availability. The purpose of the critique is to identify deficiencies in the management system, rather than to find faults with the personnel involved. Completing the operational critique improves performance and planning by increasing efficiency in addressing identified shortcomings (Cvetković, 2014).

4. Conclusions

The number of hazardous materials is increasing alongside the development of science and technology in industry. As the bearer of overall environmental security, the state assumes responsibility in this area. One of the key security risks is hazardous materials, which can daily endanger large numbers of people, the environment, and property during their production, storage, distribution, transport, and use worldwide, as well as through their potential use in the form of chemical, biological, radiological, and nuclear weapons, or in terrorist acts (Đurđević, 2016; Cvetković & Filipović, 2018).

The protection and rescue system must be adequately prepared, organized, equipped, and trained to prevent such emergencies and provide a rapid, efficient response. It is clear that, in addition to significant resources for ensuring appropriate equipment for working with hazardous materials, the basis of successful preparedness lies in the awareness of the existence of real large-scale threats and the competence of all actors within the security system, as well as other participants present at the scene of hazardous material incidents (Đurđević, 2024; Cvetković, 2018; Cvetković & Milašinović, 2017; Cvetković et al, 2019).

In the future, members of emergency response and rescue units responsible for responding to hazardous material incidents will be repeatedly put to the test. Modern technologies pose increasing challenges for the readiness and training of all emergency personnel to respond to terrorist attacks adequately. The use of highly dangerous substances as weapons for terrorist purposes further complicates the actions of responders in such emergencies (Đurđević, 2016).

All of the above indicate the need to improve and develop all competent emergency response and rescue units as one of the fundamental pillars of security in the Republic of Serbia. Competent emergency services must be prepared to respond to incidents involving hazardous materials that create emergencies and crises. Procedural activities of emergency services involved in responding to hazardous material incidents must be further developed, all members of the operational structure must be trained, and they must be adequately equipped to operate in such conditions. The seriousness of a country in preparing for responses to terrorist attacks involving hazardous materials is reflected in the adoption of national plans and procedures addressing this type of threat. Responsible planning authorities should timely develop and adopt plans and procedures for coordinated and individual action of all emergency services. In addition, continuous, regular, and frequent testing of the functionality of adopted plans and procedures is essential (Cvetković & Mlađović, 2015; Đurđević, 2016).

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Disaster Resilience in Serbia: A Narrative Synthesis of Institutional, Social, and Perception-Based Evidence

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Abstract

This paper examines disaster resilience from a multidisciplinary perspective in the Republic of Serbia. It analyses the development of disaster management within the contemporary Integrated Disaster Risk Reduction System, which is grounded in the core principles of com-

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munity resilience. The study explores how resilience is perceived by stakeholders involved in its development, primarily institutions and their organizational structures in Serbia, as well as individuals, including professional representatives of institutions and citizens. Drawing on findings from studies measuring the resilience of local communities in Serbia, the paper identifies key challenges Serbia faces in strengthening disaster resilience. Although normative frameworks for enhancing resilience exist, mechanisms for implementing instruments at the local level remain insufficient. Limited public awareness, fragmented cooperation, and a pronounced reliance on central authorities persist as the main institutional constraints. At the individual level, structural and psychosocial factors shape perceptions of resilience. An assessment of the current status of key resilience stakeholders in Serbia indicates a clear need for continuous resilience measurement and for identifying the most influential determinants. Resilience cannot be adequately understood without a deeper and more comprehensive consideration of its constituent factors. Low perceived resilience among both institutional representatives and citizens underscores the need for comprehensive, targeted reforms to address deficiencies consistently revealed in empirical research. Strengthening the institutional capacities of local self-government units, encouraging citizen participation in planning processes, integrating traditional values with scientific approaches, and promoting a culture of prevention through education are among the short-term steps to be undertaken. In contrast, long-term strategic investment in community and institutional capacities is a fundamental requirement. These measures can foster social cohesion, institutional trust, and local capacities, which are key determinants of resilience.

Keywords

Community resilience; integrated disaster risk reduction system; disaster resilience measurement; resilience stakeholders; resilience perception; prevention.

1. Introduction

Disaster risk represents one of the most significant challenges to the stability, security, and sustainable development of contemporary societies (Beli, Renner, Cvetković, Ivanov, & Gačić, 2025; Dada, Hamza, & Mohammed, 2025; Desalit, Duque, Edradan, Enciso, Enriquez, & Pan, 2025; Hanspal & Behera, 2025; Jevtić, Cvetković, Gačić, & Raonić, 2025; Masaba, Aryatwijuka,

Ntayi, & Bagire, 2025; Tushabe et al., 2025; Vidović, Cvetković, Beriša, & Milašinović, 2025). In this context, disaster resilience has emerged as a central analytical and operational concept, referring to the capacity of individuals, communities, institutions, and systems to anticipate, absorb, respond to, recover from, and adapt to hazardous events while maintaining essential functions. Within the Republic of Serbia, a country exposed to a wide range of natural, technological, and environmental hazards, including floods, earthquakes, landslides, droughts, fires, environmental pollution, and industrial accidents, strengthening disaster resilience has become an increasingly important policy and research priority.

Although Serbia has developed a formal institutional and normative framework for disaster risk reduction and emergency management, the extent to which this framework is translated into practical resilience at the local and community levels remains a critical issue. Existing research indicates that resilience in Serbia is shaped by a complex interaction of institutional capacities, local implementation mechanisms, citizen preparedness, social capital, trust in authorities, demographic and socio-economic characteristics, and previous disaster experience. However, these dimensions are often examined separately, either through institutional analysis, resilience measurement models, or perception-based empirical studies. As a result, there remains a need for a more integrated interpretation of how formal institutions, community capacities, and individual perceptions jointly shape disaster resilience in the Serbian context.

This paper addresses this gap by synthesizing theoretical, institutional, and empirical evidence on disaster resilience in Serbia, with particular attention to the role of key resilience actors, including state institutions, local self-government units, professional response structures, civil protection actors, civil society, and citizens. Rather than presenting newly collected primary data, the paper integrates findings from recent studies on community disaster resilience, institutional capacities, regional disparities, social capital, trust, and perceived resilience. In doing so, it seeks to clarify how resilience is constructed and operationalized within the Integrated Disaster Risk Reduction System and how it is experienced at the community level.

The paper is guided by three analytical questions. First, how is disaster resilience institutionally framed and operationalized in Serbia? Second, what do recent empirical studies reveal about the gap between formal disaster risk reduction frameworks and actual community-level preparedness? Third, which institutional, social, and perceptual factors appear most relevant for strengthening disaster resilience in Serbia? By addressing these questions, the paper contributes to a more nuanced, evidence-based understanding of disaster resilience as a multidimensional and socially embedded process. It

also identifies key limitations in the current system and outlines potential pathways for strengthening resilience through institutional reform, local capacity-building, citizen participation, risk communication, and the development of a prevention-oriented culture.

Methodologically, the paper draws on a narrative and conceptual synthesis of the theoretical literature, institutional documents, and recent empirical studies on disaster resilience in Serbia. The following sections first outline the conceptual and institutional foundations of disaster resilience in the Serbian context, then examine the development of integrated disaster management and the role of key resilience actors, before synthesizing recent empirical findings and identifying implications for future resilience-building policies and practices.

2. Methodology

This study employs a narrative and conceptual synthesis of existing theoretical, institutional, and empirical evidence related to disaster resilience in the Republic of Serbia. Rather than presenting newly collected primary data, the research integrates and interprets available knowledge on resilience actors, institutional capacities, and community-level preparedness through a qualitative desk-research approach. The methodological design comprised three interconnected stages. The first stage involved reviewing relevant theoretical literature on disaster resilience, community resilience, social resilience, integrated disaster management, and disaster risk reduction to establish the conceptual foundation of the study. Special emphasis was placed on literature that conceptualizes resilience as a multidimensional construct encompassing institutional, infrastructural, social, economic, psychological, and cultural dimensions. This theoretical review established a framework for understanding resilience as both a technical or administrative capacity and a socially embedded process shaped by trust, participation, preparedness, and collective action.

The second stage examined the institutional and normative framework of disaster risk reduction and emergency management in Serbia. This analysis encompassed the organization, responsibilities, and operational roles of key actors within the Integrated Disaster Risk Reduction System, such as national institutions, local self-government units, emergency management bodies, civil protection structures, professional response units, humanitarian organizations, scientific and educational institutions, the private sector, civil society organizations, and citizens. This stage facilitated the identification of formal resilience actors and their expected roles in prevention, preparedness, response, recovery, and long-term resilience-building.

The third stage synthesized findings from recent empirical studies on community disaster resilience in Serbia, with particular attention to research addressing resilience measurement, the BRIC and DROP frameworks, perceived community resilience, institutional trust, social capital, demographic and socio-economic determinants, and regional disparities. These studies were selected for their direct empirical insight into the manifestation, measurement, and perception of resilience in the Serbian context. Their findings were interpreted comparatively to identify recurring patterns, structural weaknesses, and practical implications for disaster risk governance. The analytical procedure employed a thematic synthesis approach. The reviewed material was organized according to key analytical categories, including institutional capacity, local-level implementation, citizen preparedness, social capital, trust in institutions, risk perception, demographic and socio-economic differences, regional disparities, and the roles of formal and informal actors in disaster resilience. This process aimed to identify the primary gaps between normative frameworks and practical capacities, as well as the factors that strengthen or weaken disaster resilience in Serbia.

This study combines conceptual analysis, institutional review, and secondary interpretation of empirical findings. This approach is appropriate because disaster resilience in Serbia cannot be adequately understood through a single dataset or a one-dimensional indicator system. Instead, an integrated interpretation of formal institutional arrangements, measurable community capacities, and subjective perceptions of resilience among various actors is required. This methodological approach facilitates a comprehensive understanding of the interactions among policy, institutions, communities, and individuals in the development of disaster resilience. Several limitations must be acknowledged. This paper does not include original field research, interviews, or survey data collected specifically for this study. Consequently, its conclusions are based on the synthesis and interpretation of existing studies, institutional documents, and relevant scientific literature. Nevertheless, by integrating available empirical and conceptual evidence, the paper offers a structured overview of the current state of disaster resilience in Serbia and identifies key directions for future research, policy development, and institutional improvement.

3. Disaster resilience in the context of the Republic of Serbia

Disaster risks represent one of the most significant challenges to the long-term stability, security, and sustainable development of contemporary socie-

ties. The Republic of Serbia, as a country exposed to a wide range of natural hazards and technological–industrial threats, has intensified its efforts in recent decades toward establishing institutional and operational mechanisms for risk prevention and mitigation. At the same time, increasing emphasis is being placed on strengthening the resilience of local communities and the broader social system to ensure effective protection of the population, material assets, and natural resources, as well as maintain continuity in social and economic processes following catastrophic events (Milenković, Cvetković, Ivanov, & Renner, 2024). A particular source of vulnerability in Serbia lies in its exposure to diverse types of disasters, including floods, earthquakes, landslides, droughts, and fires. Historical records indicate that nearly 850 floods were recorded over the past century (through 2013), resulting in the loss of 133 human lives. The most severe and widely recognized were the catastrophic floods of May 2014. Under such conditions, the development and strengthening of local community resilience emerge as critical prerequisites for effective risk reduction and disaster impact mitigation (Cvetković et al., 2021).

Although Serbia formally aspires to establish a functional, integrated disaster risk management system, in practice, a unified index to measure community resilience has yet to be developed. According to findings by the United Nations Development Program (UNDP), key weaknesses include institutional and governance deficiencies, as well as limitations in risk reduction, which significantly diminish communities' overall capacity to respond effectively to disasters. In particular, systemic fragmentation, underdeveloped institutional frameworks and procedures, and insufficient capacities at both local and national levels in the domains of prevention, preparedness, and response have been identified as critical challenges directly affecting community resilience and operational efficiency (EU za Srbiju otpornu na katastrofe, 2024).

A fundamental prerequisite for effective preparedness, adequate response, and successful recovery from disasters is the systematic measurement of resilience, which has gained increasing importance over recent decades and toward which Serbia is progressively orienting its efforts. In this context, the Ministry of Interior conducted a national disaster risk assessment in 2017. When compared with internationally recognized indicators and models, the BRIC methodology was found to provide the most comprehensive and quantitatively robust framework for assessing resilience. This approach enables the systematic incorporation of Serbia's specific characteristics, thereby offering the most appropriate basis for further advancement of disaster risk management systems (Milenković, Cvetković, & Renner, 2024; Milenković et al., 2025).

In contemporary literature, resilience is increasingly conceptualized as a multidimensional construct that extends beyond narrowly defined technical frameworks and encompasses multiple interrelated dimensions. In addition to technical and infrastructural resilience, referring to the robustness and reliability of critical infrastructure, growing attention is being paid to economic resilience, which ensures the economy's stability and capacity to absorb losses and maintain functionality after a disaster. Furthermore, social connectedness, reflected in strong interpersonal ties and mutual support within communities, is recognized as a crucial factor enabling a more effective response and faster recovery. Institutional sustainability denotes the capacity of governance systems and public policies to ensure continuity in prevention, coordination, and response. At the same time, psychological flexibility highlights the importance of individual and collective mental resilience in coping with stress and the long-term consequences of disasters. This comprehensive perspective facilitates a deeper understanding of the complexity of societal responses to disasters and provides a foundation for more systematic risk reduction strategies (Cutter, Ash, & Emrich, 2014). In the Serbian context, research findings indicate that the greatest weaknesses lie in institutional and social capacities for risk management, a fact particularly evident during the floods that affected the country in 2014 (Cvetković, Jakovljević, & Gačić, 2015). At the same time, studies have shown that a high level of social cohesion can significantly compensate for institutional shortcomings, as demonstrated in several local communities during the floods in Obrenovac, Šabac, and other affected municipalities (Cvetković, 2023).

The concept known as the "MODERSI Model" (Predictive Model of Community Disaster Resilience based on Social Identity Influences) was developed to more precisely examine and quantify the impact of social indicators on local community resilience under disaster conditions. This model emphasizes the importance of trust among community members, solidarity, and overall social cohesion as key mechanisms facilitating more effective recovery processes following emergencies. Additionally, the model recognizes religious beliefs and cultural values as relevant factors that can significantly shape risk perception and influence population behavior during disasters (Cvetković, 2023).

Cultural values, religious beliefs, and traditional norms constitute important factors shaping how communities perceive and respond to disasters. Within the Serbian socio-cultural context, elements of fatalism are often present as a cultural pattern, the perception of disasters as "acts of God", which may reduce motivation among the population to engage actively in preventive measures and systematic risk reduction activities. However, religious communities and traditional forms of collective action, such as communal labor ("moba") or charitable initiatives, can play a constructive role

in mobilizing local populations. The positive influence of religion is most commonly reflected in the promotion of solidarity, empathy, and mutual trust among individuals; however, unless this influence is integrated into institutional frameworks and supported through cooperation with formal structures, its scope and effectiveness remain limited (Cvetković, Romanić, & Beriša, 2023).

Demographic and socio-economic factors, such as age structure, education level, income, gender, and overall health status, play a crucial role in assessing community resilience to disasters. In Serbia, the population is characterized by an unfavorable age structure, accompanied by significant emigration of younger generations, leading to demographic decline and the weakening of the working-age and healthy population, particularly in smaller and rural areas. These trends directly reduce local communities' capacity to organize and respond effectively to crises. Women in rural areas often face limited access to information, education, and training programs in disaster risk management, further exacerbating gender inequalities in this domain. Nevertheless, numerous studies indicate that, despite these limitations, women demonstrate high levels of solidarity, practical engagement, and organizational capacity during crises, making them a significant and often under-recognized resource in disaster response and recovery (Cvetković & Šišović, 2024).

Local self-governments are key actors in the overall disaster risk management process, as they are closest to the population and best positioned to identify community-specific needs. However, their functioning is frequently constrained by multiple challenges, including a lack of financial and technical resources, insufficient personnel training in applying modern risk management approaches, and limited, inadequately institutionalized cooperation with other stakeholders at the local, regional, and national levels. For this reason, the systematic strengthening of institutional and operational capacities at the local level constitutes a fundamental prerequisite for enhancing community resilience, both in the prevention phase and during response and post-disaster recovery processes (Cvetković & Radonjić, 2022).

4. Development of integrated disaster management in Serbia

Disaster management can be understood as a distinct discipline and professional field that integrates scientific knowledge, the application of modern technologies, systematic planning, and diverse management methods. Its primary objective is to prevent and control extreme events that could

endanger human lives, cause mass injuries or fatalities, result in significant material losses, and severely disrupt the normal functioning of communities. In addition, this field encompasses activities aimed at mitigating the consequences of disasters and enabling faster societal recovery, thereby strengthening overall resilience and public safety (Phillips & Jenkins, 2010).

In contemporary literature and practice, it is widely accepted that two dominant paradigms of disaster management exist: the traditional and the modern. Their fundamental differences are reflected in organizational structures, approaches to information, operational models, management methods, and established priorities. The modern concept of disaster management is based on a flexible organizational structure and a multidimensional approach, enabling faster and more effective adaptation to unforeseen circumstances. A key feature of this approach is system adaptability, manifested in the continuous adjustment of plans and measures in response to evolving conditions and crisis dynamics. Within this framework, information is oriented toward real-time conditions and serves as the basis for timely, evidence-based decision-making. Furthermore, individuals are not viewed solely as passive recipients of protection but also as active resources whose knowledge, skills, and engagement contribute to collective disaster response. Particular emphasis is placed on the community as a whole, where collective resilience, cross-sectoral cooperation, and citizen participation become central factors in managing and mitigating the impacts of extreme events (Hromada & Lukáš, 2012; Savić, Stanković, & Anđelković, 2005).

In scientific and professional practice, specialized models are frequently developed to simplify extensive empirical data, anticipate future events, and guide appropriate responses. These models are designed to enable timely, coordinated, and optimal actions under crisis conditions. Through modeling, complex and dynamic phenomena are structured and simplified, enabling rapid and systematic real-time responses. At the same time, modeling enhances situational awareness among all stakeholders, enables the quantification of disaster intensity and scope, and establishes a unified basis for understanding the context and challenges faced by different actors. Moreover, such models serve not only to improve immediate response but also to support mitigation processes and ensure more organized and efficient post-disaster recovery (Cvetković, 2023).

When a disaster management model is precisely designed and clearly defined, it becomes the foundation for all subsequent activities in this field. Such a model not only formalizes and structures response systems but also ensures consistency in implementing various measures and procedures. Its role is to encompass all phases of disaster management, from prevention and preparedness to response, mitigation, and recovery, thereby creating a com-

prehensive framework that guides the actions of institutions, organizations, and individuals. "In professional literature, general disaster management models are identified as logical, integrated, causal, and others" (Asghar, Alahakoon, & Churilov, 2006, p. 31). The essence of the integrated model lies in clearly structured phases that enable disasters to be understood through strategic planning and systematic monitoring. This model effectively organizes diverse actors and their activities, directing them toward coordinated, comprehensive action in disaster contexts. Events and activities within this approach are highly interdependent, requiring a high level of coordination and cooperation.

The integrated disaster management model, developed during the 1980s, forms the basis of contemporary approaches in this field. It encompasses all four phases of disaster management—prevention, mitigation, response, and recovery, while placing particular emphasis on hazard identification and vulnerability assessment. In this way, the model supports decision-making across all key segments, from preventive measures and timely response to post-disaster recovery processes (Lettieri, Masella, & Radaelli, 2009). It enables a balanced allocation of societal responses in accordance with established priorities, such as saving human lives, protecting property, and preserving the environment, thereby ensuring the long-term sustainability of communities following crises. The fundamental principles underlying this process include systematicity, partnership among all stakeholders, consideration of uncertainty, geographical orientation, the use of reliable data, and the application of scientific methods (Simonovic, 2011). These principles may be proactive through mitigation, preparedness, and early warning activities or reactive, focusing on efficiency, cooperation, communication, and the achievement of defined objectives after disaster occurrence. Consequently, the integrated model, as a systemic approach, enables comprehensive risk assessment, prevention, mitigation, and preparedness, significantly reducing overall disaster risk. It integrates real-time information, mitigation strategies, and response measures while involving all relevant actors across all stages of disaster management, thereby ensuring the rational and efficient use of available resources (Henderson, 2004).

As with most disaster management frameworks, the integrated model is fundamentally based on "four phases: preparedness, mitigation, response, and recovery. The implementation of these phases aims at addressing problems and deficiencies within disaster management processes; preventing, mitigating, preparing for, and responding to disasters through strengthening local capacities and capabilities, particularly in risk management, which includes identification, management, and reduction of risks, as well as decision-making; and applying a multidimensional and multidisciplinary approach in coordinating all actors and resources to achieve an effective re-

sponse and optimal use of limited resources" (Henderson, 2004, p. 23). "Within these phases of integrated disaster management, five processes are incorporated that complete the disaster management cycle: forecasting, warning, emergency response, recovery, and reconstruction" (Moe & Pathranarakul, 2006, p. 399). Forecasting involves implementing measures to mitigate and ensure timely preparedness, thereby reducing disaster impacts. The warning phase refers to the timely dissemination of information to authorities and the population regarding impending risks, enabling the adoption of effective measures. Emergency response is provided during and immediately after the disaster and may vary in duration, ranging from immediate, short-term actions to prolonged interventions. Recovery, as the final phase, includes activities undertaken after a disaster to restore and improve living conditions, allowing the community to reach or surpass its pre-disaster level of functioning. "Reconstruction encompasses a set of activities that enable the development of systems better prepared for future disasters, ensuring more efficient responses" (Moe & Pathranarakul, 2006, p. 400).

To fully understand the integrated disaster management model, it is necessary to consider it in direct relation to risk management. The risk context is essential in the mitigation phase, as it enables the identification of key threats and system vulnerabilities. Processes of risk identification, analysis, and assessment constitute central elements of both mitigation and preparedness phases, providing the foundation for planning appropriate preventive measures and ensuring effective action in disaster conditions. "Risk treatment, or appropriate response to risk, is associated with the response phase to disaster consequences" (O'Brien, O'Keefe, Gadema, & Swords, 2010, p. 500).

Disaster risk reduction through the integrated model represents a systemic approach involving a comprehensive and coordinated process. It is grounded in administrative decision-making, institutionally structured through appropriate organizations, and supported by the knowledge and skills needed to implement established policies and strategies. In this way, society's overall capacities are mobilized to confront disasters and reduce their impacts effectively (Cvetković & Martinović, 2020). The integrated model has significantly shifted the approach to disaster management, from a focus primarily on post-disaster recovery and immediate response toward proactive risk management and impact mitigation. The emphasis is no longer solely on hazards and protection against them, but also on community vulnerability, alongside the development of early warning systems and mechanisms to reduce exposure. This principle has evolved to the point where disasters are increasingly considered at the local level, as an integral component of societal functioning and planning (Cyr, 2005).

Although the integrated disaster management model has become a widely accepted standard, certain deviations have persisted in practice, particularly regarding the harmonization of approaches and the codification of the theoretical framework. The key scientific and theoretical foundations established during its development primarily concern the definition of process phases, the identification of system actors and capacities for protection and rescue, and the typology and flow of information. Additionally, particular importance has been attributed to technologies that serve as critical resources in disaster response, enabling faster and more efficient action (Balanggoy, 2024).

The preparedness phase focuses on organizing disaster response by institutions, forces, and actors within the protection and rescue system, including the broader public. This process requires integrating civil organizations and individuals who, through participation in planning and appropriate training, acquire the capacity to contribute to a more effective and comprehensive response (Alexander, 2003). Plans developed within the system must ensure effective and efficient integrated disaster management. Of particular importance is the main plan, which provides a clear, structured framework within which institutions, organizations, and individuals can act in a coordinated, optimal manner (Wisner, 2004). Furthermore, plans must be tested in practice to assess their effectiveness and identify potential weaknesses that need to be addressed (Janković, Sakač, & Iričanin, 2023).

Disaster mitigation aims to reduce the vulnerability of social and environmental systems by lowering risk and preventing disasters. Mitigation actions are undertaken prior to the manifestation of hazards and are based on the analysis and assessment of potential threats. This approach includes preventive activities, asset protection, and measures implemented during disasters. Within this context, the most vulnerable areas are identified, organizational plans are developed to reduce exposure, and actions are taken to create safer living conditions. Simultaneously, data collection is conducted, damage is assessed, aid distribution is organized, and measures are implemented to mitigate remaining consequences. Mitigation measures may be structural, such as the construction of protective infrastructure, or non-structural, involving planning, education, and organizational activities aimed at reducing community exposure to hazards (Cvetković, Romanić, & Beriša, 2023). "The organization of disaster response aims to minimize human and material losses. The main components of response include evacuation, sheltering, protection, search and rescue, property protection, and damage control" (Henderson, 2004, p. 23). Effective coordination among all participants is essential in this phase, and specific measures are defined within protection and rescue plans (Cvetković & Miladinović, 2018). "Disaster recovery involves a set of measures that rehabilitate affected areas, often restoring them to the same or an improved condition compared to the pre-disaster state" (Simo-

novic, 2011, p. 31). During the recovery phase, institutions, organizations, and communities implement measures to restore normal living conditions as quickly as possible. The pace and extent of recovery depend on the scale of damage and society's actual capacity to respond. Unlike reconstruction, recovery primarily refers to short-term activities and the implementation of temporary solutions that enable community functioning until conditions for permanent restoration are established (Cvetković & Šišović, 2024).

5. Institutional and organizational aspects

One of the most critical aspects of the Integrated Disaster Management model is the presence of institutions in a country capable of providing comprehensive and effective responses during disasters. The establishment of institutions is defined by each country's legal framework, which not only specifies the institutions themselves but also their responsibilities and tasks in disaster situations (Lipovac & Cvetković, 2015). In addition to their existence and mutual organization, institutions must meet several appropriate criteria, which also serve as measures of their capacity to respond to disasters. Institutions must satisfy organizational criteria, meaning they must have appropriate units prepared to respond to disasters. These units must be adequately staffed with individuals who meet the necessary expertise criteria. Furthermore, personnel must be trained and prepared to work during disasters, with clear tasks and responsibilities assigned to the institution in which they operate. Finally, to effectively counter disasters, institutions must be equipped with the necessary material resources essential for disaster response (Cvetković, 2022).

In accordance with widely accepted principles for the Integrated Disaster Management method, the Integrated Disaster Risk Reduction System relies on international agreements and strategies, such as Yokohama, Hyogo, Sendai, and the International Strategy for Disaster Risk Reduction. These agreements recognize the institutions involved in the systemic integrated approach to disaster response (Jazić, 2015). Based on the legislation of the Republic of Serbia, it can be concluded that it aligns with international norms for Integrated Disaster Management, and that institutions can be divided into three main segments. These include state (national) institutions, which are further divided into state, regional, and local levels. Specifically, these include government bodies, provincial authorities, local self-government units, public services, educational institutions, research organizations, public agencies, etc. The second segment comprises the socio-economic sector, including the economy, entrepreneurs, and other legal entities. The third segment involves individuals and their organizations, such as groups, associations, and civil

society organizations (Cvetković & Šišović, 2024). The role or function of these institutions in the disaster risk reduction system is clearly regulated by state institutions through regulations within their jurisdiction. Notably, the Law on Disaster Risk Reduction and Emergency Management in the Republic of Serbia defines the Government's role as the highest institution responsible for establishing, developing, coordinating, managing, and organizing the integrated disaster risk reduction system. The Ministry of the Interior has been designated as the agency responsible for directly executing government tasks. Within it, a special unit has been formed: the Sector for Emergency Situations, which addresses disaster-related issues. According to the law, the Ministry of the Interior is assigned 28 responsibilities that complete the Integrated Disaster Risk Reduction System. The Ministry of Defense is the second ministry with a role to play in disaster response if primary institutions are unable to address the situation. Other ministries, together with other state administration bodies and autonomous provinces, have defined obligations and tasks that ensure the smooth functioning of primary agencies during a disaster. Local self-government units are especially crucial, as they play a primary role in disaster risk management. They are responsible for field-level tasks, including assessments and plans, and for organizing the execution of disaster response tasks, including securing financial resources.

The second segment of institutions is the socio-economic sector, which, under the law, includes economic entities and other legal persons. These entities are required to take measures within their jurisdiction according to the scale and nature of their activities. They are also obligated to provide their material resources or facilities to state authorities as needed and to provide relevant data to authorities to create necessary documents and databases. Special emphasis is placed on critical infrastructure operators, including entities engaged in specific activities considered critical or possessing critical infrastructure. These entities are particularly obligated to contribute resources during disasters to ensure the protection and rescue of people and assets (Cvetković, Filipović, & Gačić, 2019). Higher education institutions and scientific research organizations are also required to provide expert support and information relevant to disaster risk reduction and management.

Humanitarian organizations and associations with special significance, such as the Red Cross of Serbia, the Mountain Rescue Service, and the Firefighters' Union of Serbia, play a vital role in disaster situations. These organizations assist when necessary and, upon engagement, are designated as Civil Protection units. Other associations and organizations have the right to be informed and take an active role in matters related to disaster risk reduction. Their involvement can be proactive, particularly in improving the system or raising awareness of the issue. Citizens hold a special and unique status within the Integrated Disaster Management model. In addition to the

right to full and comprehensive information, citizens are obligated to train and prepare for protection and rescue, participate actively in Civil Protection or Military units, respond to calls from established bodies for participation in their actions, and follow prescribed safety and rescue measures. Moreover, citizens must provide material goods and real estate when needed. The ability of institutions to respond adequately to all disaster risk reduction demands and immediate disaster situations primarily depends on the personnel and forces actively engaged in these tasks (Tanasić & Cvetković, 2024).

The Ministry of the Interior, through the Sector for Emergency Situations, organizes response forces within its depth. The Sector, as the direct carrier of all activities, includes organizational units staffed with appropriate personnel. The Sector's components include the Directorate for Preventive Protection, the Directorate for Firefighting and Rescue Units, and the Directorate for Risk Management. Additionally, the Sector has independent departments focused on economic and material-technical support, as well as on legal and international affairs (Milošević, Cvjetković, & Baturan, 2024).

The law prescribes that the forces within the disaster risk reduction and emergency management system include emergency response staff, Civil Protection units, firefighting and rescue units, the 112 emergency service, the Serbian Armed Forces, the Red Cross of Serbia, the Mountain Rescue Service, the Firefighters' Union of Serbia, the Serbian Radio Amateur Federation, and various other entities. The institutional responsibility for training and preparing their members lies with the Ministry of the Interior, which operates regional and national training centers. For medical first-aid training, health institutions and the Red Cross of Serbia are responsible for citizens, while Civil Protection units are responsible for the units.

International cooperation between institutions within the Integrated Disaster Risk Reduction and Emergency Management System is a key segment for the system's effective and successful operation. This cooperation ensures the implementation of international agreements, data exchange, and direct collaboration with foreign and international bodies. A special aspect of international cooperation involves the receipt or dispatch of international aid, which may include specialized teams, equipment, and resources necessary for disaster response. Regardless of the system, the Red Cross of Serbia holds special rights and powers regarding international cooperation (Ivanov, 2024).

The integrated disaster risk reduction system is based on a multidisciplinary and intersectoral principle. Its foundation is proactivity, encompassing planning, preparation, and preventive measures to reduce disaster risk before it occurs. As a modern approach, it reflects a prevention culture and promotes awareness of risks and the need for preventive actions. This approach integrates all aspects of society, from individuals to the highest state author-

ities, highlighting the importance and relevance of every actor involved. The collaboration of numerous entities necessitates interoperability among them, enabling simultaneous functioning across sectors, international aid, local communities, and individuals (Öcal, 2021).

For the integrated system to be successfully organized and operational, certain principles have been aligned to support this. The first principle is that people are the priority. The second principle is inclusivity, which highlights the need to include all necessary entities coordinated by the disaster protection sector. The third principle emphasizes the need to consider both human and environmental hazards without exclusion. The fourth principle is prevention and risk reduction, which integrates these into development processes and strategies. The fifth principle concerns the application of knowledge, innovation, and education, including the latest technologies and innovations, as well as training and educating the population. The sixth principle concerns the establishment and involvement of partnerships among the public and private sectors, civil society, and the academic community. The seventh principle is based on risk management, founded on knowledge and information necessary to reduce risks and provide an adequate response. The eighth, final, and key principle is precautionary, referring to the adoption of all available preventive measures to reduce the risk of a disaster, even when there is no scientific certainty about whether or not a disaster will occur or its magnitude. This principle is applied across all levels of the Integrated Disaster Risk Reduction model, from policy, planning, and funding to training and implementation (United Nations Office for Disaster Risk Reduction, 2015).

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In addition to these principles, the successful organization and implementation of Integrated Disaster Risk Reduction requires sound policy, intersectoral cooperation, and public-private partnerships. Policy defines and influences societal priorities. It defines decision-making processes and the allocation of available resources within a society. Additionally, policy can guide society toward cooperation and coordination across sectors, and influence the development of new capacities aimed at reducing disaster risks or enhancing disaster response. Generally, societies establish one or more central bodies to organize, coordinate, and guide the system in disaster risk reduction (Schneid & Collins, 2001).

The Republic of Serbia strives to implement all European Union directives in this field. These directives standardize practices across the entire community and contribute to interoperability in international cooperation. The European Union's disaster risk reduction policy is based on five priorities: prevention, preparation, response, recovery, and international cooperation. When it comes to intersectoral cooperation, it is not only the essence and

application of all the principles but also an indicator of success in combating disasters. Since both risks and disasters are multidimensional and affect a broad spectrum of societal elements, intersectoral cooperation is the foundation for all societal actions. A society's resilience depends on the cooperation of all institutions, or societal entities. Through this cooperation, not only is direct action and collaboration achieved, but it also enables the exchange of knowledge, experiences, and, above all, resources among sectors of society. This way, society can more effectively and efficiently move toward the desired resilience against disasters. Special attention should be given to intersectoral cooperation with state institutions, which should be the initiators of cooperation with the private and civil sectors or the establishment of partnership relations. This leads to public-private partnerships that create a new way of organizing the implementation of elements that contribute to risk reduction. The state and public sectors often act as investors. In contrast, the private, scientific, or local sectors are the main drivers of projects that reduce risk, as they often have all other resources available, except for financial means (Cvetković V, 2023).

In the Republic of Serbia, the Law formulates these principles as guiding priorities: integrated action and intersectoral cooperation, the primary role of local communities, the gradual use of forces and resources, equality, joint participation, solidarity, and public information. The disaster risk reduction system is organizationally integrated into the security system, which uniquely and comprehensively manages and organizes all relevant entities. From a political perspective, the Strategy for Disaster Risk Reduction and Emergency Management is essential for setting policy and guiding government bodies and sectors in the country, directing the engagement of capacities. It also guides the development of the regulatory and institutional framework. The National Platform in Serbia is represented by the Republic Emergency Situations Headquarters, which adopts an intersectoral approach to disaster response and risk reduction. Disaster risk assessments are conducted according to the vertical principle, meaning that institutions and entities, starting from the state level down to the lowest levels, are responsible for conducting such assessments in compliance with the law. After the risk assessment, the necessary Disaster Risk Reduction Plans are created, in accordance with the Law, which outlines organizational measures for the entire risk reduction process. These plans also have a vertical structure, being developed from the national level down to the local level. In addition to these preventive plans, the Law also prescribes the development of protection plans. The protection and rescue plan provides an organizational framework for measures and activities to prevent and mitigate the consequences of disasters. It consists of five key sections: early warning and preparedness, mobilization and activation, protection and rescue, civil protection measures, and the use of

protection and rescue forces and entities. The external protection plan for large accidents refers to local government units with complexes containing hazardous substances. Following assessments and plans, the state also regulates specific registers that cover all disaster risks and define risk zones (Cvetković, Filipović, & Gačić, 2019).

A crucial element in organizing the Integrated Disaster Risk Reduction model is also the organization of the forces of the disaster risk reduction system entities. The forces of these entities form the basis for integrated actions to reduce risks and combat disasters. To monitor and coordinate activities aimed at disaster risk reduction, and to manage and coordinate activities during disasters, the state, according to the Law, establishes the Emergency Situations Headquarters. These Headquarters are formed from the national level down to the municipal level. The Headquarters may form expert-operational teams as needed, given that the command structure comprises political figures appointed to specific positions. Regardless of their level, Headquarters have 13 defined competencies, which pertain to organizing the entire process of risk reduction or disaster response. Particularly important are the powers that have imperative character in relation to specific institutions or entities. In addition to the core competencies, depending on the level of the Emergency Situations Headquarters, each has a specific range of authority, with the highest level of authority granted to the Republic Emergency Situations Headquarters. The organization of the Emergency Situations Headquarters comprises three phases: the preventive phase, the operational phase, and the recovery phase. In the preventive phase, the capabilities and readiness to respond to risks and threats are assessed. The operational phase is the most demanding, involving the organization, leadership, and coordination of the entities and forces of the risk reduction and emergency management system. The recovery phase involves planning, organizing, leading, and coordinating activities to enable the recovery, reconstruction, and rehabilitation of the affected community. The expert-operational teams formed by the Headquarters are responsible for specialized tasks requiring the involvement of skilled and competent individuals and entities with the necessary capacities (Milenkovic, 2025).

Civil protection is part of the forces within the disaster risk reduction and response system. Civil protection involves the personal and mutual protection of individuals, as well as measures, commissioners, deputy commissioners, and civil protection units. Personal and mutual protection is a form of citizen organization. Civil protection measures are divided into 13 sections, including: warning, evacuation, sheltering, care, CBRN protection, protection from technological accidents, rescue from debris, flood protection, rescue in inaccessible areas, fire and explosion protection, protection from unexploded ordnance, first aid, and terrain sanitation. For all these

measures, organizational principles have been defined to specify how system forces must act during implementation. Commissioners and deputy commissioners are considered members of civil protection and are responsible for coordinating the engagement of system forces during risk reduction and disaster response. Civil protection units are the equipped and trained operational forces of the system entities that execute civil protection measures. These units are divided into general-purpose units and specialized civil protection units. The Ministry of the Interior forms specialized units, while local governments form general-purpose and warning units. To enhance the capacity and capabilities of civil protection units, an active civil protection reserve can be formed in accordance with the regulations. Units are formed by the relevant authorities in cooperation with the Ministry of Defense to ensure record alignment. Specialized units are formed for fire-fighting, water and underwater rescue, medical care, first aid, CBRN protection, debris rescue, and warning. Civil protection units can be engaged independently or in combination with other forces in situations such as the declaration of an emergency, extraordinary events, imminent natural disasters, or technological accidents, and during a state of emergency or war, for training and drills. General-purpose units are engaged in other tasks related to risk reduction and, where possible, mitigating the consequences of disasters.

Firefighting-rescue units, in one part, represent the only professional and continuously engaged components of the disaster risk reduction and emergency management system. This component comprises professional, permanent employees within the Ministry of the Interior's Emergency Situations Sector. In general, fire-fighting units can be professional or volunteer-based. Professional units are divided into: firefighting-rescue units of the Ministry of the Interior, firefighting units of the Ministry of Defense, firefighting units of local governments, and firefighting units of legal entities. Legal entities and associations can form volunteer firefighting units. Firefighting-rescue units are territorially organized and prepared to respond in operations aimed at eliminating disaster occurrences, rescuing endangered populations and material goods, and removing disaster consequences. The organization of professional firefighting units within the system is defined in the Law. It consists of 13 sections that generally pertain to the imperative powers of authorized commanders, who, for their engagement, have certain rights and capabilities, mainly concerning the disposal and use of material resources and the directing of other individuals during direct engagement processes (Emergency Situations Sector, Serbia, 2025).

6. Main actors involved

The concept of resilience encompasses specific actors, first and foremost, individuals, various social groups, and the community as a whole. All of these actors draw on the resources available to them, both individual and collective, in efforts to overcome chronic or sudden threats to life. In doing so, they not only seek pathways for adaptation and recovery but also identify opportunities for self-improvement, transformation, and social development under crisis conditions, thereby linking resilience directly to processes of empowerment and progress (Pavićević, Bulatović, & Ilijić, 2019).

A complex interplay of internal and external factors conditions individual resilience. Internal factors include the person's physical and psychological characteristics, which, to a certain extent, make the individual more resistant to the impacts of disasters (Cvetković, 2020). An empirical study conducted in Australia sought to identify the traits of "resilient people" living in rural areas. Respondents highlighted resourcefulness, acceptance of change, a positive outlook, adaptability and flexibility, innovativeness, creativity, goal-setting or a future vision, readiness for a new start, persistence, and "grit," diligent work, the use of humor as a defense mechanism, as well as hope and faith. It was found that, as life experience and age increase, individuals are more likely to adopt and develop these traits, thereby strengthening their personal resilience (Maclean, Cuthill, & Ross, 2013). Conversely, excessive fear or denial of disaster threats can yield adverse consequences that directly reduce a person's readiness for preventive action (Hegney et al., 2007; Mavrodieva, Budiarti, Yu, Pasha, & Shaw, 2019).

Beyond identifying traits associated with "resilient individuals," a sizable body of research examines factors that increase resilience itself. Findings indicate that people who have previously experienced a disaster or accident, as well as those with greater knowledge of and information about risks, are better able to prepare, recover, and mitigate the impacts of crises. Such individuals also exhibit a lower likelihood of depression or post-traumatic stress disorder (Maduz, Prior, Roth, & Käser, 2019). Research further points to the concentration of economic and financial resources in urban areas, the unequal distribution of natural assets, and structural inequalities in urban development. Urban residents enjoy a greater degree of protection than those in rural regions. Insufficient or ineffective resilience at one social level can have negative repercussions for other levels, destabilizing the broader system (Boon, Cottrell, King, Stevenson, & Millar, 2012).

A central principle underlying strategies that enable individuals and groups to cope with unpredictable and ever-changing situations is captured by the concept of habitus. Habitus is defined as a set of internalized skills and

dispositions that guide behavior in specific social situations, often without conscious planning or deliberation. In other words, it enables individuals to make the "right move" intuitively within a given context. As such, habitus functions as a form of social inculcation through which a group systematically orients its members, fostering reflexes that contribute to faster and more effective responses in crises, thereby reducing negative consequences and elevating collective resilience (Bourdieu, 1990). Social resilience refers to the capacity of diverse societal actors, individuals, groups, communities, and organizations to respond adequately and successfully to problems and crises. It includes the composite set of collective capabilities that constitute social resilience, as well as recovery capacities, and encompasses all actions undertaken to overcome disasters and mitigate their impacts (Maguire & Hagan, 2007; Keck & Sakdapolrak, 2013; Guo & Kapucu, 2019).

Creativity within a community, as a distinct dimension of social resilience, is reflected in the ability to implement an effective and efficient recovery process across social levels, ultimately restoring functioning to pre-crisis conditions. At the same time, community capacity represents the essential power to overcome the consequences of disasters and to transform negative experiences into opportunities to strengthen cohesion (Maguire & Hagan, 2007). A society that can attain such functioning, ensuring a healthy, safe, and fulfilling life for its members, may be regarded as genuinely successful (Hall & Lamont, 2013).

Globally, resilience to natural and climate-related hazards has attracted considerable attention since the early twenty-first century. Multiple United Nations–sponsored conferences mapped and defined mechanisms for strengthening resilience. They also specified expected outcomes and set goals, including enhancing and empowering institutions, tools, and capabilities across sectors, with particular emphasis on the local community. In addition, these efforts highlighted the use of scientific advances and the adoption of innovations to cultivate a culture of safety and resilience across all social strata (Cvetković, Filipović, & Gačić, 2018).

Social resilience can be improved by strengthening economic indicators, such as income growth and higher living standards, as well as by enhancing communication mechanisms, increasing population preparedness for crises, building interpersonal trust, and improving the education system and access to protective resources. Collectively, these dimensions foster communities capable of acting preventively, recovering more rapidly, and developing a culture of resilience as a lasting social value (Cutter, 2024).

7. Key research findings in Serbia

Recent empirical studies on disaster resilience in Serbia consistently depict a system that is formally established yet unevenly implemented. While Serbia has developed institutional and normative foundations for disaster risk reduction, resilience remains moderate to low, territorially inconsistent, and highly contingent upon institutional performance, local capacities, social capital, trust, and citizens' risk perceptions. Collectively, these studies demonstrate that disaster resilience in Serbia cannot be fully understood through legal frameworks or administrative structures alone. Instead, it must be analyzed as a multidimensional and socially embedded process shaped by interactions among institutions, communities, and individuals (Cvetković et al., 2025; Cvetković, Milenković, & Lukić, 2026; Cvetković et al., 2026).

A key recurring finding is the persistent gap between formal institutional arrangements and their practical implementation at the local level. Research indicates that local self-government units typically possess basic organizational structures, planning documents, communication mechanisms, and prior disaster experience. Nevertheless, these components often remain procedural and are insufficiently operationalized in daily preparedness and response activities. Constraints such as limited financial resources, uneven technical capacities, inadequate personnel training, weak intersectoral coordination, and discontinuity in preparedness efforts hinder the transformation of formal responsibilities into effective resilience-building measures. Thus, institutional resilience in Serbia is determined not solely by the presence of laws, plans, and authorities, but also by the extent to which these arrangements are implemented, tested, localized, and adequately resourced (Cvetković et al., 2025; Cvetković, Milenković, & Lukić, 2026).

At the citizen level, empirical evidence reveals fragmented preparedness and an underdeveloped culture of prevention. Citizens' knowledge and readiness are more frequently shaped by prior disaster experience than by systematic education, organized training, participation in drills, or familiarity with emergency protocols. While past events, particularly floods, have increased practical awareness in certain communities, such experiences do not necessarily foster sustained preparedness or long-term preventive behavior. Generational differences are notable: older citizens often exhibit greater awareness due to direct experience, whereas younger groups may be less familiar with disaster risks and response procedures. As a result, resilience tends to be reactive rather than preventive, activated primarily during or after disasters rather than being continuously developed through education, planning, and community engagement (Cvetković et al., 2025; Cvetković et al., 2026).

The reviewed studies further demonstrate that social capital and informal support networks constitute significant sources of resilience in Serbia. Family ties, neighborly assistance, local solidarity, and community-based support often compensate for institutional shortcomings during crises. These informal mechanisms enhance immediate coping capacity and facilitate short-term recovery, particularly in communities where formal responses are perceived as slow or insufficiently effective. However, this dynamic reveals a broader resilience paradox: while Serbian communities may exhibit strong informal adaptive capacities, these are not consistently integrated with formal disaster risk reduction mechanisms. Informal solidarity can support response and recovery, but it cannot substitute for institutional preparedness, professional expertise, reliable early warning systems, or systematic risk reduction policies. Consequently, social capital should be regarded as a valuable yet incomplete resilience resource that requires integration with institutional planning and local governance (Cvetković et al., 2025; Cvetković et al., 2026).

Institutional trust and communication emerge as additional critical factors. Citizens' assessments of resilience are significantly shaped by their confidence in public authorities, early warning systems, evacuation planning, administrative efficiency, and the perceived ability of institutions to provide timely and reliable support. In contexts with low trust, citizens tend to assess resilience more critically, even when formal institutional capacities are present. This underscores that resilience depends not only on infrastructure, equipment, legal competence, or planning documents, but also on credibility, transparency, communication, and perceived institutional reliability. A lack of trust in warnings, plans, or authorities can diminish citizens' willingness to follow instructions and participate in preparedness activities. Therefore, strengthening resilience in Serbia necessitates not only technical and organizational enhancements, but also ongoing risk communication, public participation, transparent decision-making, and trust-building between institutions and communities (Cvetković et al., 2025; Cvetković et al., 2026).

Empirical evidence also reveals that resilience in Serbia is both territorially and socially uneven. Regional disparities manifest in economic development, infrastructure, institutional resources, environmental exposure, and local preparedness. More developed and urbanized regions generally exhibit stronger structural capacities, whereas less developed regions often experience greater vulnerability due to weaker infrastructure, limited financial capacity, and fewer institutional resources. However, higher socio-economic development does not guarantee resilience across all dimensions, as urbanized and economically robust areas may also encounter environmental pressures, technological hazards, and complex governance challenges. These findings confirm that resilience is a multidimensional phenomenon,

and regional differences must be analyzed using a combination of social, institutional, infrastructural, economic, and environmental indicators (Cvetković, Milenković, & Lukić, 2026).

Socio-demographic factors further influence perceptions and capacities for resilience. Variables such as age, gender, education, income, prior disaster experience, and risk awareness shape how citizens interpret hazards and assess their own preparedness and community capacities. Older citizens and women may report more critical perceptions of resilience, potentially reflecting heightened risk awareness or perceived vulnerability. Individuals with higher education or greater economic status may exhibit greater skepticism toward institutional performance, possibly due to heightened awareness of systemic deficiencies and heightened expectations of public authorities. These findings suggest that perceptions of resilience are shaped not only by available resources but also by awareness, expectations, social position, and lived experience (Cvetković et al., 2026).

The reviewed findings carry significant implications for resilience measurement and policy development. While structural indicators such as infrastructure, economic capacity, and institutional organization are essential for assessing resilience, they are insufficient in isolation. These must be supplemented with indicators addressing citizen preparedness, institutional trust, risk communication, social capital, demographic vulnerability, regional disparities, and hazard-specific perceptions. The application of adapted BRIC and DROP-based methodologies offers a robust foundation for measuring spatial and structural dimensions of resilience, whereas perception-based research provides valuable insights into how resilience is experienced and evaluated by citizens and institutional actors. Integrating these approaches facilitates a more comprehensive understanding of resilience as both an objective and subjective phenomenon (Cvetković, Milenković, & Lukić, 2026; Cvetković et al., 2026).

In summary, empirical evidence indicates that disaster resilience in Serbia remains in a developmental stage. Further progress requires more effective implementation of existing normative frameworks, enhanced local capacities, improved intersectoral coordination, systematic citizen education, increased institutional transparency, and the integration of informal community strengths into formal disaster risk reduction mechanisms. Accordingly, resilience should be conceptualized not as a static institutional condition, but as an ongoing process involving continuous interaction among institutions, communities, and individuals (Cvetković et al., 2025; Cvetković, Milenković, & Lukić, 2026; Cvetković et al., 2026).

8. Conclusion

This paper has analyzed disaster resilience in the Republic of Serbia through a multidisciplinary lens, with particular emphasis on the role and perception of key resilience actors, including institutions, professionals, and citizens. The analysis was explicitly grounded in the empirical findings presented in the section "Key Research Findings in Serbia," which served as the primary evidence base for understanding how resilience is structured and experienced in practice.

The synthesized findings confirm that disaster resilience in Serbia remains uneven, fragmented, and context-dependent. Despite the existence of a formally developed Integrated Disaster Risk Reduction System, there is a persistent discrepancy between normative frameworks and their practical implementation. Institutional capacities are often characterized by limited coordination, uneven operational efficiency, and insufficient localization of disaster risk management functions. At the same time, citizens' preparedness levels remain relatively low and are predominantly shaped by personal experience rather than systematic education or institutional engagement.

A key conclusion emerging from the empirical findings is that resilience in Serbia cannot be reduced to infrastructural or institutional indicators alone. Instead, it represents a complex interaction between formal governance structures, informal social networks, trust in institutions, and individual perceptions shaped by socio-demographic and experiential factors. In many cases, informal mechanisms such as family support and local solidarity partially compensate for institutional weaknesses, yet they remain insufficient for ensuring sustainable, system-wide resilience.

The analysis further confirms that perceptions of resilience vary significantly across population groups and hazard types, reinforcing the conclusion that resilience is not a homogeneous category but a socially differentiated construct. Trust, risk perception, and prior disaster experience emerge as decisive factors influencing both individual and collective preparedness. These findings underscore the importance of integrating psychological, social, and cultural dimensions into resilience-building strategies, alongside technical and institutional reforms.

Overall, the study demonstrates that strengthening disaster resilience in Serbia requires a shift from a predominantly formal, reactive system to a more integrated, participatory, and prevention-oriented model. This includes enhancing the capacities of local self-government units, improving intersectoral coordination, strengthening public trust, and systematically developing a culture of preparedness through education and training. In the long term, resilience can only be achieved through the coherent integration

of institutional efficiency, social cohesion, and informed citizen participation. In conclusion, the empirical evidence presented in this study clearly indicates that disaster resilience in Serbia is still in a developmental phase. Addressing existing gaps between policy and practice, as well as between institutional and community-level capacities, is essential for building a more robust, adaptive, and sustainable disaster risk reduction system.

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Review article

The Role of Electronic Communications and the Media in Integrated Risk Management: The Case of a Public Warning System

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Abstract

Effective risk management in modern society requires a comprehensive and integrated approach that includes coordination and cooperation among various government bodies, institutions, and other relevant stakeholders. In this context, electronic communications and the media play a particularly important role as key instruments for rapid, reliable, and wide-reaching public information in situations of heightened risk, emergencies, and crises. Timely and accurate information is one of the fundamental prerequisites for prevention, mitigation of the consequences of hazardous events, and the protection of citizens' lives and property. In addition to the public warning function, the media and electronic communications also have an important educational and preventive role through continuous public information, raising awareness of risks, and countering misinformation that may further affect safety in crisis situations. This paper focuses on the importance of institutional cooperation between the Ministry of the Interior and

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the Ministry of Information and Telecommunications of the Republic of Serbia in establishing and operating a public warning system within the broader framework of integrated risk management. Special attention is given to the analysis of two specific mechanisms: the "Find Me" system, activated in cases of missing minors, and the early warning and public warning message system for impending or imminent threats via SMS and other electronic communications channels. Through these two examples, the paper points to the potential of modern communication technologies and the media to improve coordination among competent institutions, increase response effectiveness, and strengthen public trust in institutional protection mechanisms. The aim of the paper is to demonstrate that emergency alerting systems are not merely technical solutions, but an important element of public policy in the areas of security, prevention, and risk management, contributing to greater societal resilience in the face of contemporary challenges and threats.

Keywords

Emergencies; Find Me; SMS; CBS; Ministry of the Interior (MoI); Ministry of Information and Telecommunications (MIT); electronic communications; media

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1. Introduction

In the context of increasingly pronounced global and local risks, crisis management has become a central challenge for contemporary societies. Accordingly, modern approaches to risk management increasingly rely on the integration of institutional mechanisms and the use of advanced information and communication technologies, which enable rapid and reliable public information.

The advancement of technologies—including the internet, social networks and digital media, geographic information systems (GIS), sensor technology, satellite communications, robotics, and the Internet of Things—can support the planning and implementation of disaster risk reduction measures. To ensure a strategic advantage, it is necessary to apply new communication technologies to facilitate reliable information exchange among all stakeholders involved in emergency management (Janković & Komazec, 2023, p. 126). In addition, these technologies can enhance an organization's capacity to identify and assess potential crisis situations before they escalate by enabling the analysis of large data volumes in order to detect causes, trends, and anom-

alies (Vuletić & Vukadinović, 2024, p. 112). Delays in public communication during crises may have significant adverse consequences for life, health, and property. Consequently, the development of effective public warning systems constitutes a priority for modern states. In this process, electronic communications and the media are essential, as they enable the rapid dissemination of verified information to broad audiences.

The Republic of Serbia is exposed to a range of risks and has been developing integrated mechanisms intended to strengthen prevention and enable timely response so as to avert or mitigate adverse consequences. This paper presents and analyzes a model of institutional cooperation between the Ministry of the Interior and the Ministry of Information and Telecommunications of the Republic of Serbia in the operation of a public emergency alerting system. The analysis relies on a qualitative approach with elements of a case study and uses analytical and descriptive methods, with particular emphasis on the role of electronic communications and the media.

2. Legal and Institutional Framework for Emergency Alerting and Risk Management

The legal framework is the foundation for establishing and operating risk management systems and public warning mechanisms, as it defines institutional competencies, operating procedures, and the rights and obligations of participants in the system. In the Republic of Serbia, this area is regulated through multiple legal acts which together form the normative basis for prevention and response in emergencies, as well as for organized and timely public information.

In this context, the Law on Disaster Risk Reduction and Emergency Management ("Official Gazette of the RS", No. 87/2018) is of particular importance, as it regulates the preparation, organization, and operation of the protection and rescue system, as well as the role of competent authorities in the event of natural and other disasters. This law establishes the basic principles of coordination and action in crisis situations, including the obligation of timely public notification. In addition, it regulates matters significant for disaster risk reduction, as well as prevention, strengthening resilience and preparedness of individuals and the community to respond in the event of such occurrences. Furthermore, the law covers the protection and rescue of people and material, cultural, and other assets, and defines the rights and obligations of various entities in the system, including government authorities, local self-government units, legal entities, and citizens.

It is particularly important that this law explicitly regulates the operation of the early warning, public notification, and alerting system, which represents one of the key mechanisms for timely public information in crisis situations. In this way, the role of communication channels and institutional mechanisms that enable the rapid transfer of information from competent authorities to citizens is legally grounded.

The law also defines the disaster risk reduction and emergency management system as an area of special interest for the Republic of Serbia and as an integral part of the national security system, thereby emphasizing its strategic importance and the need for coordinated action by all relevant stakeholders.

In addition to the above law, the Law on Electronic Communications ("Official Gazette of the RS", No. 35/2023) plays an important role, as it regulates, among other things, the functioning of electronic communications networks and services, as well as the conditions for using these systems for mass public warning. This law provides the basis for the technical implementation of systems enabling the delivery of public warning messages via SMS and other digital channels. Article 96 of the Law on Electronic Communications states that "providers of interpersonal communications services based on the use of numbering in a mobile public electronic communications network are obliged to enable end users to receive public warning messages of interest for protection and rescue free of charge, in accordance with the law regulating disaster risk reduction and emergency management." For this purpose, the law also recognizes other publicly available electronic communications services, provided that such a public warning system is equally effective in terms of coverage of a certain part of the territory or population and that end users receive public warning messages in a simple manner. This obligation is further extended when it is necessary to deliver notifications of importance for preserving and improving public health in accordance with the law regulating protection of the population from infectious diseases. The law prescribes that the delivery of such messages to end users is free of charge, and that the Government may determine additional cases of free-of-charge delivery of other public notifications to end users, of importance for achieving the public interest.

In addition, the Law on Public Information and the Media ("Official Gazette of the RS", Nos. 92/2023 and 51/2025) contributes to the legal regulation of communication with the public, emphasizing the importance of accurate, timely, and responsible information—especially in situations of public interest, such as emergencies and crises. In this sense, the media have an important role in conveying information originating from competent institutions. The Law on Public Information and the Media provides general provisions on reporting and highlights that everyone has the right to be truthfully, ful-

ly, and timely informed on matters of public importance. The Law on Electronic Media ("Official Gazette of the RS", Nos. 92/2023 and 51/2025) devotes significant attention to provisions strengthening the Regulator's oversight of media service providers in order to ensure professional and timely reporting, and pays special attention to the protection of minors in the media space.

Overall, the legal framework in the Republic of Serbia provides the normative prerequisites for the development of an integrated system for risk management and public emergency alerting. However, a key challenge remains consistent implementation, alongside the continued strengthening of institutional coordination and technical capacities.

Given the legal framework defining emergencies and the role of public warning as a core element of that system, it is necessary to outline the institutional framework, including the competent authorities, their roles, and coordination mechanisms. In this context, the institutional framework comprises the bodies and organizations responsible for planning, coordinating, and implementing measures in situations that require urgent public warning. Its effectiveness depends on clearly delineated competencies, established coordination procedures, and the timely exchange of information among institutions at the national, provincial, and local levels. Against this background, the need for stronger and more coordinated cooperation between the Ministry of the Interior and the Ministry of Information and Telecommunications has been identified.

In accordance with the Law on Ministries ("Official Gazette of the RS", Nos. 128/2020, 116/2022, 92/2023 – other law), the Ministry of the Interior (hereinafter: MoI) is the central state administration body whose primary task is the protection of citizens' lives and personal and property security, as well as safeguarding the legal order of the Republic of Serbia. Within its broad scope of work, the MoI performs operational duties including the prevention and detection of criminal offences, locating perpetrators, and maintaining public order and peace. It is also responsible for border security, foreigner control, and migration management. In addition, it carries out administrative and legal tasks such as issuing personal documents and maintaining citizens' records. It also manages fire protection systems, traffic safety, and weapons control. In modern conditions, the MoI is also engaged in electronic data management and international cooperation, giving it a key role in the national security system. Within the MoI, the Police Directorate and the Emergency Management Sector have a particularly important role in collecting and exchanging information, responding in emergencies, ensuring security and order, and supporting activation of the public warning system—especially in cases of missing persons and other situations requiring rapid and coordinated intervention.

Media and electronic communications services represent an important link between competent institutions and the public, enabling rapid and reliable transmission of information. The Ministry of Information and Telecommunications (hereinafter: MIT) performs state administration tasks aimed at regulating and developing public information, electronic communications, and the information society.

MIT plays a key role in ensuring the technical and regulatory conditions for the operation of electronic communications systems used for mass public warning. Through cooperation with other institutions, the ministry supports the use of modern communication channels (e.g., SMS and digital platforms), enabling rapid dissemination of information in crisis situations. In addition, as the body responsible for supervising the implementation of legislation in the field of information, MIT is positioned as a partner that can contribute—through multiple communication channels—to informing the public in emergency situations. As noted, "Rapid growth in the number of social media users, as well as the explosive growth in the volume of published information, leads to an increasing problem of fake news, which can have serious consequences for individuals and society, especially in emergencies. Moreover, the secondary effect of fake news can impact the loss of trust in reliable news sources" (Kovačević, 2024, p. 41). Accordingly, public communication in emergencies should be based on verified information disseminated through credible institutional and media channels.

In addition to national authorities, local self-government units also play an important role in the context of public emergency alerting, acting as the first line of response at the local level. They participate in organizing protection and rescue measures, coordinating local resources, and cooperating with national institutions in the process of informing and alerting the population. The institutional framework also includes other relevant institutions and entities, such as emergency services, healthcare institutions, public utility companies, telecommunications operators, media service providers, regulatory bodies, and others, which play an important role in information transmission and raising citizens' awareness of risks.

The effectiveness of the institutional framework largely depends on the level of coordination, clearly defined communication procedures, and the maturity of integrated information-exchange systems—factors of particular importance for the functioning of public emergency alerting and timely response in crisis situations. The remainder of this paper presents examples of public emergency alerting via electronic communications and the media following the successful cooperation of the two ministries (MoI and MIT) and other bodies and organizations of the Republic of Serbia.

3. Examples of Public Emergency Alerting Systems via Electronic Communications and the Media in the Republic of Serbia

Within the contemporary architecture of public emergency alerting, electronic communications and the media are operationalized through two distinct but functionally connected models: the "Find Me" system (based on the *Amber Alert* mechanism, originally developed in the United States in 1996) and a general emergency notification system via SMS.

The "Find Me" system was launched in the Republic of Serbia on 25 October 2023. Its purpose is to inform the public in cases involving missing minors in order to increase the likelihood of locating them during the critical initial period. The system was established through cooperation between the MoI and MIT, which signed a Cooperation Agreement concerning public warning in cases of missing minors. The agreement serves as the legal basis for the system and defines the roles of relevant stakeholders in the event of a missing minor, with the aim of ensuring an effective response. It was preceded by a Government Conclusion ("Official Gazette of the RS", No. 60/2023), which determines that transmitting notifications about reports of missing minors via publicly available electronic communications services is in the public interest and that communications service providers are obliged to enable end users to receive such notifications free of charge.

The system is based on the principle of urgency and on prioritizing the best interests of the minor. The basic premise for activating the system is that the disappearance of a minor represents a flagrant violation of fundamental human rights and an immediate threat to the child's physical and mental health. The agreement explicitly requires that personal data processing be carried out in accordance with national legislation and ratified international treaties, and that no measures be undertaken that could cause additional harm to the child.

The central instrument of cooperation is a joint electronic platform owned by MIT through which the MoI initiates public emergency alerting. Since MIT had previously established a national contact center system for children's online safety, designed to connect a large number of users from different domains, it was assessed that this system was suitable for upgrading and implementing a system intended to inform the public about missing minors (the "Find Me" system). Technically, the contact-center software consists of mutually integrated CRM segments (Customer Relationship Management—user database) that enable linking all system users with information across the chain of resolving safety-related issues. For full implementation of the

"Find Me" system, it was necessary to enable direct connectivity for a large number of external users via the system application (three mobile operators, around 500 TV and radio media outlets at national and local levels, 50 users related to airports, motorways and railway/bus stations, etc.). After system testing and training of key users, the "Find Me" application was established, and by signing the Cooperation Agreement between the two ministries, the system was officially put into operation.

3.1. How the "Find Me" System Operates

The MoI reports a missing minor by registering an authorized internal user/agent from the relevant police directorate within the system and opening a new case. The case file includes data on the missing person, as well as on the police directorate that generated the case. Information is entered into the system through pre-defined forms on the platform, which take into account formatting requirements or character limits for individual fields. Entering data for SMS and motorway signage is subject to character limits (160 characters for SMS messages and 114 for motorway signs).

After the missing minor is reported at a police station and the police assess whether the criteria are met (the child's age, disability, or suspected life-threatening circumstances), the MoI generates a notification on the electronic platform. The notification contains standardized data: a current photo, personal description, description of clothing and footwear, time and place of disappearance, and the 192 contact number (Figure 1.).



Figure 1. Notification appearance

MIT retrieves the data from the platform and immediately activates the network of media service providers and mobile operators. Based on the created case (Figure 2.), an automatic email notification is sent to the "Find Me" user group, containing the unique case ID, case name, and case link, so that each group member can download the material intended for them (e.g., radio stations download audio material, TV stations material with an image, mobile operators the text content of the future message, etc.).

Detalji predmeta	
Naziv	Test 17.06.2024. Test 17.06.2024.
Tip predmeta	Pronađi me
Status	Potvrđeno
Zadužen	TEST PRONADI ME 30.4.
Vreme poslednje promene	17.06.2024. 15.26.22
Prioritet	Visoki
Vreme sledeće eskalacije	18.06.2024. 15.05.52

Pregled predmeta

Figure 2. Created case

The agreement precisely regulates the frequency of publishing information in order to maintain a high level of public vigilance without causing information desensitization. Obligations are divided by communication channel:

- Television and radio stations:

In the first eight hours after activation, the notice is broadcast every 30 minutes. After that, the frequency changes to every 60 minutes. The overall period of intensive notification lasts 48 hours. This schedule is prescribed by the Rulebook on the Emergency Public Notification of a Missing Minor ("Official Gazette of the RS", No. 43/2024), adopted by the Council of the Regulatory Authority for Electronic Media. This bylaw specifies the technical standards and the manner in which media outlets are required to act in order to ensure maximum visibility of the information with minimal disruption to programming. Under the Rulebook, media outlets are obliged to publish the information in an unaltered form, exactly as delivered by the competent ministry. A key feature concerns the publication format. For television stations, the notice is displayed visually via a static image or video covering the entire screen, accompanied by text. In addition, an audio recording of the text is mandatory so that the information is accessible to blind and visually

impaired persons. For radio stations, the information is broadcast exclusively in audio format, through clear and intelligible reading of the delivered text.

This framework reduces reliance on discretionary editorial decisions by establishing defined obligations for the dissemination of official information in cases of missing minors.

- Mobile operators:

All mobile operators in the territory of the Republic of Serbia are obliged to forward a one-time SMS message containing the data from the notice to their users within the shortest possible time.

One of the most important aspects of the Agreement is the regulation of the termination of information broadcasting. The system is deactivated in two cases: when the minor is found, or upon expiry of the statutory 48-hour period. As soon as the MoI confirms that the child has been found, the information is posted on the platform, after which MIT, the media, and operators are obliged to immediately stop broadcasting and permanently delete all personal data and photos of the minor. This mechanism is designed to prevent secondary victimization of the child and to enable an undisturbed return to private and social life without a lasting digital trace of the traumatic event.

Since its establishment, the "Find Me" system has been activated several times. From a technical perspective, it has demonstrated full functionality and effectiveness.

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3.2. Public Warning System for Emergencies

The public warning platform is an integrated early warning system for cases of natural disasters or large-scale technical-technological accidents, with the primary goal of protecting human life and health, material assets, and the environment. The purpose of the system is to ensure timely and comprehensive public awareness so that protective measures can be implemented effectively, achieved through a multimodal approach to distributing information. This process includes sending one-time public warning messages via mobile operators in affected areas, broadcasting notifications via television and radio stations, informing the public through infrastructure companies responsible for roads, and publishing official recommendations on the websites of the Ministry of the Interior and other competent authorities.

The essential function of this subsystem is to support rapid operational response within a defined territory by generating a public warning message containing key information, which is then distributed to a network of approximately 600 external users. This group consists primarily of organizations whose activities complement those within the "Find Me" framework, enabling coordination among stakeholders in national security and civil protection and providing additional functionalities compared to the aforementioned platform. Whereas the "Find Me" system is intended for cases of missing minors, the public warning system has broader scope and may be used for different types of emergencies, including floods, storms, flash floods, earthquakes, fires, and other hazards assessed by the MoI as requiring public warning. The system is designed to enable geographically targeted warning for affected areas rather than nationwide dissemination, thereby supporting timely delivery and prioritization of information for populations at risk (Figure 3.). Information is also transmitted electronically to local and regional television and radio stations to facilitate timely public communication. Unlike the "Find Me" system, media service providers are not required to repeat urgent information at prescribed intervals; rather, they are expected to align dissemination with their programming in view of the nature of the event and the affected territory. Following user training for internal and external stakeholders, the system entered production on 15 September 2024 and has been activated on multiple occasions.



Figure 3. Outline of the warning system's operation

4. Further Development Directions

Future directions for developing the national public warning system are aimed at implementing *Cell Broadcast Service* (hereinafter: CBS), a technologically superior solution compared to existing distribution channels. Unlike conventional SMS technology, which operates on a point-to-point basis and requires individual delivery to each user, CBS uses a point-to-area broadcasting principle. This enables simultaneous delivery of public warning messages to millions of users within a defined geographic area within seconds, completely eliminating the risk of network congestion. During critical events, when mobile infrastructure often collapses due to overload, CBS ensures warning message delivery via a dedicated radio channel physically separated from regular voice and data traffic.

The introduction of CBS will also support precise geographic targeting, where messages are activated only on base stations covering the specific affected area, preventing unnecessary panic among citizens outside the risk zone. These messages also have display priority on device screens and are accompanied by distinctive audio-visual signals that can cut through a phone's "silent" mode.

It is important to emphasize that implementing the CBS system does not imply abolishing the SMS service; instead, the establishment of a hybrid public warning model is planned. By retaining SMS as a secondary channel, system inclusiveness is ensured, allowing users with older generations of mobile devices that do not support the CBS standard to continue receiving public warning messages without interruption. This two-layer approach guarantees maximu population coverage and system resilience to various technical challenges. With parallel warning channels (SMS and CBS), the Republic of Serbia will join only a few European countries that have both methods of public warning (Figure 4.).

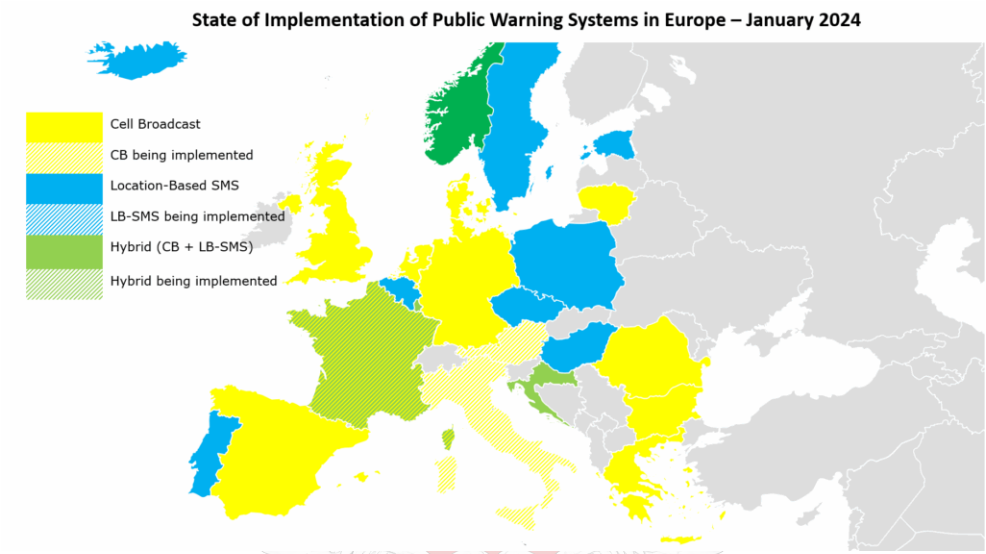


Figure 4. State of implementation of public warning systems in Europe

By integrating these solutions, the "Emergencies" system is raised to the level of advanced European standards such as *EU-Alert*, achieving full alignment with international risk management protocols. The Technical Specification for Emergency Communications, adopted by the European Telecommunications Standards Institute (ETSI) within the EMTEL technical committee for emergency communications, addresses technical requirements and mechanisms for a public warning system based on Cell Broadcast technology (European Telecommunications Standards Institute, 2023). Its application is aligned with Directive (EU) 2018/1972, which prescribes the obligation to establish public warning systems in Member States (European Union, 2018). The ultimate goal of this modernization is a transition to a digitalized, multimedia, highly reliable public warning system that combines the speed of modern technology with the comprehensiveness of traditional communication channels.

The European Emergency Number Association (*European Emergency Number Association*, hereinafter: EENA), which aims to improve emergency response in the European Union, emphasizes that technical solutions should be guided by the principle of technological neutrality, leaving Member States to decide whether to implement cell broadcast (CBS) and/or location-based SMS messaging. In view of the respective advantages and limitations, EENA indicates that using both technologies may provide the most comprehensive approach. In addition, EENA does not support the use of smartphone applications as a replacement for mobile broadcasting and/or location-based SMS,

primarily because applications require downloads and high penetration is difficult to achieve solely through voluntary uptake (Vivier, 2022).

EENA anticipates that public warning systems in the near future will communicate directly with smart devices in homes. According to EENA documents, the future of public warning lies in connecting state platforms with IoT infrastructure, where an emergency message could automatically switch on lights in tunnels, stop trains, or activate audible alarms in smart buildings—reducing the human factor in the response chain to a minimum (Vivier, 2022, pp. 14–16).

5. Conclusion

The establishment of the "Find Me" system and the public warning platform for emergencies illustrates the relevance of coordinated institutional action and modern communication technologies for citizen protection in the digital environment. By defining protocols through the Cooperation Agreement between the MoI and MIT, the Republic of Serbia developed a structured approach to public communication in specific critical events, with implications for the timeliness of response and the broader security framework related to the protection of minors, the population, and property.

Further development of this national system is inseparably linked to the full establishment of the single European emergency number 112, which requires continuous and intensive interdepartmental cooperation. This model is firmly grounded in the Law on Electronic Communications, which imposes on service providers the imperative to enable free access to emergency services from any device. While MIT, through this regulation, ensures technical enablement and implementation of advanced functions such as AML (*Advanced Mobile Location*) for precise caller location, the MoI assumes the key operational role in incident management and coordination of field response.

Based on the results and experience achieved so far in implementing these systems, the planned implementation of CBS technology represents the natural next step in the evolution of the national public warning system. With the introduction of this solution, the system moves from an exclusively reactive to a proactive mode, enabling mass broadcasting of warnings that are immune to network congestion and capable of reaching users within a specific geographic area in real time. According to the Strategy for the Development of the Electronic Communications System ("Official Gazette of the RS", No. 70/2024), CBS implementation was initially planned for 2025, but for economic reasons it was postponed until the end of 2026. Introducing

CBS technology does not imply discontinuing SMS messaging in emergencies. The strategic decision by the MoI and MIT to retain SMS as a secondary channel ensures the necessary inclusiveness for owners of older devices, thereby maximizing population coverage.

This multisector approach, which translates legal provisions into technical and operational mechanisms, is aligned with European standards such as EU-Alert and with EENA recommendations. In addition, continued investment in electronic communications infrastructure and the strengthening of cooperation with media actors remain important for developing a robust public warning system capable of responding to complex contemporary security risks.

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Article

The Role of Higher Education Institutions in the Development of Multidisciplinary and Integrated Risk Management

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Abstract

Contemporary security and legal systems are increasingly confronted with complex, interconnected, and difficult-to-predict risks, which challenge the effectiveness of traditional, sector-based approaches to risk management. Integrated Risk Management has emerged as a response to this complexity, based on the assumption that risks must be addressed systemically, taking into account their social, legal, and security dimensions. In this context, education, and higher education institutions in particular, play a crucial role in developing the knowledge, competencies, and security culture necessary for implementing an integrated approach. This paper examines the role of higher education institutions in the development of multidisciplinary and integrated risk management, drawing on theoretical approaches to risk and contemporary security studies. Special attention is paid to education as a security resource, the role of higher education institutions in shap-

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ing professional identities and security culture, and the importance of multidisciplinarity in understanding and managing contemporary risks. The analysis draws on relevant domestic and international academic literature in security, law, education, and risk studies. The paper concludes that integrated risk management cannot be sustained without a strong educational foundation and that higher education institutions represent one of the key actors in building institutional and societal resilience.

Keywords

Integrated risk management; higher education institutions; education; multidisciplinarity; security culture.

1. Introduction

Contemporary security and legal reality is marked by a persistent state of uncertainty, arising from interconnected global processes—technological development, economic crises, migration, climate change, transnational crime, and emerging forms of security threats. The risks generated by these processes do not manifest as isolated, clearly delineated events; rather, they appear as complex, multidimensional phenomena that can simultaneously affect multiple social systems and institutional spheres. For this reason, traditional sectoral and hierarchical models of response reveal significant limitations in both normative and operational terms. In both theoretical and practical debates, there is a growing consensus that contemporary risks require an integrated approach, one that entails the coordination of knowledge, policies, and institutional practices across different domains. Integrated risk management has emerged as a response to the fragmentation of security and legal regimes, offering a framework for addressing risks systemically, taking into account their interdependencies, cumulative effects, and long-term consequences (Graham, 2009). In a broader sense, this integrated approach transcends a purely technical-administrative understanding of risk and opens space for normative, social, and educational considerations.

Within contemporary security studies, risk is no longer viewed solely as an objective hazard measurable through statistical indicators, but also as a socially and institutionally constructed category (Dada, Mohammed, & Quadir, 2025; Janković, Cvetković, Gačić, Renner, & Jakovljević, 2025; Metić, 2025a, 2025b). The manner in which risks are defined, prioritized, and normatively regulated depends on the knowledge, values, and discursive frameworks within which relevant actors operate (Samier, 2015). In this process,

education plays a crucial role, as it is through educational systems that professional standards, security paradigms, and interpretative frameworks are formed—frameworks through which risks are recognized and addressed. The security-legal context further underscores the importance of education in risk management. Legal norms and security policies, however precisely formulated, remain limited in their effectiveness if not accompanied by adequate knowledge, competencies, and a developed security culture among the actors responsible for their implementation. From this perspective, education functions as an intermediary between normative requirements and the actual practice of risk management, shaping the understanding of law, responsibility, and institutional action.

Higher education institutions occupy a particularly significant position in this process. They simultaneously function as spaces for knowledge production, the education of future professionals, and the shaping of social values. Through curricula, research activities, and academic debate, universities contribute to the development of both theoretical and practical foundations of security, law, and risk management. In domestic literature, Milica Bošković and colleagues emphasize that education is a key factor in the development of security culture, which implies not only familiarity with regulations and procedures but also the cultivation of awareness of risks, responsibility, and the consequences of behavior (Bošković et al., 2025).

The interconnection between education and security is further confirmed by studies that conceptualize the educational system as a resource of national and societal security. Education enhances a society's capacity to recognize threats, adapt to change, and develop institutional resilience (Klein, Rice, & Levy, 2012). From this perspective, the role of higher education institutions extends beyond knowledge transmission to include the shaping of professional identities and normative orientations of future decision-makers within the security-legal system. Building on these considerations, this paper analyzes the role of higher education institutions in the development of multidisciplinary and integrated risk management. The paper assumes that an integrated approach to risk is not feasible without a strong educational foundation that enables the integration of different disciplines, normative frameworks, and professional practices. The paper aims to highlight education as a key resource for integrated risk management and to examine how higher education institutions contribute to the development of knowledge, competencies, and security culture necessary for effective responses to contemporary security challenges.

2. Integrated Risk Management as a Response to the Complexity of Contemporary Threats

The development of the concept of integrated risk management has been conditioned by changes like contemporary security threats, which are increasingly difficult to reduce to clearly defined and isolated hazards. Instead, contemporary risks are characterized by interdependence, multilayered structures, and the capacity to produce cumulative effects across different social and institutional domains. Within the security-legal context, this complexity calls into question the effectiveness of normative and institutional solutions based on strict divisions of competences and disciplinary approaches.

Integrated risk management has emerged as both a theoretical and practical response to such fragmentation. In its broadest sense, this approach assumes that risks must be understood systemically, taking into account their causes, interconnections, and potential long-term consequences (Graham, 2009). Unlike traditional models that focus on individual threats or sectors, the integrated approach seeks to connect different types of risks within a unified analytical framework.

The literature emphasizes that integrated risk management is not merely a technical model but also a normative concept that entails a shift in how security and responsibility are understood. Different professional and institutional cultures often rely on distinct concepts, criteria, and value frameworks, which complicates coordinated action.

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These observations carry particular weight in the security-legal domain. Law tends toward clarity, normative precision, and stability, whereas security practices often require flexibility and adaptation to changing circumstances. Integrated risk management seeks to bridge this tension, but it can do so only if there exists a shared knowledge base that enables the understanding of risks from multiple perspectives.

Contemporary security studies further indicate that many risks are simultaneously legal, social, and security-related. Risks associated with terrorism, radicalization, migration, or cybersecurity cannot be adequately addressed solely through repressive or regulatory measures, but require preventive and educational strategies (Samier, 2015). In this sense, integrated risk management necessarily entails the inclusion of education as an integral component of security policy.

Studies focusing on risk analysis within higher education institutions further confirm that contemporary risks manifest through a combination of organizational, social, and security factors (Raanan, 2009; Ramrakhiani et al., 2021). Although these studies primarily examine the institutional context,

their findings have broader relevance, as they demonstrate that risk management requires an understanding of actors' behavior, values, and competencies, rather than relying solely on formal procedures.

It is particularly significant that contemporary approaches to risk increasingly emphasize the role of knowledge and learning. Integrated risk management presupposes actors' capacity to recognize emerging threats, understand their implications, and act in accordance with legal and ethical standards. Without this cognitive and normative foundation, the integrated approach remains merely declarative.

Such an understanding suggests that normative and institutional reforms alone are insufficient for the realization of integrated risk management. Its sustainability depends on educational processes that enable the development of multidisciplinary understandings of risk and the capacity for coordinated action in complex security-legal environments. This relationship between integrated risk management and education constitutes the starting point for examining the role of higher education institutions in contemporary security systems.

3. Multidisciplinarity as an Epistemological and Institutional Requirement of Integrated Risk Management

One of the key prerequisites of integrated risk management is a multidisciplinary understanding of contemporary threats. Contemporary risks cannot be reduced to a single type of knowledge, a single professional perspective, or a single normative framework, as they emerge at the intersection of various social, technological, legal, and security processes. In this sense, multidisciplinarity does not represent a methodological choice, but rather an epistemological and institutional requirement of an integrated approach to risk.

In risk theory, there is an increasing recognition that fragmented approaches based on individual disciplines are insufficient in addressing complex and systemic risks. Graham (2009) argues that integrated risk management requires integrating different forms of knowledge to identify interdependencies among risks and to avoid partial or contradictory institutional responses. This approach is particularly relevant in the security-legal context, where decisions made from a single perspective may produce unintended consequences in other domains.

Multidisciplinarity, in this context, does not imply merely aggregating knowledge from different disciplines, but rather their mutual integration. Security risks often simultaneously entail legal, social, political, and educational implications. For example, cyber threats are not solely a technical issue, but also involve questions of legal responsibility, data protection, institutional culture, and user education. For this reason, an integrated approach to risk requires education that enables the understanding of these complex interrelations.

Multidisciplinarity is closely linked to the educational role of higher education institutions. Universities represent a unique space in which different academic disciplines and professional traditions converge. However, research indicates that institutional diversity alone is insufficient to achieve genuine multidisciplinarity. Raanan (2009) notes that higher education institutions often maintain disciplinary fragmentation, which limits the educational system's capacity to respond effectively to complex security challenges.

In this regard, integrated risk management requires a shift in educational paradigms. Instead of discipline-bound programs, there is a need for educational models that foster the integration of knowledge from law, security studies, management, information technology, and the social sciences. Such models enable future professionals to understand risks as systemic phenomena rather than isolated incidents.

International research further confirms that education integrating multiple perspectives contributes to the development of institutional resilience. Analyses of risks in the higher education sector indicate that institutions investing in multidisciplinary education and competency development are better equipped to recognize and anticipate emerging risks (Higher Education Risk Register Analysis, 2023). Although these findings primarily relate to the institutional context, their broader implications point to education as a key resource for integrated risk management.

It is important to emphasize that multidisciplinarity also has a normative dimension. Within the security-legal framework, understanding risk requires knowledge of legal constraints, human rights, and ethical principles. Studies addressing the relationship between education, security, and citizenship suggest that educational systems play a crucial role in balancing security demands with democratic values. Without such a balance, an integrated approach to risk may be reduced to an instrument of control rather than a means of strengthening societal resilience.

All of the above indicates that multidisciplinarity constitutes the foundation of integrated risk management and that education represents the key

mechanism through which it is achieved. Higher education institutions, as spaces where different disciplines and normative frameworks intersect, play a central role in the development of knowledge and competencies necessary for understanding and managing contemporary risks. This role of education serves as the starting point for examining security culture as a distinct component of integrated risk management.

4. Education as a Key Resource for Integrated Risk Management

In the contemporary security-legal context, education is increasingly recognized as a structural resource of integrated risk management. This understanding is based on the assumption that society and institutions' ability to identify, interpret, and normatively frame risks is not determined exclusively by formal regulations and institutional mechanisms, but also by the knowledge, values, and competencies of the actors who apply those mechanisms. Risk, understood as a socially and institutionally mediated phenomenon, requires educational processes that enable an understanding of its multidimensionality and long-term consequences (Samier, 2015, p. 685).

Theories of education and adult education indicate that professional action under conditions of uncertainty cannot be reduced to the application of predefined procedures. Instead, the development of the ability to analyze, interpret, and make responsible decisions in changing circumstances is crucial. Despotović emphasizes that adult education aims to develop competencies that enable the transfer of knowledge to new and unpredictable situations, which is particularly important in areas characterized by high risk (Despotović, 2012). This approach to education is directly relevant to integrated risk management, which implies continuous adaptation to new threats and contexts.

Security studies further emphasize that education has a preventive function. Instead of reactive action after damage has occurred, education enables the earlier identification of risks and an understanding of the causal relationships that lead to them. Samier points out that educational institutions help shape "security imaginaries," that is, how risks are conceptualized and legitimized in society (Samier, 2015, pp. 689–690). In this sense, education affects not only individual competencies but also broader social patterns of response to risks.

A particularly important contribution to understanding education as a security resource comes from domestic literature on security culture. Bošković

et al. define security culture as a set of knowledge, attitudes, values, and behavioral patterns that shape how individuals and institutions perceive and manage security challenges (Bošković et al., 2025). Within this framework, education represents the basic mechanism through which security culture is developed and maintained. Without systematic education, legal and security mechanisms remain formal and often insufficiently effective.

The connection between education and integrated risk management is particularly evident in security-legal professions. Lawyers, security analysts, and public officials in practice face situations in which it is necessary to simultaneously apply legal norms, assess security risks, and consider the social consequences of decisions. Such an ability cannot be developed exclusively through narrowly specialized professional education, but requires a multidisciplinary educational framework that connects law, security, the social sciences, and ethics (Klein, Rice, & Levy, 2012, p. 7).

The andragogical literature also emphasizes the importance of lifelong learning in areas characterized by rapid change and high uncertainty. Živković points out that professional competencies are not static but are continuously developed through formal and non-formal learning, which is particularly important in the fields of security and risk management (Živković, 2016). Integrated risk management, understood as a dynamic process, requires precisely this kind of educational approach.

International research confirms that educational systems that encourage critical thinking and interdisciplinary learning strengthen institutional and social resilience. Analyses in the field of higher education and security indicate that knowledge acquired through educational processes has a longer-term effect on the capacity to respond to risks than short-term administrative measures (Raanan, 2009, pp. 47–48). These findings confirm that education represents a strategic resource of integrated risk management.

These insights confirm that education is one of the key resources of integrated risk management. Through the development of knowledge, competencies, and security culture, educational processes enable the connection of the legal, security, and social dimensions of risk. In this sense, the role of higher education institutions is not secondary or auxiliary, but structural and long-term, because they shape the cognitive and normative foundations on which integrated risk management is based.

4.1. Higher Education Institutions and the Development of Security Culture

In the contemporary security-legal context, education is increasingly recognized as a structural resource of integrated risk management. This under-

standing is based on the assumption that the capacity of societies and institutions to recognize, interpret, and normatively frame risks does not rely solely on formal regulations and institutional mechanisms, but also on the knowledge, values, and competencies of the actors who implement them. Risk, understood as a socially and institutionally mediated phenomenon, requires educational processes that enable the comprehension of its multidimensionality and long-term consequences (Samier, 2015, p. 685).

Theories of education and adult education suggest that professional action under conditions of uncertainty cannot be reduced to the application of predefined procedures. Instead, it requires developing analytical, interpretive, and responsible decision-making capacities in changing circumstances. Milan Despotović emphasizes that adult education aims to develop competencies that enable the transfer of knowledge to new and unpredictable situations, which is particularly important in fields characterized by high risk (Despotović, 2012). Such an approach to education is directly relevant to integrated risk management, which presupposes continuous adaptation to emerging threats and contexts.

In security studies, education is further emphasized for its preventive function. Rather than focusing on reactive responses after harm has occurred, education enables earlier recognition of risks and a deeper understanding of the causal relationships that produce them. Samier points out that educational institutions help shape "security imaginaries," that is, how risks are conceptualized and legitimized within society (Samier, 2015, pp. 689–690). In this sense, education influences not only individual competencies but also broader societal patterns of risk response.

A particularly important contribution to understanding education as a security resource comes from domestic literature on security culture. Milica Bošković and colleagues define security culture as a set of knowledge, attitudes, values, and behavioral patterns that shape how individuals and institutions perceive and manage security challenges (Bošković et al., 2025). Within this framework, education represents the primary mechanism through which security culture is developed and sustained. Without systematic education, legal and security mechanisms remain formal and often insufficiently effective.

The link between education and integrated risk management is particularly evident in security and legal professions. Legal professionals, security analysts, and public officials are frequently confronted with situations that require the simultaneous application of legal norms, the assessment of security risks, and the consideration of the social consequences of decisions. Such capacities cannot be developed solely through narrowly specialized educa-

tion, but require a multidisciplinary educational framework that integrates law, security, social sciences, and ethics (Klein, Rice & Levy, 2012, pp. 7).

Andragogical literature further emphasizes the importance of lifelong learning in fields characterized by rapid change and high uncertainty. Dragan Živković argues that professional competencies are not static, but are continuously developed through both formal and informal learning processes, which is particularly relevant in the fields of security and risk management (Živković, 2016). Integrated risk management, understood as a dynamic process, requires precisely such an educational approach.

International research confirms that educational systems that promote critical thinking and interdisciplinary learning strengthen institutional and societal resilience. Analyses in the fields of higher education and security indicate that knowledge acquired through educational processes has a more lasting effect on the capacity to respond to risks than short-term administrative measures (Raanan, 2009, pp. 47–48). These findings reinforce the understanding of education as a strategic resource for integrated risk management.

These insights confirm that education represents one of the key resources of integrated risk management. Through the development of knowledge, competencies, and security culture, educational processes enable the integration of legal, security, and social dimensions of risk. In this sense, the role of higher education institutions is neither secondary nor auxiliary, but structural and long-term, as they shape the cognitive and normative foundations upon which integrated risk management is built.

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4.2. Competencies for an Integrated Approach to Risk

An integrated approach to risk requires developing specific competencies that go beyond narrowly technical or purely normative knowledge. Within the security-legal context, these competencies include the capacity for systemic thinking, normative reasoning, and decision-making under conditions of uncertainty. Such capacities cannot be developed through short-term training or procedural manuals, but require educational processes that connect theory, practice, and critical reflection.

In andragogical literature, a clear distinction is made between skills and competencies. Milan Despotović emphasizes that competencies imply the ability to apply knowledge in new and unpredictable situations, whereas skills are associated with the routine execution of tasks under familiar conditions (Despotović, 2012, p. 46). This distinction is particularly important for an integrated approach to risk, as contemporary security challenges frequently exceed prior experience.

Further research in adult education highlights the importance of reflective competencies. Dragan Živković argues that professional action in high-risk fields requires the capacity for critical reflection on one's own practices and underlying normative assumptions (Živković, 2016, p. 113). Such reflective capacity enables professionals to recognize the limitations of existing norms and to adapt their actions to new circumstances.

Contemporary security studies further confirm that an integrated approach to risk requires multidisciplinary competencies. Understanding risk involves linking legal norms, security assessments, and social implications, which is possible only if the educational system promotes the integration of diverse perspectives (Samier, 2015, p. 687).

Empirical analyses in higher education indicate that limited educational frameworks lead to fragmented understandings of risk and uncoordinated institutional responses (Raanan, 2009, p. 48). These findings confirm that without education fostering systemic thinking, an integrated approach to risk cannot be sustainable.

It follows that competencies for an integrated approach to risk are fundamentally an educational issue. Higher education institutions, through the design of curricula and pedagogical methods, play a crucial role in developing the knowledge and capacities necessary for understanding and normatively responsible action within contemporary security-legal environments.

An integrated approach to risk presupposes a dynamic set of knowledge and competencies that cannot be acquired or maintained solely through initial education. The pace of change in security threats, normative frameworks, and technological conditions requires continuous learning and professional development for actors involved in the security-legal system. In this sense, lifelong learning constitutes a structural condition for the professionalization of an integrated approach to risk.

Andragogical literature emphasizes that professional competencies in high-risk fields develop through ongoing learning processes that integrate theoretical knowledge, experience, and reflection on practice (Despotović, 2012, p. 45; Živković, 2016, p. 112). This approach is particularly relevant for security-legal professions, where decisions are made under conditions of uncertainty and often under pressure from competing normative demands. Lifelong learning enables professionals not only to adapt their knowledge to new risks but also to critically reassess established patterns of action.

Contemporary analyses of risk management indicate that institutional responses often lag behind changes in the security environment, precisely because of the lack of continuous professional development (Graham, 2009). In the security-legal domain, such lag can have serious consequences, as nor-

mative solutions and security practices lose relevance if they are not accompanied by the development of competencies among those who implement them.

Lifelong learning also has an important normative dimension. Literature linking education, citizenship, and security emphasizes that professional education must include an understanding of human rights, the rule of law, and the ethical limits of security action. Without this dimension, the professionalization of an integrated approach to risk may be reduced to technical training devoid of critical and normative grounding.

Research on education in the context of social and economic security further confirms the importance of continuous learning. Gelepithis and Giani demonstrate that education shapes attitudes toward redistribution, solidarity, and social cohesion—factors that directly influence the perception and management of social risks (Gelepithis & Giani, 2020). These findings suggest that the professionalization of an integrated approach to risk depends not only on technical knowledge but also on the broader educational context that shapes value orientations.

The role of higher education institutions in the institutionalization of lifelong learning is particularly significant. Through professional development programs, specialized studies, and collaboration with practice, universities can provide a stable framework for the development and maintenance of competencies relevant to an integrated approach to risk. Analyses of risk in the higher education sector indicate that institutions that systematically invest in professional development demonstrate greater capacity to adapt to environmental changes (Raanan, 2009).

In the context of security-legal professions, lifelong learning also contributes to the development of a shared professional language. An integrated approach to risk requires coordination among diverse actors and disciplines, which is difficult to achieve without a common foundation of knowledge and understanding. Studies on integrated risk management indicate that the lack of standardized educational frameworks is a key obstacle to the effective integration of different sectors.

Finally, it is important to emphasize that the professionalization of an integrated risk approach through lifelong learning has long-term implications for institutional and societal resilience. Educational processes that enable continuous professional development contribute to the formation of professional communities capable of responding to emerging security challenges in a normatively grounded and socially responsible manner (Klein, Rice, & Levy, 2012). Lifelong learning thus emerges as a key mechanism for the professionalization of integrated risk management. Without continuous

education, the integrated approach remains a theoretical concept of limited practical reach. The role of higher education institutions in this process is therefore strategic, as they provide the institutional framework for the development and maintenance of competencies necessary for contemporary security-legal practice.

Within the security-legal framework, an integrated approach to risk operates within clearly defined normative boundaries that determine the competences, obligations, and responsibilities of institutions and individuals. Law, in this sense, does not function as an abstract regulator of risk, but as a normative system that guides action under conditions of uncertainty, both constraining and enabling legitimate forms of security practice. Understanding this normative function of law requires knowledge and competencies acquired through educational processes, particularly within higher education.

Contemporary risks often emerge in forms that are not fully anticipated by existing normative frameworks. In such circumstances, legal norms do not operate automatically, but require interpretation and application in concrete security situations. This interpretative space does not represent a legal gap, but rather a domain of professional responsibility for those who apply the law. Doscher highlights that education plays a crucial role in developing the capacity to reconcile security demands with legal standards, particularly in situations involving value conflicts or heightened social pressure (Doscher, 2008).

In this context, an integrated approach to risk requires actors capable of understanding the legal consequences of security decisions and the security implications of legal solutions. Graham (2009) emphasizes that fragmented normative and institutional frameworks complicate the management of complex risks, leading to partial and often uncoordinated decisions. Education plays a decisive role in overcoming these limitations by enabling the integration of legal knowledge with broader security and social insights.

A particularly important issue in this context is professional and institutional responsibility. Security-legal decisions are often made under conditions of limited information and time pressure, where responsibility cannot be fully transferred to normative frameworks or hierarchical structures. Education contributes to the development of the capacity to assess proportionality, necessity, and legality of measures, which constitutes the foundation of responsible action in accordance with the rule of law.

Studies examining the relationship among education, security, and social values indicate that legal responsibility cannot be separated from actors' value orientations. Gelepithis and Giani demonstrate that education influences understandings of solidarity, social cohesion, and responsibility, thereby

indirectly shaping how social and security risks are addressed (Gelepithis & Giani, 2020). These findings confirm that risk management is not solely a technical or normative issue, but also a matter of attitudes and values shaped through education.

Empirical analyses of risks in public and educational institutions further confirm the importance of education for a clear understanding of responsibility. Reports on key risks indicate that insufficient understanding of legal obligations, divisions of competence, and communication among actors often contributes to the escalation of risks and institutional failures (United Educators, 2023). These findings have broader implications within the security-legal context, highlighting the need for education that fosters a clear understanding of responsibility in complex institutional environments.

The role of education in this context is not limited to the transmission of knowledge about existing regulations. It also encompasses the development of normative reasoning, an understanding of the consequences of decisions, and awareness of the limits of legitimate security action.

Based on the above, it can be concluded that education represents a key link between law, security, and responsibility within an integrated approach to risk. Through educational processes, the capacity is developed to apply the law in complex security situations in a lawful, proportional, and socially responsible manner. Higher education institutions, as the primary providers of such education, therefore play a central role in building a normatively grounded and sustainable framework for integrated risk management.

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5. Conclusion

Contemporary security challenges, characterized by complexity, interdependence, and uncertainty, require approaches that transcend traditional, sectorally fragmented models of response. Integrated risk management has emerged as a response to this reality; however, its implementation depends not solely on normative and institutional solutions, but to a decisive extent on the knowledge, competencies, and value frameworks of the actors operating within these systems. In this context, education—particularly higher education—represents a structural precondition for a sustainable and legitimate integrated approach to risk.

This paper has demonstrated that integrated risk management cannot be reduced to a technical-administrative concept. It entails a multidisciplinary understanding of risk, the capacity for systemic analysis of security threats, and normatively grounded decision-making under conditions of uncertainty. These capacities are primarily developed through educational processes

that integrate law, security studies, social sciences, and ethics, enabling future professionals to act responsibly and in accordance with the principles of the rule of law.

Particular attention has been paid to the role of higher education institutions in developing security culture and professional competencies relevant to an integrated approach to risk. Universities constitute a key environment in which professional identities, interpretative frameworks, and value orientations of future actors in the security-legal domain are formed. Through education that fosters critical thinking, multidisciplinarity, and normative reasoning, higher education institutions help strengthen both institutional and societal resilience.

The analysis has also shown that lifelong learning occupies a central position in the professionalization of an integrated approach to risk. The dynamic nature of contemporary security threats and the evolving character of normative frameworks require continuous development of knowledge and competencies. In this sense, education is not a one-time process, but a permanent mechanism of adaptation and responsible action in complex security-legal environments.

In conclusion, an integrated approach to risk management is not sustainable without a strong educational foundation. The role of higher education institutions in this process is not auxiliary, but essential and long-term, as it is through education that the knowledge, competencies, and values are developed which enable normatively grounded, responsible, and socially legitimate management of contemporary risks.

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The Importance, Content, and Implementation of Environmental, Social, and Governance Principles in the Field Of Sustainability And Local Community Development

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Abstract

The contemporary concept of sustainable development in local communities increasingly relies on integrated governance frameworks that connect economic, social, environmental, institutional, and security dimensions of development. One of the most influential frameworks of this kind is ESG, which refers to Environmental, Social, and Governance principles. Although ESG originally emerged in the fields of corporate governance, investment decision-making, and non-financial reporting, it has increasingly gained relevance in the public sector, particularly at the local level of self-government. This paper analyses the meaning, content, and practical applicability of ESG principles in the context of sustainability and development of local communities, with particular emphasis on civil protection, public safety, disaster risk reduction, and community resilience. Special attention is devoted to the relationship between the ESG framework and the legal framework of the Republic of Serbia, especially the Law on Disaster Risk Reduction

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and Emergency Management. The paper argues that ESG principles should not be understood as a new or externally imposed normative obligation for local governments, but rather as a conceptual, analytical, and operational framework that can improve the implementation of already existing legal duties. The analysis shows that the environmental component of ESG is directly linked to climate risk, environmental protection, spatial planning, and prevention of natural and technological hazards; the social component is related to the protection of citizens, inclusion of vulnerable groups, public health, social cohesion, and community preparedness; while the governance component concerns transparency, institutional responsibility, coordination, accountability, planning, and risk-informed decision-making. By integrating ESG principles into local development strategies, civil protection plans, disaster risk reduction plans, public investment planning, and budgetary processes, local governments can strengthen their capacity to prevent, prepare for, respond to, and recover from disasters. The findings indicate that ESG represents a practical tool for improving resilience, transparency, and sustainable development at the local level, particularly in societies exposed to climate change, demographic decline, infrastructural vulnerability, and increasing disaster risks.

Keywords

ESG; sustainable development; local self-government; civil protection; community resilience; public safety; disaster risk management; disaster risk reduction; local governance; Republic of Serbia.

1. Introduction

Local communities represent the fundamental level at which sustainable development is translated from a general policy concept into practical social, economic, environmental, and institutional action (Cvetković et al., 2018; Cvetković & Radonjić; Cvetković, Aleksov, Renner, Gačić, Ivanov, & Milašinović, 2025). It is precisely at the local level that economic interests, social needs, environmental protection requirements, public safety concerns, and institutional governance capacities intersect. In contemporary conditions marked by climate change, demographic decline, economic inequalities, rapid urbanization, infrastructural vulnerability, and increasing security risks, local governments are faced with the need to develop integrated, preventive, and long-term sustainable models of development (Abu-Rayash & Dincer, 2025; Birchall, Bonnett, & Kehler, 2023; Cid & Lerner, 2023; Cvetković,

Tanasić, Ocal, Kešetović, Nikolić, & Dragašević, 2021; Das, 2025; Deslatte, Hatch, & Stokan, 2020; Hossain, 2025).

Experience from other countries, as well as previous national and local experience in responding to emergencies, indicates that addressing disaster risks is insufficient at the central state level alone. It is necessary to plan systematically, implement preventive measures, and build a functional emergency management and disaster risk reduction system at the local community level (Ali, 2025; Chukwunka, 2025; Garba & Akaan, 2025; Hamza & John, 2025; John, Mohammed, Diana, & Ajayi, 2025; Karmaker, 2025a; Mančević, 2025; Mančić, 2025; Marković, Mandić, & Bukvić, 2025). The preparedness of local communities to manage disaster risks in a timely and adequate manner is of crucial importance because disaster risk management should be understood as an integral part of the broader sustainable development of communities (Cvetković, Renner, & Jakovljević, 2024; Cvetković & Vanja Šišović, 2024a, 2024b; Cvetković & Šišović, 2024; Cvetković, Sudar, Ivanov, Lukić, & Grozdanić, 2024). Floods, earthquakes, hailstorms, droughts, fires, landslides, epidemics, industrial accidents, and other natural and technological hazards do not threaten only individuals' lives and property. They can also disrupt local economies, damage critical infrastructure, reduce social stability, increase poverty, and disturb the ecological balance of entire regions (Cvetković, 2025, 2026; Cvetković, Milenković, Lukić, & Renner, 2026; Jevtić, Cvetković, Gačić, & Raonić, 2025; Manojlovic, Cvetkovic, Renner, Grozdanic, & Peroševic, 2025; Nikolić, Cvetković, Renner, Cvijović, & Gačić, 2025).

The role of local self-government in disaster risk management has grown significantly with the development of modern concepts of civil protection and community resilience (Nayak & Nayak, 2026; Sacyaten, 2025; Salam, Hemel, Roni, & Pandith, 2025; Samira, 2025; Shahriah et al., 2025; Sunday, Mohammed, & Quadir, 2025a; Yamah & Folorunsho, 2026). In recent decades, disasters around the world have shown that strengthening national capacities and specialized rescue agencies may be insufficient when hazards require an immediate response at the site of occurrence. For this reason, increasing attention has been given to strengthening the role of local governments, local institutions, public services, civil protection units, volunteers, and citizens in disaster preparedness and response. In the pursuit of sustainable development, it is necessary to understand that development at any level should be a process that reduces vulnerability while simultaneously strengthening capacities (Cvetkovic, Lipovac, Renner, Stanarevic, & Raonic, 2025; Gajović, Cvetković, & Renner, 2025; Tanasić & Cvetković, 2024).

The ESG framework, which stands for Environmental, Social, and Governance, is increasingly recognized as a useful model for such an integrated approach. ESG enables a systematic assessment of risks and institutional

performance not only through financial indicators, but also through the effects that organizations, institutions, and public authorities have on society, the environment, and the quality of governance (Eccles, Ioannou, & Serafeim, 2014). Although the ESG concept was initially developed within the corporate sector and investment practice, its logic is highly applicable to local governments because local authorities are responsible for environmental management, social protection, public safety, infrastructure, local development, transparency, and risk governance.

In the context of local self-government, ESG should not be interpreted as a narrow reporting tool or as a concept intended only for companies. Rather, it can be understood as a broader governance framework that helps local communities organize existing legal obligations, strategic priorities, development programs, and emergency management duties more coherently and transparently. This is especially important for local governments in the Republic of Serbia, where the Law on Disaster Risk Reduction and Emergency Management already establishes extensive responsibilities in risk assessment, prevention, preparedness, response, recovery, civil protection, public warning, and coordination among relevant actors.

This paper aims to analyze the meaning and content of ESG principles in relation to the sustainability and development of local communities, with particular attention to disaster risk management and civil protection. The paper seeks to demonstrate that ESG principles are compatible with the legal and institutional obligations of local governments in Serbia and that their systematic application can contribute to more effective local governance, stronger community resilience, and better alignment with European and international development standards.

2. Methodological Framework

This paper is designed as a theoretical and analytical study based on qualitative analysis of relevant scientific literature, strategic documents, normative acts, and international policy frameworks. The methodological approach includes content analysis of international and European policies in the areas of sustainable development, disaster risk management, climate resilience, public governance, and community resilience. The analysis includes documents and policy frameworks developed by the European Union, the Organization for Economic Co-operation and Development, the World Bank, the United Nations, and other relevant international organizations.

In addition, the paper applies normative-legal analysis to the Law on Disaster Risk Reduction and Emergency Management of the Republic of Serbia.

The purpose of this analysis is to examine the extent to which the existing legal obligations of local self-government units correspond to the environmental, social, and governance dimensions of ESG. Through a comparative and interpretative approach, the paper maps ESG dimensions onto key local government functions across sustainable development, public safety, disaster risk reduction, emergency management, and civil protection.

The paper also uses conceptual analysis to clarify the meaning of ESG in a public-sector context. Since ESG is frequently associated with corporate sustainability, investment risk, and non-financial reporting, it is necessary to adapt its content to the institutional realities of local government. This adaptation does not imply a mechanical transfer of corporate tools into public administration, but rather the identification of functional similarities between ESG principles and the responsibilities of local authorities.

The methodological limitation of this paper lies in the absence of empirical research based on a sample of local communities. Therefore, the paper does not measure the actual implementation of ESG principles in Serbian municipalities and cities. Instead, it provides a conceptual and normative foundation for future empirical research. Future studies could develop indicators for assessing ESG implementation in local self-government units, examine the quality of local disaster risk reduction plans, analyze budget allocations for prevention and resilience, and evaluate the degree of citizen participation in local risk governance.

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3. Theoretical Framework: Sustainable Development of Local Communities

The concept of sustainable development implies balanced development that meets the needs of present generations without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987). At the local level, sustainability is usually considered through several mutually connected dimensions. These dimensions include economic, social, environmental, and institutional sustainability.

Economic sustainability refers to a local community's ability to maintain employment, support local entrepreneurship, ensure fiscal stability, attract investment, develop infrastructure, and create conditions for long-term economic vitality. A local community cannot be sustainable if it lacks stable economic foundations or if its development depends on short-term, environmentally harmful, or socially exclusionary practices.

Social sustainability encompasses social cohesion, public services, inclusion, equality, public health, education, social protection, safety, and citizens' quality of life. It is particularly important in communities exposed to poverty, demographic aging, migration, social exclusion, or disaster risk. A socially sustainable local community must be able to protect vulnerable groups, ensure access to essential services, and strengthen solidarity and trust among citizens.

Environmental sustainability concerns the responsible management of natural resources, environmental protection, pollution reduction, climate adaptation, waste management, water management, spatial planning, and the preservation of biodiversity. At the local level, environmental sustainability is directly linked to the quality of communal infrastructure, land-use planning, energy efficiency, and the prevention of natural and technological hazards.

Institutional sustainability refers to the capacity of local institutions to govern transparently, responsibly, efficiently, and in a participatory manner. It includes administrative capacity, strategic planning, accountability, public participation, risk-informed decision-making, intersectoral coordination, and the ability to implement public policies. Without strong local institutions, even well-designed development strategies and legal obligations often fail to be effective.

These four dimensions provide the foundation for the operational application of the ESG framework in local communities. The environmental component of ESG corresponds to environmental sustainability and climate resilience; the social component to social protection, inclusion, public safety, and community well-being; and the governance component to institutional capacity, transparency, accountability, and risk governance.

4. The ESG Concept: Meaning and Content

4.1. Environmental Dimension

The environmental component of ESG encompasses the management of environmental impacts and risks, including climate change, pollution, water management, waste management, biodiversity protection, energy efficiency, spatial planning, and ecosystem protection. In the context of local self-government, this dimension is directly connected to communal infrastructure, land-use regulation, environmental monitoring, disaster prevention, and reducing exposure to natural and technological hazards (Ocal & Torun, 2025; Ojha, Bhattarai, & Devkota, 2025; Okpan, Okwose, Edwards, & Sanni,

2025; Premović, Arsenović, Pavić, Cvetković, & Lukić, 2025; Rahman, Sarker, Biswas, Roy, & Mahmud, 2025; Roy, Shawon, & Hasan, 2025).

For local communities, the environmental dimension is not limited to narrow environmental protection. It also includes the capacity to recognize how environmental degradation increases disaster risk. Poorly planned construction, deforestation, inadequate drainage systems, illegal waste disposal, unregulated riverbeds, uncontrolled urban expansion, and insufficient infrastructure maintenance can all increase the likelihood and severity of disasters. Therefore, environmental governance at the local level must be closely linked to disaster risk reduction (Goswami & Ahmad, 2025; Hanif, Awais, & Shah, 2025; Hanspal & Behera, 2025; Joshi & Poudel, 2025; Karmaker, 2025b; Kayes, Tabassum, & Khan, 2025; Matewos, 2025).

In practical terms, the environmental dimension of ESG requires local governments to integrate environmental and disaster risk considerations into spatial plans, development strategies, infrastructure projects, public procurement, and budget planning (Ahmed, 2025; Akinwale, Adongo, Nasir, Akinwale, & Sanni, 2025; Ayalew, 2025; Baturan, Milošević, & Cvjetković-Ivetić, 2025; Bošković, Putnik, Stevanović, Suknovic, Akgul, & Milašinović, 2025; V. M. Cvetković, Aleksova, Renner, Gačić, Ivanov, & Milašinović, 2025; Molnár, 2024; Öcal & Torun, 2024; Vidović, Cvetković, & Beriša, 2024). Such integration helps reduce future losses and improves the resilience of local communities.

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4.2. Social Dimension

The social dimension of ESG refers to the protection of people, public health, social inclusion, labor rights, equality, safety, access to services, and quality of life. At the local community level, this dimension includes the availability and quality of public services, the protection of vulnerable groups, the strengthening of social capital, community participation, public awareness, education, and trust between citizens and institutions (Alhazemi, 2025; Chaudhuri, Sharma, & Yazan, 2025; Nyoman, Sakarani, Gede, & Kurniawan, 2025; Princiya, Priya, & Silviya, 2025; Zhu & Wang, 2024).

In disaster risk management, the social dimension is particularly important because disasters affect all groups differently. Children, older persons, persons with disabilities, poor households, rural populations, isolated communities, migrants, and socially marginalized groups are often more exposed and less able to recover. Therefore, a socially responsible local disaster risk management system must identify vulnerable groups, include them in

planning, ensure accessible warning and evacuation procedures, and provide targeted support during response and recovery.

The social component of ESG also includes developing volunteer capacities, educating citizens, training civil protection units, running public awareness campaigns, and fostering a culture of safety. A community that is informed, connected, and socially cohesive is more likely to respond effectively to crises and recover more quickly after disasters.

4.3. Governance Dimension

The governance dimension of ESG refers to the quality of decision-making, transparency, accountability, risk management, institutional integrity, public participation, and stakeholder cooperation. For local governments, this dimension includes the functioning of local authorities, public procurement, strategic planning, budget transparency, emergency management, civil protection organization, crisis communication, and interinstitutional coordination (Alvarez-Galvez et al., 2025; Augustine, 2024; Liu, Cifuentes-Faura, Zhao, & Wang, 2023; Salvador & Sancho, 2023; Zaitul, Ilona, & Novianti, 2023; Кащенко, 2024).

Governance is the dimension that connects environmental and social objectives with practical implementation. Without good governance, environmental and social goals remain declarative. In the context of disaster risk reduction, governance includes risk assessment, planning, early warning, coordination among institutions, maintenance of civil protection systems, budget allocation for prevention, cooperation with neighboring municipalities, and transparent communication with the public.

The governance dimension is also essential for building trust. Citizens are more likely to follow evacuation orders, participate in prevention programs, and cooperate with local authorities when institutions are transparent, competent, and accountable. Therefore, the governance component of ESG has direct implications for public safety and community resilience.

5. Applicability of ESG in the Work of Local Self-Government

The Law on Disaster Risk Reduction and Emergency Management of the Republic of Serbia establishes the responsibilities of local self-government units in this field. Within their respective areas of competence, local govern-

ments are required to perform a wide range of tasks closely aligned with the ESG framework.

According to the law, a local self-government unit adopts an act on the organization and functioning of civil protection on its territory, based on the proposal of the competent emergency management headquarters, and ensures its implementation. This obligation primarily falls under the governance component of ESG because it concerns institutional organization, responsibility, and coordination.

Local governments are also required to develop and adopt risk assessments, local disaster risk reduction plans, protection and rescue plans, and external protection plans when a higher-tier SEVESO complex is located on their territory (Garba & Akaan, 2025; Metić, 2025; Milenkovic, 2025; Miletic & Stojanović, 2025; Porel, 2025; Sunday, Mohammed, & Quadir, 2025b; Unaam, 2025). These obligations correspond to both the environmental and governance components of ESG because they require identifying hazards, assessing exposure and vulnerability, and systematically planning preventive and response measures.

The law further requires local governments to establish emergency management headquarters, identify entities of special importance for protection and rescue, plan and secure budget funds for disaster risk reduction and emergency management, establish civil protection units, and create situation centers where technical and material conditions allow. These activities directly reflect the governance dimension of ESG and support the social dimension by protecting citizens, public health, property, and critical services.

Local self-government units are also responsible for developing studies of public warning system coverage, maintaining and installing sirens and other warning equipment within the unified public warning system of the Republic of Serbia, cooperating with neighboring local governments, undertaking urgent and preventive measures to reduce disaster risks, adopting annual work plans and reports of emergency management headquarters, and performing other tasks established by law. These obligations demonstrate that disaster risk management is not a single-sector activity, but a broad governance process involving prevention, preparedness, response, recovery, communication, budgeting, infrastructure, and intermunicipal cooperation (Albris, Lauta, & Raju, 2020; Ardaya, Evers, & Ribbe, 2019; Kim, 2025; Mirza, Erinaldi, & Adilla, 2024; Vasileiou, Barnett, & Fraser, 2022).

The Law on Disaster Risk Reduction and Emergency Management, therefore, establishes a cycle of risk governance that is fully compatible with ESG logic. Risk assessment corresponds to the environmental and governance dimensions of ESG. Preventive measures reflect the environmental compo-

nent because they aim to reduce exposure to hazards and prevent damage to the environment and infrastructure. Training, public information, population protection, and civil protection activities reflect the social dimension. Organization, coordination, leadership, planning, financing, and reporting represent the core of the governance dimension.

This analysis shows that ESG does not represent an external concept imposed on local governments. Rather, it is an interpretative and operational framework that enables more systematic implementation of existing legislation. ESG can help local governments organize their obligations, identify priorities, monitor implementation, communicate results to citizens, and align local development with international sustainability and resilience standards.

The application of ESG principles in local self-government does not require the establishment of a parallel governance system. On the contrary, ESG should be understood as a framework that integrates existing strategies, plans, laws, budgetary procedures, investment priorities, and civil protection mechanisms. Local development strategies, capital investment plans, protection and rescue plans, disaster risk reduction plans, environmental protection programs, and public budgets can all be analyzed and improved through ESG criteria.

6. ESG, Civil Protection, and Community Resilience

Community resilience can be defined as the ability of systems, institutions, and populations to anticipate, absorb, adapt to, and recover from the negative consequences of hazardous events while preserving essential functions and structures (UNDRR, 2015). Civil protection represents a central operational mechanism for building resilience and a natural point of application for ESG principles at the local level.

The environmental component of ESG within civil protection is reflected in the identification and reduction of risks arising from floods, landslides, droughts, storms, fires, industrial accidents, infrastructure failures, and the consequences of climate change. It also includes environmental monitoring, spatial planning, watercourse management, waste control, and the protection of ecosystems that reduce disaster risk. For example, maintaining drainage systems, preventing illegal construction in flood-prone zones, protecting forests, and investing in nature-based solutions can all be understood as environmental ESG measures with direct disaster risk reduction benefits.

The social dimension of ESG in civil protection encompasses protecting lives and health, training and informing citizens, developing volunteer capacities, strengthening social cohesion, and ensuring the inclusion of vulner-

able groups in emergency planning. Civil protection is not only a technical response system. It is also a social system based on preparedness, solidarity, trust, and cooperation. Local communities with higher levels of social cohesion and better communication between citizens and institutions are generally better prepared to respond to emergencies.

The governance dimension of ESG includes the institutional organization of protection and rescue systems, the functioning of emergency management headquarters, intersectoral coordination, public communication, accountability, and transparent decision-making. Effective governance ensures that local civil protection systems are not activated only after a disaster occurs, but are continuously developed through prevention, training, planning, exercises, monitoring, and evaluation.

The integrated application of ESG principles through civil protection enables a transition from a reactive safety model to a preventive, anticipatory model of community development. Instead of treating disasters as isolated events, ESG-based local governance recognizes that risk is produced through development choices. Poor infrastructure, weak institutions, social inequality, inadequate planning, and environmental degradation all increase disaster risk. Therefore, reducing risk requires coordinated action across sectors.

7. ESG, European Union Policies, and the Sendai Framework for Disaster Risk Reduction

European Union policies in sustainable development, climate resilience, and community safety are strongly aligned with ESG principles. Through the European Green Deal, the 2030 Agenda, the EU Civil Protection Mechanism, and the EU Strategy on Adaptation to Climate Change, the European Commission promotes an integrated approach that connects environmental protection, social resilience, climate adaptation, risk management, and quality of governance (European Commission, 2019; European Commission, 2021).

The European Green Deal emphasizes the transformation of European economies and societies towards climate neutrality, resource efficiency, and environmental sustainability. Although it is often discussed in relation to energy, industry, and climate policy, its implications are also highly relevant for local governments. Local communities are responsible for many practical aspects of green transition, including urban planning, waste management, public transport, energy efficiency in public buildings, and adaptation to climate-related hazards.

The EU Strategy on Adaptation to Climate Change further emphasizes the need for smarter, faster, and more systemic adaptation. This is particularly relevant for municipalities and cities because climate risks are experienced locally through floods, heatwaves, droughts, storms, erosion, and infrastructure disruptions. In this respect, the ESG framework can help local governments translate European climate adaptation priorities into measurable and operational local policies.

A particularly important international document is the Sendai Framework for Disaster Risk Reduction 2015–2030, which defines four priorities for action: understanding disaster risk; strengthening disaster risk governance to manage disaster risk; investing in disaster risk reduction for resilience; and enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction (UNDRR, 2015). These priorities directly correspond to the ESG structure. Understanding and assessing disaster risk correspond to the environmental and governance dimensions. Investing in risk reduction corresponds to environmental and infrastructural sustainability. Preparedness, response, and recovery rely on the social and governance components of ESG.

In this context, ESG can be understood as an operational framework that enables local communities to translate international and European policies into concrete development, safety, and governance practices. It provides a language and structure that can connect climate adaptation, disaster risk reduction, public safety, social inclusion, budget planning, and institutional accountability.

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8. ESG Indicators for Local Governments

For ESG to become practically useful at the local level, it should be accompanied by measurable indicators. These indicators need not be overly complex, but they should enable local governments to monitor progress and identify weaknesses.

Environmental indicators may include the number of risk assessments completed, the percentage of territory covered by disaster risk reduction plans, the number of flood-prone zones regulated through spatial planning, investment in drainage and water management, waste management coverage, air and water quality indicators, the share of green public spaces, and the number of climate adaptation measures implemented.

Social indicators may include the number of citizens trained in civil protection, the availability of emergency shelters, the inclusion of vulnerable groups in emergency plans, the level of public awareness about disaster risks,

access to public services in rural or marginalized areas, the number of volunteers, and the existence of targeted support mechanisms for persons with disabilities, older persons, children, and socially vulnerable households.

Governance indicators may include the regularity of emergency management headquarters meetings, the adoption and updating of risk assessments and protection plans, budget allocations for prevention, transparency of public procurement, public availability of emergency information, cooperation agreements with neighboring municipalities, the frequency of civil protection exercises, and the publication of annual reports on disaster risk reduction activities.

Such indicators can help local governments move from formal compliance to performance-based governance. Instead of only adopting plans to meet legal obligations, municipalities and cities can use ESG indicators to evaluate whether those plans actually improve safety, resilience, and sustainability.

9. Discussion

The application of ESG principles at the local level contributes to improved risk identification and management, greater institutional transparency, better coordination among stakeholders, and increased public trust in local authorities. In this sense, the ESG framework fits well with contemporary European and international policies that treat sustainability and resilience as inseparable development objectives. The European Commission, through the European Green Deal and the EU Strategy on Adaptation to Climate Change, emphasizes the need to integrate climate, social, and governance aspects into all levels of public policy, including local self-government (European Commission, 2019; European Commission, 2021).

OECD findings indicate that insufficiently developed risk governance mechanisms are among the key drivers of high economic and social losses from disasters. Strengthening local governance, coordination, institutional responsibility, and stakeholder engagement is therefore a precondition for building community resilience (OECD, 2014; OECD, 2021). In this context, the governance dimension of ESG enables the operational application of these recommendations through clearer procedures, defined responsibilities, monitoring mechanisms, and accountability.

The World Bank also emphasizes that integrating climate and disaster risks into development planning is one of the most cost-effective forms of public investment because it can significantly reduce future recovery and reconstruction costs (World Bank, 2014). From this perspective, ESG principles

enable local communities to understand development, safety, environmental protection, and risk management as parts of a single system rather than as separate sectoral areas.

The discussion also shows that ESG can be particularly useful in countries and communities undergoing institutional modernization, European integration, or public administration reform. By adopting ESG logic, local governments can improve the quality of public policies, strengthen transparency, communicate development priorities more clearly, and demonstrate compliance with international standards. However, the application of ESG must be adapted to the public-sector context. Local governments should not simply imitate corporate ESG reporting. Instead, they should use ESG as a framework for improving public value, citizen safety, environmental protection, and institutional responsibility.

One of the main challenges in applying ESG principles to local governments is limited administrative capacity. Many municipalities, especially smaller and less developed ones, may lack sufficient human resources, technical expertise, digital tools, and financial resources to implement advanced ESG reporting or monitoring systems. Therefore, ESG implementation should be gradual and realistic. It should begin with integrating ESG principles into existing documents and processes, such as local development strategies, disaster risk reduction plans, environmental protection programs, civil protection plans, and annual budgets.

Another challenge is the risk of formalism. If ESG is reduced only to written reports or declarative statements, it will not improve local resilience. Its value lies in practical application: better planning, stronger prevention, improved infrastructure, more transparent decision-making, more inclusive emergency planning, and greater accountability. Therefore, ESG should be linked to measurable local outcomes, not just to general policy declarations.

10. Conclusion

ESG principles represent a powerful conceptual and operational framework for improving the sustainability and development of local communities because they enable an integrated understanding of environmental, social, and governance aspects of public policies. The analysis shows that ESG principles are highly compatible with international and European development and security frameworks, including the Sendai Framework for Disaster Risk Reduction, European Union policies on climate neutrality and adaptation, and recommendations from the OECD and the World Bank on risk governance and resilience.

In the Republic of Serbia, the existing legal framework, especially the Law on Disaster Risk Reduction and Emergency Management, already includes key elements of an ESG approach. Its systematic interpretation through ESG logic can contribute to more efficient local self-government, improved civil protection, better disaster preparedness, stronger institutional coordination, and more resilient communities. This is particularly important in the context of European integration, climate change, increasing disaster risks, and the need for more transparent and accountable public administration.

This paper concludes that local communities in Serbia should not view ESG as an abstract, external, or exclusively corporate concept. Rather, it should be understood as a practical tool for improving safety, sustainability, resilience, and long-term development. By integrating ESG principles into local governance, municipalities and cities can better connect their legal obligations, development priorities, disaster risk reduction measures, environmental policies, and social responsibilities. Such an approach strengthens local communities' capacity to protect citizens, reduce vulnerability, manage risks, and build a more sustainable future.

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Article review

Legal and Institutional Framework for Emergency Management in the City of Belgrade

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Abstract

Emergency management in large cities represents a complex security and organizational process. The subject of this paper is the analysis of the legal and institutional framework for emergency management at the City of Belgrade level. The paper aims to determine the degree of complementarity between relevant regulations and institutional actors, i.e., to what extent legal norms are aligned with the actual capacities for their implementation. The legal analysis encompasses Republic laws (primarily the Law on Disaster Risk Reduction and Emergency Management), by-laws, the Statute of the City of Belgrade, city decisions and planning acts, as well as regulations of city municipalities. The main findings indicate that the legal framework is formally established at all three levels (republic, city, and municipal) and that institutional bodies have been established. However, the substantive complementarity of the legal and institutional framework – i.e., the ability of institutions to actually fulfill the tasks prescribed by law – is significantly impaired. The following deficiencies have been identified: noncompliance with statutory deadlines for adopting planning acts, pronounced inequality in municipal capacities (equipment, training, financial resources), and hampered vertical and horizontal coordination. The reasons for this are financial, cultural, and

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regulatory control in nature. It is concluded that the complementarity of the legal and institutional framework in Belgrade is largely formal, whereas the system's actual preparedness varies significantly. It is recommended to establish minimum equipment standards with financial support (equalization fund), to introduce mandatory annual exercises and joint training, and to establish clear criteria for activating higher levels of assistance.

Keywords

Emergencies, legal framework, institutional framework, complementarity, City of Belgrade, municipal headquarters, principle of subsidiarity.

1. Introduction

Emergency management in large cities is one of the most complex challenges in contemporary society. The City of Belgrade, as the capital of the Republic of Serbia, faces various risks – from natural disasters (floods, earthquakes, storms) to technological accidents and epidemics. Given the population concentration (close to 1.7 million inhabitants) and the infrastructural, economic, and administrative capacities, it is necessary to establish an efficient system that, in a legally based and institutionally organized manner, enables prevention, preparedness, response, and recovery from emergencies.

The subject of this paper is the analysis of the legal and institutional framework for emergency management at the City of Belgrade level. Within the legal framework, the analysis encompasses republic laws (primarily the Law on Disaster Risk Reduction and Emergency Management, but also related laws such as the Law on Local Self Government and the Law on Defence), key by laws (on headquarters, on assessments and plans), then acts of the City of Belgrade (Statute, decisions, planning acts), and regulations of city municipalities. The institutional framework includes a presentation of the bodies and entities responsible for emergency affairs – from the republic level (the Republic Headquarters, the Sector for Emergency Management of the Ministry of Internal Affairs), through the City Headquarters, the Secretariat for Defense, Emergency Situations and Coordination, and specialist operational teams, to municipal headquarters and public and communal companies as operational executors. In this way, the entire normative and organizational hierarchy relevant to emergency management in the City of Belgrade is covered.

The paper aims to determine, through legal analysis, the degree of complementarity between the legal and institutional framework. The paper is structured into five chapters. After the introduction, the second chapter ana-

lyzes the legal framework by levels of authority (republic, city, municipal), while the third chapter presents the institutional framework. The fourth chapter examines the complementarity of these two frameworks and highlights key deficiencies in their alignment. In contrast, the concluding chapter summarizes the main findings and outlines directions for overcoming the identified problems.

2. Legal Framework for Emergency Management in Belgrade

The legal framework for emergency management in the territory of the City of Belgrade is built on three interconnected levels of regulations: the republic, city, and municipal levels. Republic regulations (primarily the Law on Disaster Risk Reduction and Emergency Management) establish the basic legal concepts, principles, and obligations for all subjects. Still, they are formulated in general terms and require further elaboration. The regulations of the City of Belgrade (Statutes, decisions, planning acts) adapt the Republic's framework to the specificities of the capital – specifically, its size, population density, complex infrastructure, and the types of risks to which the capital is exposed. The regulations of city municipalities (17 in total) represent the lowest, but practically the most important, level because, under the principle of subsidiarity (as set out in Article 6 of the Law on Disaster Risk Reduction), municipal headquarters and services constitute the first echelon of response in emergencies. Therefore, for a comprehensive understanding of the system, it is necessary to present all three levels of legal sources.

2.1. Influence of International Law

The legal framework of the Republic of Serbia in the field of emergency management was created under the direct influence of the Sendai Framework for Disaster Risk Reduction 2015–2030 (United Nations, 2015). After the devastating floods that hit Serbia in 2014, the Republic of Serbia was among the first countries to adopt this framework in full, incorporating it into national legislation. The Sendai Framework emphasizes the transition from a reactive to a proactive approach, putting risk reduction and prevention in the foreground – an approach that has become the basic principle of the domestic legal framework.

2.2. Republic Level: Legislative and By-law Acts

The basic source of law at the republic level is the Law on Disaster Risk Reduction and Emergency Management (Official Gazette of the RS, No. 87/2018) (hereinafter: LDRREM). This law regulates the unified system of emergency management, defines basic terms (disaster, emergency, risk, resilience), and prescribes that this system is of special interest for the Republic of Serbia (LDRREM, Art. 2). The law introduces a new conceptual paradigm: the focus shifts from passive response to active risk reduction and strengthening community resilience. Moreover, this law has the character of lex specialis in relation to the Law on Local Self-Government and the Law on Defense.

For the subject of this paper, the provisions relating to decentralization and the role of local self-governments are of particular importance. The principle of the primary role of local communities (LDRREM, Art. 4) establishes that local self-government units have a leading role in risk management on their territory. The principle of subsidiarity (Art. 6) prescribes that in protection and rescue actions, the local self-government's own resources are used first, and only when they become insufficient are higher levels (provincial, republican) activated. This establishes a clear hierarchy of responsibility and action.

The same law mandates the mandatory adoption of strategic and planning acts at the local level: Disaster Risk Assessment (Art. 15), Disaster Risk Reduction Plan (Art. 16), Protection and Rescue Plan (Art. 17), and, if there are establishments with hazardous materials on the territory of the local self government unit, the External Major Accident Prevention Plan (Art. 33). For the City of Belgrade, on whose territory the SEVESO Directives cover facilities, this last obligation is particularly relevant. In addition, the Law prescribes a reporting obligation: municipal headquarters report to the City Headquarters, and the City Headquarters reports to the Republic Headquarters (Art. 27–29), thereby ensuring vertical coordination.

In addition to the basic law, the following have subsidiary significance at the republic level: the Law on Local Self Government (Official Gazette of the RS, No. 129/2007), whose Article 20 determines that affairs in the field of emergency management are part of the original competence of municipalities; the Law on Defence (Official Gazette of the RS, No. 116/2007), which prescribes the obligation to draw up defence plans for the city and municipalities; the Law on Fire Protection (Official Gazette of the RS, No. 111/2009), which regulates the organization of the firefighting service; and the Law on Critical Infrastructure (Official Gazette of the RS, No. 87/2018).

A key by-law act is the Decree on the Composition, Method and Organization of Work of the Headquarters for Emergency Situations (Official Gazette of the RS, No. 27/2020). This decree prescribes in detail the composition of headquarters at all levels, their method of work, and decision-making. It represents a direct legal basis for the functioning of the City Headquarters and the municipal headquarters. Another significant act is the Decree on the Content, Method of Preparation and Obligations Related to the Preparation of Disaster Risk Assessments and Protection and Rescue Plans (Official Gazette of the RS, No. 48/2019), which regulates the technical methodological framework, i.e., specifies the content, procedure, and responsibilities in the preparation of the aforementioned documents.

2.3. City of Belgrade Level

The highest legal act of the City of Belgrade is the Statute of the City of Belgrade (Official Gazette of the City of Belgrade, Nos. 39/2008, 6/2010 and 23/2013, Official Gazette of the RS, No. 7/2016 – decision of the Constitutional Court, and Official Gazette of the City of Belgrade, No. 60/2019). The Statute, in Article 3, establishes that the City, in accordance with the law, forms the City Headquarters for Emergency Situations, provides fire protection, prepares its defense plan, and performs other protection and rescue tasks.

Based on the legal authorizations and the Statute, several city acts have been adopted. The most comprehensive is the Decision on the Organization and Functioning of Civil Protection in the Territory of the City of Belgrade. This decision regulates in detail the organization of civil protection: it determines the system's subjects (City Assembly, Mayor, City Headquarters, Secretariat, communal companies, Red Cross, citizens' associations) and defines their duties.

The basic operational document at the city level is the City of Belgrade's Protection and Rescue Plan. It elaborates on the measures, forces, and response mechanisms for all types of emergencies. In addition, the Defense Plan of the City of Belgrade (based on the Law on Defense) and the Rules of Procedure of the Headquarters for Emergency Situations are adopted as internal acts.

2.4. Level of City Municipalities

The legal framework at the level of the 17 city municipalities (Čukarica, Novi Beograd, Palilula, Rakovica, Savski venac, Stari grad, Voždovac, Vračar,

Zemun, Zvezdara, Barajevo, Grocka, Lazarevac, Mladenovac, Obrenovac, Sopot, Surčin) is founded on the obligations from the Republic Law (Arts. 4 and 6) and the Decree on Headquarters. Each municipality is obliged to have its own municipal headquarters for emergencies, headed by the municipality's president. The number of municipalities is determined by the Statute of the City of Belgrade (Art. 26).

Municipal regulations include several types of acts: decisions on the establishment of municipal headquarters (adopted by the Municipal Assembly), decisions on the organization and functioning of civil protection in the territory of the municipality (each municipality adopts its own decision, harmonized with the city decision), rules of procedure of the municipal headquarters, and annual plans and reports on work. For illustrative purposes, the Municipality of Novi Beograd has adopted a Decision on Civil Protection in its territory, and regularly adopts its own Protection and Rescue Plan. All municipalities are obliged to prepare a disaster risk assessment for their territory and a defense plan in accordance with the Law on Defense. These acts establish operational capacity at the lowest level. Municipal headquarters represent the first echelon of response, directly implementing the principle of subsidiarity (Art. 6 of the Law).

2.5. Challenges in the Application of the Legal Framework

Despite the formally established legal framework, practice indicates several challenges in its implementation in the territory of Belgrade. Deadlines for adopting strategic acts (risk assessment, protection, and rescue plan) mandated by law are often not met. Municipal headquarters exist mostly in name only – their work is irregular, members are not adequately trained, and material-technical equipment is often insufficient. Also, a certain inconsistency between city and municipal acts is observed (for example, different degrees of elaboration of responsibilities), which creates legal uncertainty and hinders coordination. The reporting and supervision system, although prescribed by law, has not fully taken root in practice. These problems reduce the complementarity of the legal and institutional framework, which will be discussed in the fourth chapter.

3. Institutional Framework for Emergency Management in Belgrade

The institutional framework consists of a network of bodies, entities, and services that implement legally established competences at the republic, city, and municipal levels. Its structure directly reflects the principle of subsidiarity from Article 6 of the Law on Disaster Risk Reduction and Emergency Management (Official Gazette of the RS, No. 87/2018): the first response is expected from municipal headquarters, then from the city, while the republic level intervenes only when local and city resources become insufficient. Bearing in mind the importance of each level, the following section will analyze the main actors at each level.

3.1. Republic Level – System Bearers

At the republic level, the central place is occupied by the Republic Headquarters for Emergency Situations. The Decree prescribes its composition, method of work, and decision-making on the Composition, Method, and Organization of Work of the Headquarters for Emergency Situations (Official Gazette of the RS, No. 27/2020). The role of the Republic Headquarters is not direct management on the ground in Belgrade, but strategic direction, making unified risk assessments, and providing resources when the city's capacities become insufficient.

The operational bearer at the republic level is the Sector for Emergency Situations of the Ministry of Internal Affairs. This sector includes professional firefighting and rescue units, specialized teams (for search-and-rescue from ruins, water rescue, etc.), and material-technical resources. Its importance to Belgrade is reflected in its constant presence within the city's territory, both through the Belgrade Firefighting and Rescue Brigade and through engagement at major public events.

3.2. City Level – Coordination and Operations

At the City of Belgrade level, the key body is the City Headquarters for Emergency Situations. It is headed by the Mayor of Belgrade, and its members include representatives of city secretariats (especially the Secretariat for Defense, Emergency Situations and Coordination, the Secretariat for Health, the Secretariat for Transport, and the Secretariat for Communal Affairs), managers of public companies, and presidents of municipalities. Such

a structure ensures that all sectors potentially affected by an emergency are involved in decision-making (Statute of the City of Belgrade, Art. 3; Decree 27/2020).

The Headquarters convenes as needed, when there is an immediate danger or when an emergency has already occurred. Its functions include adopting the Protection and Rescue Plan of the City of Belgrade, activating and coordinating specialist operational teams, ordering the use of communal and other resources, and informing the public and issuing warnings. For illustrative purposes, during the first wave of the COVID-19 pandemic in 2020, the City Headquarters met daily, adopting movement restriction measures and organizing temporary hospital capacities.

The Secretariat for Defense, Emergency Situations, and Coordination represents a professional, permanently employed city administration that provides expert and administrative support to the Headquarters. Its role is often neglected in public discourse, although it prepares analyses, drafts decisions, and ensures the implementation of the Headquarters' conclusions.

A special feature of the organization at the city level is the presence of specialist operational teams, as provided for by the Decision on the Organization and Functioning of Civil Protection in the Territory of the City of Belgrade (Official Gazette of the City of Belgrade, No. 6/2026). They are formed for each type of risk: a team for floods, earthquakes and ruins, epidemics, snowstorms and ice, storm winds and hail, drought and high temperatures. Each team is led by an expert from the relevant field (for example, the director of PWC "Belgrade Water" for flood management, the secretary of health for epidemic management). Such a division enables fast and focused response.

3.3. Municipal Level – First Echelon of Response

Each of the 17 Belgrade municipalities has its own municipal emergency headquarters, headed by the municipality's president (Law 87/2018, Arts. 4 and 6; Decree 27/2020). These headquarters are the first to be activated in the event of a localized emergency – for example, floods in a suburban settlement, a storm blocking several streets, an epidemic in a single school. Their task is to use their own human and material resources (municipal communal services, volunteer firefighting associations, Red Cross). Only when they assess that their own capacities are insufficient do they seek assistance from the City Headquarters.

In practice, the capacities of municipal headquarters are rather uneven. Municipalities in a better material position have better-equipped headquarters and more regular training. In contrast, more remote and less developed

municipalities often lack equipment, trained personnel, and financial resources. Municipal regulations, such as decisions on the establishment of headquarters, on civil protection, on rules of procedure, on annual plans, and the like, exist in formal form. Still, their implementation at the municipal level is not uniform.

3.4. Public and Communal Companies – Operational Strength

The operation of each headquarters necessarily relies on the operational capacities of implementing entities, typically public and communal companies. In Belgrade, this role is taken over by the city's communal and public companies. Their competence derives from the Statute, the Decision on Civil Protection, and special operational plans. The most important are: PUC "Belgrade Put" (winter service and remediation of storm damage), PWC "Belgrade Water" (flood defence and drainage), PUC "City Cleanliness" (waste disposal and cleaning after emergencies), PUC "Belgrade Power Plants" and "Electricity Distribution Belgrade" (energy supply), and PUC "Belgrade Transport" (transport of affected population and rescue teams). These companies are not merely executors of orders; in accordance with the Law (87/2018, Art. 17), they are obliged to have their own internal protection and rescue plans and to train their employees regularly. In this sense, they form an integral part of the City of Belgrade's institutional framework for emergency response.

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3.5. Cross-Sectoral and Vertical Coordination – Challenges

The effectiveness of such a complex network of actors depends on the quality of coordination. Vertical coordination (municipality – city – republic) is often slowed by untimely reporting and unclear criteria for when local resources are truly insufficient. Horizontal coordination (between municipalities or between city secretariats) suffers from fragmentation of competencies. For example, in the case of simultaneous floods in several municipalities, the City Headquarters must coordinate them, but some municipalities are not accustomed to exchanging information.

These challenges do not diminish the value of the institutional framework. Still, they indicate that its functionality is conditioned not only by regulations but also by a culture of cooperation, staff training, and the availability of financial resources. The fourth chapter will analyze whether and to what extent the legal framework supports overcoming these coordination

problems, i.e., where full complementarity occurs and where there is a gap between the prescribed and the actual.

4. Complementarity of the Legal and Institutional Framework in Emergency Management in Belgrade

The complementarity of the legal and institutional framework implies that regulations and organizational structures operate in close and mutual conditionality – legal norms provide legitimacy and guidelines, while institutions, through their actions, implement those norms. In an ideal case, a legal obligation meets the institutional capacity to fulfill it. In Belgrade, this relationship is present only formally, while substantive alignment – i.e., the ability to actually act in accordance with the law – is significantly impaired.

The basic precondition for complementarity is fulfilled at the level of the formal establishment of institutional bodies (headquarters, secretariats, teams). The Law on Disaster Risk Reduction and Emergency Management (Articles 4 and 6) and the Decree on Headquarters mandate the existence of headquarters at the republic, city, and municipal levels. The City of Belgrade and all 17 municipalities do have such headquarters established, which is a necessary but not sufficient condition for the system to function. The same applies to planning acts: the Law (Arts. 15–17) prescribes the Risk Assessment, the Disaster Risk Reduction Plan, and the Protection and Rescue Plan. The City of Belgrade has adopted the Protection and Rescue Plan, and the municipalities have, at least formally, adopted their plans. However, complementarity almost stops here.

The most obvious lack of alignment is reflected in the non-compliance with legal deadlines. According to the Law (Articles 15–17), the Risk Assessment and the Protection and Rescue Plan were to be adopted within two years of the law's entry into force. However, practice shows that some municipalities are slow to adopt these acts. Without these acts, headquarters cannot know exactly what their obligations are, what resources they have at their disposal, or how to act in specific situations. Therefore, one key characteristic of the absence of substantive complementarity is that the legal framework prescribes imperative obligations. At the same time, institutional capacities are often unable to fulfill them, both due to resource constraints and untimely responses.

Another deficiency is the unevenness of municipal capacities. The principle of subsidiarity (Art. 6) prescribes that municipal headquarters should respond first, using their own resources. Nevertheless, municipalities vary

significantly in terms of equipment, staff training, and financial resources. The law does not provide mechanisms to equalize these capacities; it merely imposes an obligation but provides no funds. The consequence is that municipalities most exposed to risks may be the least capable of independent response. In this sense, complementarity becomes largely formal.

The third problem concerns the inconsistency of acts and competences. The Statute of the City of Belgrade and the Decision on Civil Protection, in some places, define competencies differently from those of the Republic Law. The distribution of responsibilities between the City Headquarters and the municipal headquarters in the event of an emergency affecting several municipalities is not precisely defined, which can delay coordination. Also, the obligation of communal companies to draw up internal protection plans (Art. 17) is often not implemented consistently due to a lack of systematic supervision. The legal framework exists, but institutions do not always have the mechanism or the will to apply it consistently.

The reasons for this situation can be grouped into several categories. Financial reasons are the most obvious. It has already been pointed out that the law imposes obligations but does not provide funds, so municipalities are left to their own budgets, and the poorer ones are often unable to equip their headquarters. There is no regular inter-municipal reporting and cooperation; institutions often operate in a particularistic and isolated manner. Normative control reasons are reflected in the inefficient system of supervision over the implementation of the law at the local level. Hence, inspections are rare, and sanctions are lacking when needed.

Overcoming these deficiencies would require systemic interventions. It is necessary to improve the legal provisions by prescribing minimum equipment standards for municipal headquarters and providing financial support from the republic budget (for example, an equalization fund). Also, the introduction of mandatory annual exercises and joint training for all municipal headquarters would help build a culture of cooperation. Finally, establishing clear criteria for assessing the "insufficiency of own resources" would help avoid arbitrariness and delays in seeking assistance.

Finally, the complementarity of the legal and institutional frameworks in Belgrade is formal rather than substantive. While bodies and acts are established on paper, the actual ability of institutions to perform the tasks prescribed by law varies significantly, primarily due to uneven equipment, non-compliance with deadlines, and insufficiently efficient supervision. Without systemic interventions (financial, training, and control interventions), this gap between the prescribed and the actual will remain a permanent feature of the emergency management system in the City of Belgrade.

5. Conclusion

The analysis of the legal and institutional framework for emergency management in the City of Belgrade has shown that the system is well-founded in principle. Still, substantive complementarity – i.e., the ability of institutions to fulfill the tasks prescribed by law – lags seriously behind. Republic laws, primarily the Law on Disaster Risk Reduction and Emergency Management, together with the Decree on Headquarters, establish a clear hierarchy and obligations at the republic, city, and municipal levels. Formally, all necessary bodies (headquarters, secretariats, specialist operational teams) exist, and planning acts have been adopted. However, at the implementation level, three key deficiencies already emerge: non-compliance with legal deadlines, pronounced unevenness in municipal capacities, and hampered coordination. Financial and normative control reasons lead to complementarity remaining largely formal, while the system's actual preparedness varies across municipalities.

Overcoming this gap requires systemic interventions: establishing minimum equipment standards with financial support, mandatory annual exercises and joint training, and clear criteria for activating higher levels of assistance. Without these measures, even a relatively good legal framework will not ensure efficient emergency management in the territory of Belgrade.

This paper aimed at a normative institutional analysis, but its limitation is the lack of empirical data on the actual capacities of municipal headquarters. Future research should focus on field collection of such data and on a comparative analysis with other cities in Serbia and/or the region.

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Article review

Corporate Security as an Integral Part of the Disaster Risk Reduction and Emergency Management System

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Abstract

The Disaster Risk Reduction and Emergency Management System in the Republic of Serbia (hereinafter: DRREMS) is regulated by the Law on Disaster Risk Reduction and Emergency Management. This Law establishes an integrated approach to disaster prevention, preparedness, resilience, response, and recovery. Although the Law recognizes the importance of companies and legal entities participating in this system, the question of how to operationalize their role in practice arises. Namely, companies and other legal entities have a legal obligation to prepare a Disaster Risk Assessment and a Protection and Rescue Plan, and to undertake risk prevention and reduction measures within the framework of their activities. They are also required to act upon the request of the competent emergency headquarters and participate in implementing protection and rescue measures. A special role is played by companies and other legal entities recognized

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as of particular importance for protection and rescue, as well as those that perform certain activities, mainly facilities and systems that constitute critical infrastructure. The efficiency and effectiveness of these entities depend on an optimally organized and functional corporate security system. In addition to the basic function of corporate security, which is the security of persons, property, and operations at the level of a legal entity, it should be borne in mind that corporate security systems have significant potential for taking measures to reduce the risk of disasters, for effective risk management, and even for the rehabilitation and mitigation of the consequences of disasters. As the DRREMS is recognized as an integral part of the national security system, corporate security systems can be viewed and appreciated as a subsystem of DRREMS in the same way. The paper starts from the thesis that corporate security is an integral part of DRREMS in the Republic of Serbia. Corporate security, through its functions, primarily through risk assessment, development of protection and rescue plans, crisis management, and ensuring business continuity, contributes to the improvement of proactive action, reduces the consequences of disasters, and increases the overall resilience of society.

Keywords

Corporate security, private security, disaster risk reduction, emergency management, Republic of Serbia.

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1. Introduction

Governance has become one of the key tools for addressing an increasingly diverse and complex set of social problems. A special place in this context is occupied by disaster risk management and/or emergency management, as a dynamic and multidisciplinary field that encompasses prevention, preparedness, response, and recovery from various types of risks and disasters. Modern approaches indicate that this field is inseparable from the broader concept of disaster risk reduction, which strives for proactive action and for strengthening society's resilience as a whole. Today, it is impossible to imagine emergency management as an area in which government agencies, i.e., state bodies, act independently (Kapucu, 2012, p. S41). On the contrary, the effective functioning of this system implies the involvement of a wide range of actors, including the private sector, non-governmental organizations, academia, and local communities. Corporate security is of particular importance in this system, which extends beyond individual organizations and becomes an integral element of national security and social resilience.

The Disaster Risk Reduction and Emergency Management System (DRREMS) in the Republic of Serbia is regulated by the Law on Disaster Risk Reduction and Emergency Management (hereinafter: Law). This system is of particular interest to the Republic of Serbia and represents an integral part of the national security system (Article 1, paragraph 2). However, although companies are recognized by law as subjects of this system, their role in practice often remains insufficiently operationalized. Namely, they have certain obligations: to prepare disaster risk assessments and protection and rescue plans, to act at the request of the competent emergency headquarters, or to participate in protection and rescue measures. Despite this, the actual implementation of these obligations in practice remains unclear and questionable. It is accompanied by numerous problems, such as a lack of trained and professional personnel, insufficient financial investment, a lack (or complete absence) of effective cooperation among the system's subjects (for example, those within or between local government units), etc.

The paper starts from the thesis that corporate security, as part of the national security system, also constitutes an integral subsystem of the DRREMS, as reflected most clearly in its functions. This thesis is further supported by the fact that the Sendai Framework for Disaster Risk Reduction emphasizes the importance of investing in innovation and technology development in disaster risk management. In this context, in one of the texts of the United Nations Office for Disaster Risk Reduction, the private sector is recognized as an important stakeholder, i.e., an interested party whose role is reflected in the development and application of innovations, technological progress, strengthening public-private partnerships, as well as in improving the connection between science, policy, and practice (UNISDR, 2016). The private sector recognizes this role through corporate security, one of its business functions.

The work is organized into four interconnected units, which move from the general to the specific and individual, in such a way as to enable a gradual, logically connected view of the relationship between DRREMS and corporate security as its significant segment. The first part discusses the concept and importance of DRREMS as an integral part of the national security system; the second part analyzes the concept and functions of corporate security in the protection of persons, property and business; The third part analyzes the Law, with a special focus on the subjects and forces of the system and their obligations; while the fourth part discusses the role of corporate security within the DRREMS, with an emphasis on its functions, i.e. its contribution to prevention, risk management, response to crisis (emergency) situations and ensuring business continuity, which in fact argues for its position as an integral part of this system.

2. The concept and importance of a disaster risk reduction and emergency management system

One of the earliest and probably most frequently cited definitions of a disaster is that developed by Charles Fritz. According to this author, a disaster is "an event, concentrated in time and space, in which a society, or a part of society, is threatened by danger and suffers such losses that the social structure is disrupted and the fulfillment of all or some of the essential functions of society is prevented" (Fritz, 1961, p. 655). An emergency, on the other hand, arises when the consequences of a disaster or serious threat exceed the system's regular capacity and require the application of special response measures.[1]

The DRREMS integrates two directions of action that are usually, and especially in foreign literature, considered separately. These are disaster risk management and emergency management, which will be discussed in the rest of the paper. Some authors point out that, both for scientific study and for practical implementation, a deep understanding of the cultural and social conditions that shape the domains of disaster risk reduction and management is necessary (Sandoval et al, 2023, p. 354). What we must also take into account, and which forms the basis for the organization and operation of any system, including the DRREMS, is the law. In this regard, it is also necessary to analyze the relevant provisions of national legislation.

In the extensive literature on hazards and disasters, the DRREMS is often described through the main methods communities use to protect themselves from disasters. The main methods (or activities) of protecting communities from these phenomena are: Mitigation, Preparedness, Response, and Recovery. Mitigation refers to any action taken to minimize the impact of a potential disaster, while Preparedness refers to specific measures taken before a disaster occurs (Twigg, 2004, p. 2). Mitigation is often closely related to prevention, which refers to proactive measures to reduce the negative impacts of hazards and related disasters. However, since it is unlikely that all causes of a hazard can be proactively eliminated, prevention as a method gives way to mitigation. Although necessary, these steps are sometimes insufficient to enable a community to recover and return to optimal functioning. For this reason, after Response, as a reactive approach to negative impacts, relief and Recovery measures are introduced, which represent a key segment of the reconstruction process, aimed at re-establishing the community's functional capacities and its ability to provide basic services continuously.

1 See more in: Mandić, G. J. & Marković, J. M. (2024). Planovi za vanredne situacije u privatnom sektoru. U: Zbornik radova: Treća memorijalna naučna konferencija „Predrag Marić" (str. 94-106). Univerzitet u Beogradu - Fakultet bezbednosti.

The implementation of prevention and mitigation, preparedness, emergency response, and relief and recovery measures is also known as "disaster management" or "disaster risk reduction", which "aims to prevent new and reduce existing disaster risks and manage residual risks, all of which contribute to strengthening resilience and thereby achieving sustainable development" (UNDRR, 2017a). The term "disaster risk management" is also widely used in the literature, referring to "the implementation of disaster risk reduction policies and strategies to prevent new disaster risks, reduce existing disaster risks and manage residual risks, contributing to strengthening resilience and reducing disaster losses" (UNDRR, 2017b). This is also recognized in our Law, in which the DRREMS is defined as "part of the national security system and represents an integrated form of management and organization of the entities of this system in the implementation of preventive and operational measures and the performance of tasks of protecting and rescuing people and property from the consequences of disasters, including measures for recovery from those consequences" (Law, Art. 10).

Based on the above, we can say that the disaster risk reduction system encompasses a wide range of activities undertaken by various societal actors (each within its own jurisdiction and capabilities), all aimed at reducing the risks of disasters to an acceptable level.[2] Understood in this way, the disaster risk reduction process is increasingly integrated into the daily planning and decision-making processes at the corporate management level. It becomes an integral part of its regular activities across all functions of the corporate security system.

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2 The solutions provided for in the Law also support the above. "Disaster risk reduction, among other things, includes: 1) accurate identification, regular assessment and monitoring of disaster risks for the purpose of their control; 2) reducing the impact of factors that cause or increase disaster risks through responsible and appropriate management of the environment, land, water and other natural resources, planned land use and taking appropriate technical and other measures; 3) mitigating harmful consequences based on a more complete understanding of their risks, planning for their prevention and increasing preparedness for response and effective response; 4) rebuilding after a disaster in accordance with the principle of building a better system, which will make infrastructure and society as a whole more resilient to future disasters; 5) investing in disaster prevention and risk reduction through encouraging public and private investment and taking structural and non-structural measures; 6) building a culture of safety and resilience of individuals and communities to disasters; 7) intensive mutual cooperation of all competent institutions at all levels of government, as well as partnership with private and public enterprises, other legal entities, entrepreneurs, civil society organizations and all interested citizens who can contribute to disaster risk reduction; 8) establishment of precise procedures for the exchange of information and experiences of importance for risk reduction and for the efficient provision and receipt of international operational and humanitarian assistance for the purpose of eliminating the consequences of a disaster and the initial reconstruction of affected areas; 9) monitoring climate change and community adaptation to the expected consequences" (Law, Article 11, paragraph 2).

One of the key activities of the DRREMS that permeates all phases of disaster risk management is effective information management. This activity includes the collection, processing, use, exchange, and distribution of information. This aspect is particularly evident in the risk assessment phase, when potential hazards are identified by analyzing historical, statistical, and other relevant data. In addition, the importance of information management is reflected in its role in enabling high-quality inter-sectoral cooperation, since the timely and reliable exchange of information among various actors involved in the risk management system is a prerequisite for making sound decisions and acting effectively across all phases of management.

The importance of the DRREMS is recognized in normative and legal regulation, where its role is defined within the framework of the entire national security system. Namely, the Law (Article 1) stipulates that the DRREMS is "of special interest to the Republic of Serbia and is part of the national security system". Such a legal solution shows that the system is not isolated but rather an important part of the institutional framework that helps prevent risks, mitigate disasters, and manage emergencies effectively. At the same time, its place in the national security system also underscores the system's recognized strategic importance in protecting and preserving societal stability.

3. Corporate security – concept and functions

Corporate security is an important segment of the broader system of private and national security, the functioning of which affects economic, social, and national security. Its importance is reflected in its dual role: on the one hand, protecting one's own values and interests, and on the other, contributing to society and the state's ability to meet its needs. Consequently, corporate security goes beyond the scope of individual organizations and is a significant factor in preserving economic stability and overall social resilience, including resilience to disasters.[3]

Given the multitude of definitions of corporate security, both because the concept is still developing and because of the divergence in the literature, choosing one is not easy. At the highest level of generality, it represents

3 This is also confirmed by the position expressed in the National Security Strategy of the Republic of Serbia (2019), which states that legal entities, entrepreneurs and individuals who perform private security activities, in accordance with the law, constitute the internal security system. In this regard, "the internal security system is a part of the national security system intended for performing tasks that ensure the safety of citizens and property... *implement preventive and operational measures and perform tasks of protecting and rescuing people and property from the consequences of natural disasters and other accidents, including measures to recover from those consequences*."

nothing less than an organization's overall security. Regardless of the organization's nature, any security-related activity falls under the umbrella of corporate security.

For this paper, we highlight the definition that defines corporate security as "a characteristic of a legal entity manifested as a state, process and/or instrument of protection of persons, property and operations (objects of protection) that are protected from all sources, carriers and forms of threat, and which is achieved by the human, material and organizational capacities of that entity" (Mandić, 2020, p. 169). From the above definition, it is clear what is protected – the values of the legal entity (persons, own and entrusted property, including information, and operations); from what – all sources, carriers and forms of threat, both internal and external, and in what way – by using all available resources, namely organizational, material and personnel capacities.

In addition to the diversity in defining the term, there is a significant body of work in the scientific and professional literature on the analysis of the functions and elements of corporate security (Marković, 2025, pp. 96-98). Understanding the functions and elements of corporate security has multiple significances. First of all, it enables the systematization and clearer definition of the role of corporate security within the organization. Furthermore, understanding these aspects contributes to improving the organization's overall security management process through better planning, coordination, and control of all security-related activities. In this way, the integration of corporate security with other organizational functions is also enabled, thereby strengthening overall resilience and ensuring business continuity. By reviewing the literature, we can see all activities of an organization that are of a security nature through the following corporate security functions (Marković, 2025, p. 191):

- workplace safety – employee safety (safety and health at work, protection from violence and mobbing);
- physical and technical protection of persons, property, and business (engaging security officers and implementing technical protection);
- collection, verification, protection, and security of data and information;
- *supervision and control* – proactive action to prevent a harmful event: supervision and control over the operations of certain sectors, process operations in production, warehouse processes (input/output of goods, semi-finished products or raw materials), supervision and control over the implementation of internal regulations;

- internal investigations (conducting internal investigations in the event of a harmful event within the organization);
- fire protection;
- environmental protection;
- *risk assessment, control, and management;*
- *crisis management;*
- *business continuity.*

In addition to the above functions, some organizations also provide others, such as economic security, property insurance, authorized supervision, and control of content placed in the media, all due to the specific activity to which the system or organization belongs (Marković, 2025, p. 191).

Of the previously mentioned, we highlight three corporate security functions that have a direct impact on disaster risk reduction and emergency management, namely risk assessment, control and management, crisis management, and business continuity management. *Risk management* is integral to business. All legal entities with potential disaster risks are required to provide procedures for identifying, assessing, analyzing, and managing key risks. It is a continuous process that consists of developing a strategy, setting goals, and making decisions. The goal of risk management is to minimize rationally possible risks. *Crisis management* encompasses a set of activities aimed at identifying, analyzing, and predicting potential crisis situations, and establishing mechanisms that enable an organization to prevent or effectively deal with a crisis, mitigate its consequences, and return to normal functioning as quickly as possible. *Business continuity management* aims to mitigate the consequences of emergencies and crises, including disasters, that directly or indirectly affect the organization. It includes identifying the risks of business processes being exposed to internal and external threats, quantifying and mitigating their impact, and ensuring rapid and efficient recovery in the event of a disaster (Cabric, 2015, p. 198).

In addition to the above, the *function of supervision and control*, carried out with a proactive aim, is also highlighted here because it enables the timely detection of deficiencies and deviations in the corporate security system. Particular importance is given to verifying compliance with applicable regulations, internal procedures, and plans, as well as to verifying the level of equipment and training for disaster risk management. In this sense, this function enables not only the identification of deficiencies, but also their timely elimination. This reduces the likelihood of unwanted events and mitigates their consequences, but also strengthens the corporate security functions, including the three highlighted above.

4. Legal framework for the disaster risk reduction and emergency management system in the Republic of Serbia

The DRREMS in the Republic of Serbia is regulated by the Law on Disaster Risk Reduction and Emergency Management from 2018. This Law defines subjects of the disaster risk reduction and emergency management system as state administration bodies, autonomous province bodies, and local self-government units, public services, companies, as well as other legal entities whose activities are of importance for this area (Law, Article 13, paragraph 1). In addition to them, organizations whose activities are of particular interest for the development and functioning of the DRREMS are classified as forces of the disaster risk reduction and emergency management system (Law, Article 13, paragraph 3).

The Law stipulates the obligation of legal entities to prepare certain documents, including the Disaster Risk Assessment, the Protection and Rescue Plan, and the Disaster Risk Register (Law, Articles 15-22).[4] The Republic of Serbia, autonomous provinces, local government units, entities of special importance for protection and rescue, as well as companies and other legal entities that carry out certain activities, are obliged to prepare a Disaster Risk Assessment (Law, Article 15). Entities that are obliged to prepare a risk assessment are also obliged to adopt a Protection and Rescue Plan (Law, Article 17). The preparation of the above documents is entrusted to authorized companies and other legal entities (Law, Articles 19-20).

A special obligation relates to the preparation of an Accident Protection Plan, which must be in place for companies and other legal entities that use or may use hazardous substances in their activities in prescribed quantities

4 "The Disaster Risk Register is an interactive, electronic, geographic-information database for the territory of the Republic of Serbia, maintained by the Ministry (of Internal Affairs) in cooperation with the competent state administration bodies, other state bodies and holders of public authority. The Risk Register contains *data of importance for risk management*, including: 1) physical-geographical data on the area affected by the risk; 2) data on the number and structure, as well as exposure and vulnerability of the population that may be affected by the occurrence of a disaster; 3) data on residential buildings and buildings for other purposes, infrastructure and other facilities, their exposure and vulnerability; 4) data on previous disasters and their consequences; 5) description and characteristics of the hazard; 6) other data of importance for risk reduction." (Law, Art. 22, paragraphs 1 and 2). The Disaster Risk Register is established, coordinated and managed by the Ministry of Internal Affairs, while other institutions – subjects of the disaster risk reduction and emergency management system, are obliged to provide the Ministry of Internal Affairs with up-to-date risk data required for the development of the Risk Register. The Republic Geodetic Authority has the role of establishing and maintaining the technical infrastructure for accessing and using data from the Risk Register. See: https://drr.geosrbija.rs/drr/home, accessed: 5 May 2026.

(Law, Articles 64-66). Based on these plans and official records, a Register of Entities Handling Hazardous Substances is formed (Law, Article 67). Also, all legal entities that are part of this system are obliged to submit up-to-date data to the Ministry of Internal Affairs to maintain the Disaster Risk Register (Law, Article 22, paragraph 3), as we mentioned earlier.

The Law specifically recognizes entities of importance for protection and rescue, which include companies and legal entities in the fields of telecommunications, energy and mining, transport, meteorology, hydrology, seismology, nuclear safety, environmental protection, water management, forestry, agriculture, healthcare, social care, veterinary, communal activities, construction, catering and other activities that have resources significant for disaster risk reduction (Law, Article 31). These entities have special legal obligations, but at the same time, every company and legal entity is obliged to implement prevention and risk reduction measures within its scope of activity, participate in protection and rescue activities upon request by the competent authorities, and provide the necessary data (Law, Article 30). In addition, all entities are obliged to provide and maintain means and equipment for personal and mutual protection, as well as to organize employee training (Law, Article 55).

Furthermore, the Law also prescribes special obligations for entities in certain activities (electronic communication networks and information systems and connections) (Law, Article 32), as well as for certain categories of companies, such as those that manage hydroaccumulations, tailings dumps and ash dumps, or are engaged in the production, storage and trade of hazardous substances (Law, Article 97). Special obligations also apply to radio and television stations and mobile telephony operators (Law, Articles 98 and 100).

Another important law for the establishment and functioning of the DRREMS is the Law on Critical Infrastructure from 2018. The Law on Critical Infrastructure recognizes the importance of risk management by requiring critical infrastructure operators to develop security plans, conduct risk analysis, and appoint a liaison officer to coordinate with competent authorities.[5] These solutions are primarily aimed at prevention through threat and vulnerability identification, the planning of risk reduction measures, and

5 The Law on Critical Infrastructure requires each operator to develop a Security Risk Management Plan, a document that establishes risk mitigation measures, defines responsibilities and duties, and procedures for eliminating or mitigating the consequences of security threats identified in the risk analysis, which is an integral part of the plan (Article 8, paragraph 1). However, the aforementioned law does not prescribe specific risk mitigation measures or provide a framework for their definition, leaving each operator to determine them independently based on the identified threats. Such a legal solution may result in the methods of protection being left entirely to the different interpretations and practices of the operators themselves (Radivojević & Marković, 2025, pp. 719-720).

the continuous exchange of information with competent institutions. At the same time, certain overlaps with the planning documents prescribed by the Law on Disaster Risk Reduction and Emergency Management indicate a regulatory inconsistency that may further burden critical infrastructure operators. However, such legal solutions confirm that risk management is a key element of critical infrastructure protection (Radivojević, 2022, pp. 114-117). What is positive about the Law on Critical Infrastructure is that it emphasizes the importance of integrating critical infrastructure into spatial, security, and emergency plans, with a focus on preventive measures and priority actions in crises, thereby encouraging a proactive approach to protection (Radivojević & Marković, 2025, p. 721).

5. The role of corporate security in the disaster risk reduction and emergency management system of the Republic of Serbia

The previous text indicated that corporate security already has functional mechanisms aligned with the concept of integrated risk management (Table 1).

Table 1. Comparative overview of DRREMS phases and separate corporate security functions (Source: Authors)

DRREMS phases	Corporate security functions
Prevention (and Mitigation)	Risk Assessment
Preparedness	(Protection) Planning
Response	Crisis Management
Recovery	Business Continuity

In the prevention phase, the emphasis is on risk assessment, which includes the identification of threats, analysis of the probability of their occurrence and possible consequences, then the categorization of risks (the so-called "triage" for their evaluation), as well as the mapping of critical processes and resources in the organization. Of particular importance is the collection of historical, statistical, and other data. Based on the risk assessment, mitigation activities are undertaken to help prevent or reduce society's vulnerability to the impacts of disasters. The role of corporate security here is primarily proactive because, through strategic planning and organizational policies, it helps reduce the overall level of risk and strengthen the organization's resilience, and, indirectly, the community's resilience.

The preparedness phase involves comprehensive protection planning through the development of various planning documents and procedures. This includes a risk management plan, a protection and rescue plan, a fire protection plan, a plan of safe work measures, a preventive health care plan, a plan for the transport of hazardous materials, and a physical and technical protection plan (security plan)[6] and an information security management plan. In addition, it includes an equipment plan, a training and development plan, a protection and rescue plan, a civil protection plan, an evacuation plan, a crisis communication plan, a plan for operating under special conditions, a chemical accident response plan, and a plan for dealing with natural disasters. This phase also envisages the activation of crisis headquarters, the definition of operational protocols for emergencies, and the development of business continuity, recovery, and damage repair plans, with mandatory analysis following the event. At the same time, preparedness also includes early warning systems for hazards, providing emergency shelter, establishing and maintaining supplies, and all other measures taken to minimize the immediate impact of disasters. Corporate security is an integrative framework that unites all of the above plans and procedures, as well as all activities carried out at the organizational level or in which the organization participates, into a single, coordinated protection system.

The response phase is the part of emergency management that involves immediate action during and immediately after a disaster. It includes the establishment and operational functioning of crisis headquarters, decision-making under conditions of uncertainty, effective management of available resources in real time, and cooperation and coordination with competent state authorities (primarily the competent emergency headquarters and the police) and other relevant actors. The main focus is on saving lives, meeting basic human needs, and preventing further destruction of property and the environment. Some activities in disaster response include search, rescue, assistance, evacuation, sheltering, and medical assistance. In this context, corporate security plays a significant operational role, ensuring the organization's internal capacity to respond effectively in emergencies. Through established procedures, trained personnel, technical protection systems, and other material assets, corporate security contributes to the rapid mobilization of the necessary resources for response, the protection of its employees and property, and the protection of the wider community and the environment. Corporate security engagement ensures an integrated response to disasters within a broader social context.

Finally, the recovery phase aims to ensure business continuity by activating alternative operations and recovery plans, returning the organization to

6 In accordance with the Law on Private Security (Official Gazette of the Republic of Serbia, No. 104-2013, 42/2015 and 87/2018).

regular operations as quickly as possible. In this context, corporate security plays a key role, as it encompasses planning, implementation, and control of measures to preserve critical functions and resources and minimize the harmful consequences of disruptions. Through the development and implementation of business continuity plans, corporate security directly contributes to strengthening the organization's resilience, reducing operational losses, and faster stabilization after emergencies.

By analyzing the relevant provisions of the Law, we can conclude that they largely follow the logic of the disaster management cycle. We will list only some of the solutions prescribed by this Law. The first phase includes disaster risk reduction (Article 3), risk assessment and preventive measures and activities (Article 4, Article 15), and strengthening community resilience (Article 11). The second phase includes the adoption of a strategy (Article 12), the development of disaster risk reduction plans (Article 16), protection and rescue plans (Article 17), including the part relating to the establishment of an early warning system, the development of major accident protection plans (Article 18), the accident protection plans (Articles 64-66), as well as the establishment of emergency headquarters (Article 41) and formation of civil protection units (Article 55, Articles 77-78), maintaining in good condition the necessary means and equipment for personal and mutual protection (Article 55, paragraph 2) and training and capacity-building (Article 101). The third phase, the response phase, relates to the declaration of an emergency (Article 38), the coordination of emergency headquarters (Article 43), and the undertaking of protection and rescue measures (Article 56). Finally, for the recovery phase, we can say that the Law also recognizes the implementation of recovery measures, i.e., reconstruction after a disaster, in accordance with the principle of building a better system.

6. Conclusions

The increasingly numerous and destructive consequences of disasters pose new challenges to society in terms of finding new approaches, primarily in their prevention, and then in reducing harmful consequences, as well as the fastest possible recovery of society. This will necessarily require a holistic approach that includes other social entities, in addition to the actions of state authorities and bodies. The entire logic of disaster risk management is directed toward reducing disaster risks, i.e., taking activities to minimize the impact of potential disasters, as well as taking specific measures and activities before a disaster occurs. After a disaster manifests, a response is necessary in the form of reactive action aimed at reducing negative (threatening) impacts, followed by recovery, i.e., a reconstruction process aimed at re-establishing

society's capacity to perform its basic functions. All of the above clearly indicate the breadth of entities that must be included in the above processes. One of these entities is certain companies and other legal entities (organizations).

All modern organizations (public or private), by developing their own capacities to protect their vital assets (employees, property, business), directly contribute to strengthening the resilience of society against the harmful consequences of disasters. Understood as a business function, corporate security directly contributes to reducing disaster risk and managing emergencies, and is integral to the system of the same name. This is supported by the following functions of corporate security: risk assessment, control and management, crisis management, business continuity, and supervision and control. In the Republic of Serbia, the DRREMS is institutionalized and regulated by the Law. Based on the analysis of the Law, we can conclude that the Law largely follows the classic disaster risk management cycle, which includes prevention, preparation, response, and recovery, and that these phases can be directly linked to the corporate security functions.

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Article

Artificial Intelligence in Integrated Disaster Risk Management: Sustainability and Human Security in the Republic of Serbia

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Abstract

The Republic of Serbia has formally committed to integrating sustainability principles into its development framework, implementing them in accordance with the sustainable development principles of the European Union and the United Nations. The objective is to establish a balance between economic growth, environmental protection, social inclusion, and institutional resilience. The National Sustainable Development Strategy of the Republic of Serbia (NSDS) is a strategic public policy document adopted by the Government in 2008. This strategy represents the first comprehensive framework for integrating economic development, environmental protection, and social cohesion into a unified, long-term development vision. Although the NSDS formally expired in 2017, its principles continue to influence the formulation of public policy. This paper analyzes the implementation of sustainability principles in Serbia from the perspective of human security, with an emphasis on protecting citizens and communities from economic, environmental, health, food, and institutional risks. The analysis iden-

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tifies significant implementation gaps in which formal sustainability policies fail to sufficiently reduce vulnerability, exposure, and inequality. Weak coordination among environmental, health, social, and infrastructure policies limits the effectiveness of sustainability principles in human security, particularly for vulnerable social groups and at-risk regions. Artificial intelligence (AI) offers substantial potential to overcome these shortcomings by enabling anticipatory, data-driven, and cross-sectoral governance. The application of AI can enhance environmental monitoring, health risk forecasting, resilience of energy and infrastructure systems, social vulnerability mapping, and the assessment of public policy impacts. However, AI achieves its full potential only when used as a decision-support instrument integrated into institutional processes, supported by interoperable data systems, ethical safeguards, and continuous human oversight. Based on these insights, the paper proposes an AI-based governance architecture for improving sustainability in Serbia. This conceptual governance model is designed as an integrative and adaptive framework, grounded in human security principles, that aims to reduce the risks posed by natural and other hazards through real-time data-driven decision-making and strengthened institutional coordination.

Keywords

Sustainability, human security, artificial intelligence, governance architecture, institutional coordination.

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1. Introduction

From the earliest human interventions in the natural environment, we can recognize the need to assess the sustainability of human activities. Certainly, today's content of the term covers a much wider area of human activity than in the time of the original human community. Today, when we talk about sustainability, we do not mean only the ecological aspects of human activities, but also the effects of the work of all systems established by man. To conclude the sustainability of a process or system's operation, it is important to analyze the input and output parameters of that unit. It is necessary to analyze the effects of used resources not only in terms of the ecological footprint but also on employees' earned income, the possibility of renewing used resources, and the workforce's motivation to continue working. Sustainability can also be connected to demographic factors and to factors that decisively influence the choice of a place to live, i.e., the decision to leave a certain area. The quality of life observed through the prism of infrastructure,

terrain, air quality, health system functionality, personal safety, and community safety is refracted by the functioning of institutions and the nature of the political system. Respecting the will of the majority and the extent to which their interests are incorporated into the legislative framework decisively affects all aspects of life, ultimately affecting the sustainability of the community living in a given territory.

Given the number of variables to be accounted for in the analysis of the sustainability of socio-economic systems, it is necessary to develop analytical models that yield the most accurate results. In this context, the concept of human security is a useful analytical framework that encompasses the greatest number of relevant factors for assessing the degree of sustainability and identifying the causes of problems that call into question the system's functionality and survival. Artificial intelligence is a valuable tool that can improve analysis quality by processing large amounts of data in a short period.

2. Methods

The research adopts an interdisciplinary approach that combines analysis of prior research and available statistical data to determine the relationships among sustainability, human security, and the functioning of modern socio-economic systems. The United Nations Development Program's concept of human security, promoted in the 1994 Human Development Report, was adopted as an analytical framework (UNDP, 1994). The holistic nature of the concept of human security enables the identification of gaps and the correlation among environmental, health, social, and infrastructure policies in the context of applying the principles of community sustainability and enhancing resilience to disasters (Đorđević, 2024).

The aforementioned methodological approach was chosen because the relationship between sustainability and human security is complex and requires analyzing political, economic, environmental, and institutional processes, as well as their impacts on individuals' and communities' quality of life and security. We use statistical analysis to test, based on available sources, a simulation model based on the system dynamics approach, which is applied to the analysis of complex systems with time-varying variables, using the Vensim software tool. The model structure is represented by a system of first-order nonlinear differential equations containing both system and auxiliary variables, with appropriate parameters that characterize the model's behavior over time.

3. The concept of human security and sustainable development

The concept of human security as an analytical framework emerged during a period of dramatic changes in the functioning of civilization following the fall of the Berlin Wall. The basic idea of the authors of the UNDP human development report for 1994 was to provide an analytical model to determine the sources of problems in countries (and/or communities) experiencing disturbances in the functioning of the system. The primary goal was to, through the analysis of transition processes and their effects in the area of the former Eastern bloc and the peripheral countries of the capitalist world, identify the causes that led to results contrary to expectations. However, as time progressed, the need for similar analyses emerged in the very center of the capitalist system.

The globalization of human activities has expanded the field of effects of many processes that were once limited to the national space. But even so, national institutions are still the only ones with real power to influence the nature of concrete processes and their effects at both the global and local levels. A holistic approach to modern processes entails a comprehensive analysis of key factors that determine the final result of their development. That's why we opted for a sustainability analysis based on the human security analytical model, which includes seven dimensions essential to people's quality of life. We think about sustainability, in the given context, as a necessary factor for the survival of the living world on planet Earth. Starting from the assumption that the basic goal of all activities undertaken by people is their well-being, and raising the level of living standards.

At the center of the analytical model based on the concept of human security is man as a factor that creates the environment, but also as one who suffers the consequences of the functioning of his activities. The neoconservative capitalist model that became dominant after the fall of the Berlin Wall propagates economic efficiency as its core value. However, in all likelihood, this efficiency has its price, as evidenced by the deterioration of the ecological situation and by climate changes that call into question the survival of the living world. If we want to determine the causes of the problems that call into question the sustainability of the modern civilizational model, then we must remember the basic postulate of democracy, which holds that the will of the majority is decisive in choosing the form of work and the way the system functions. That's why we have to introduce into the analysis the nature of political systems and the way in which an environment is created in which laws are adopted and implemented. Certain problems challenge the logic of the forward-looking democratic principle of the will of the majority. This is

supported by evidence showing that the system is increasingly instrumentalized to serve the interests of financial oligarchies. The results of the current socio-economic model indicate that the majority fall into the category of losers. At the same time, a small percentage of the world's population enjoys enormous luxury and wealth (Đorđević, 2007). The perceived problems require careful analysis to develop arguments grounded in concrete research and data that would compel the centers of power to change their relationship with the rest of humanity and with the planet as a living habitat.

The effects of such research depend on the objective presentation of the situation and the results obtained under realistic parameters. That's why we believe that research that includes the economic aspects of the process and their effect on people's health, quality of nutrition, living environment, community safety, personal safety, and the ability of the individual to express his position through the institutions of the system is the only one that can bring a qualitative change in relation to the long-term interests of civilization.

3.1. Sustainability and Human Security - Formal/integral approach

Sustainable development represents the unity and interdependence of the environment, the economy, and social relations. However, this action often results from planned and unplanned activity in these domains, leading to instability and uncertainty regarding sustainable development. A typical example is the relationship between the economic and environmental domains, where contradictory decisions are possible: a positive activity in one domain can lead to a negative process in another, and vice versa.

To that end, the paper proposes an AI-based governance architecture to improve sustainability in Serbia. This conceptual governance model is designed as an integrative and adaptive framework, grounded in human security principles, that aims to reduce the risks of natural and other hazards through real-time data-based decision-making and strengthened institutional coordination.

The conceptual model is based on three pillars that form the basis for research in the field of sustainability (Rabbi, 2025):

- Environment
- Economy
- Society

For our research, this model has been extended to the domain of human security (Jahan, 2023):

- Environment
- Economy
- Society
- *Human*

This expanded model of sustainability is shown in Figure 1.

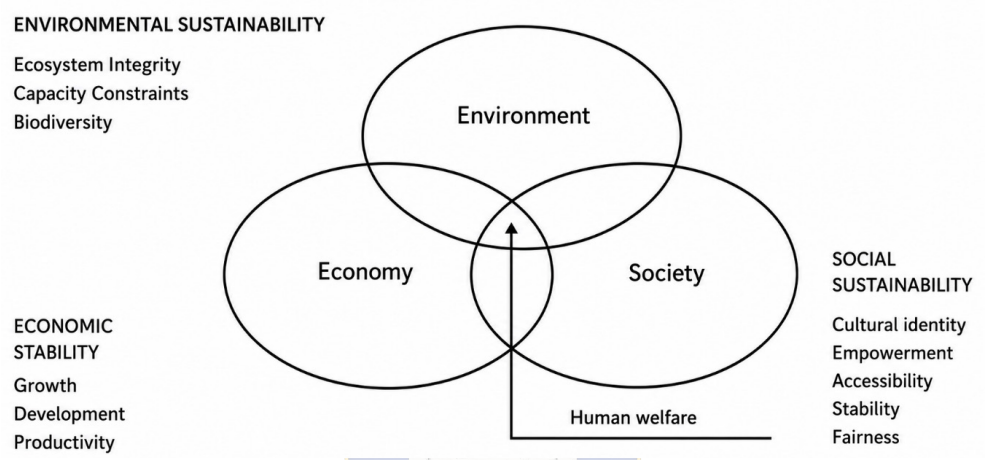


Figure 1. Elements of sustainable development. Source: Jevremović, 2007.

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For the analysis of internal dynamic processes in a complex system of sustainability, a simulation model was realized using the appropriate Vensim software tool (Vensim). The model is based on the System Dynamics approach, which is applied to the analysis of complex systems that contain time-varying processes and sub-processes (Sterman, 2000).

From a theoretical point of view, the model is presented as a system of first-order nonlinear differential equations that include both system and auxiliary variables, with parameters that characterize its behavior over time.

3.1.1. Mathematical model

System variables

dSustainability/dt= α*(w1*EconSEC+w2*SocSec+w3*EcologSec+w4*PolSec)+β*DM - -γ*Sustainability

dInstQual/dt= δ*DM+ε*PolSec-InstQual

Auxiliary variables

HumSec=w1*EconSEC+w2*SocSec+w3*EcologSec+w4*PolSec

DM=ω*HumSec-η*Sustainability+θ*Public+λ*Training+μ*Legal+ϱ*AI+σ*Assets

AI=κ-τ*Sustainability-φ*HumSec-υ*InstQual

HS domains

dEconSEC/dt = a1*EconGain-a2*EconLoss-a3*EconSEC+a4*DM-Disturbance

dSocSec/dt = b1*SocGain-b2*SocLoss-b3*SocSec+b4*DM

dEcologSec/dt = c1*EcoLGain-c2*EcolLoss-c3*EcologSec+c4*DM

dPolSec/dt= d1*PolGain-d2*PolLoss-d3*PolSec+d4*DM

External variables

Public - public opinion

Legal - legal regulations

Training - training and education

Assets - material, financial, and other resources

Where is:

w1…w4 - weighting factors that determine the relative importance of HS domains, (determined using expert assessment and AHP methodology, (Saaty, T.L., 1980).

α…ω - model parameters that determine the behavior of the model in time (stability, transition regimes, etc.),

a1…d4 - parameters that determine the dynamic characteristics of the HS domain.

For consistent analysis, all variables in the model are normalized to the range 0-1.

This model represents a dynamic system of sustainability and human security, structured as an interconnected stock-and-flow framework with feedback loops driven by policy, institutional capacity, and AI-enabled decision-making.

At its core, four sectoral human security stocks - economic (EconSEC), social (SocSEC), ecological (EcologSEC), and political (PolSec)- evolve through

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a balance of gains, losses, natural decay, and policy intervention (DM). These sectors are aggregated into a composite input (HSIn) that determines the level of human security (HumSec), capturing the system's overall resilience and well-being.

In the Human Security (HS) framework, each domain is typically decomposed into core components (sub-dimensions) that capture both structural conditions and risk exposures. Operationalization for modeling and determination of parameters and indices in the model is based on the following contents of HS sub-dimensions:

Economic Security (*EconSec*): stability of income, livelihoods, and economic resilience.

Ecological (Environmental) Security (*EcoSec*): sustainability of natural systems and exposure to environmental risks.

Social Security (*SocSec*): well-being, social cohesion, and access to essential services.

Political Security (*PolSec*): governance, rights, and institutional stability.

Furthermore, Sustainability is modeled as a higher-order stock influenced by sectoral performance (SusIn) and policy effectiveness (DM). At the same time, institutional quality (InstQual) reflects governance capacity shaped by political security and decision making, with a delay representing bureaucratic inertia.

A central endogenous driver is decision-making capacity (DM), which depends on human security, sustainability conditions, public response, legal frameworks, available assets, and AI capability. AI acts as a strategic modifier of decision-making, while also being indirectly influenced by system performance, creating a feedback loop between technology and governance.

The model includes an exogenous disturbance (shock) that perturbs the economic sector, allowing simulation of system resilience and recovery dynamics.

This model effectively represents an AI-enabled governance resilience system where:

- AI improves training capacity,
- training improves decision-making,
- better decision-making enhances sustainability,
- sustainability improves public trust,
- public trust feeds governance quality,
- Governance quality influences security domains.

Overall, the model structure captures:

- Interdependence of sustainability and human security,
- Feedback between governance, AI, and system performance,
- Resilience dynamics under external shocks.

The simulation model, created with the Vensim software, is shown in Figure 2.

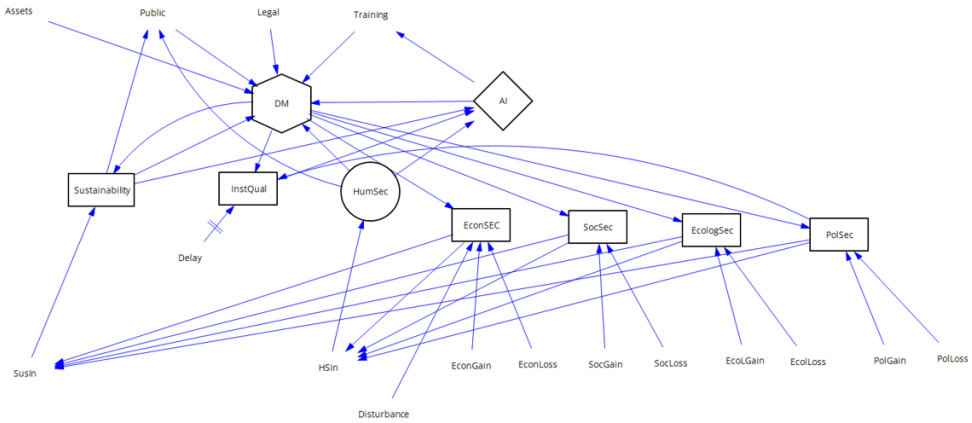


Figure 2. Simulation model of the relationship between the dimensions of human security and sustainability. Source: Authors.

The parameters in the model are determined based on **Serbian empirical indicators and** on datasets and policy benchmarks aligned with frameworks of the United Nations, the European Union, and Serbia's National Sustainable Development Strategy of the Republic of Serbia. In addition, the parameters are determined based on expert assessments, official reports, and AI assessments that are relevant to the Republic of Serbia. For this purpose, data from the following sources were used: The United Nations in Serbia, the United Nations Development Program, the Sustainable Development Goals in the Republic of Serbia, The Organisation for Economic Co-operation and Development, the Serbian Artificial Intelligence National Platform, the Environmental Performance Index, the European Environment Agency, and the World Economics Platform.

To explain the parameters using real Serbian data, should reinterpret each variable as an empirical proxy derived from official statistical indicators. This model then becomes an operationalized AI-human security-sustainability framework for Serbia.

A strong approach is to normalize all variables to a 0-1 scale. This allows heterogeneous Serbian indicators (GDP growth, corruption index, pollution, unemployment, etc.) to coexist within a single SD model.

An example of determining parameters for the economic domain within human security.

The EconSec variable that represents this domain in the model can generally represent:

- macroeconomic stability,
- employment security,
- household resilience,
- fiscal sustainability.

Table 1. Examples of data sources for indicators of economic security. Source: Authors.

Indicator	Serbian source
GDP growth	World Bank
Unemployment	Statistical Office of Serbia
Inflation	National Bank of Serbia
Public debt/GDP	Ministry of Finance
Real wages	Statistical Office of Serbia

Furthermore, the EconSec variable in the model has two components: EconGain and EconLoss. EconGain increases economic security, while EconLoss decreases it in this domain. EconGain depends on GDP growth, Employment growth, and foreign direct investment (FDI). EconLoss shows inflation, public debt pressure, external shocks, and the burden of the informal economy.

After determining the appropriate indicators for EconSec from the mentioned databases, normalization is performed to obtain parameters that are then implemented in the simulation model.

A similar procedure can be applied to the variables in other domains of human security: EcolSec, SocSec, and PolSec. However, due to limited space in the work, it was omitted.

In addition, a similar analysis and parameter determination were carried out for the variables AI, DM, InstQual, and Sustainability.

An additional condition for determining the parameters is the stability requirement (Jacobian stability conditions), which additionally determines the quality of the model's behavior over time.

By running a simulation for the model thus formed, with the application of an exogenous **disturbance (shock)** that perturbs the economic sector of human security, the time responses for the variables in the model are obtained:

- *Sustainability* – level of **sustainability**
- *HumSec* **-** level of **human security**
- *DM* – decision-making **capacity**
- *AI* - AI-enabled decision making
- *InstQual* - governance capacity
- *EconSEC* - economic security
- *PolSec* – political security
- *Disturbance* - exogenous **disturbance on** the economic sector

Time responses for these model variables are shown in Figure 3:

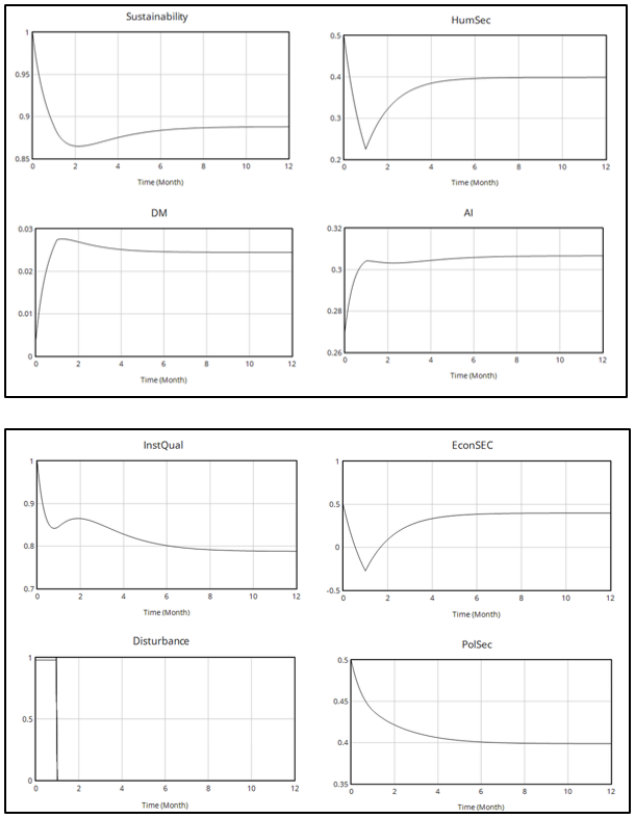


Figure 3. Graphical representation of the time response to changes in observed variables

Source: Authors.

After the conditional application of an exogenous disturbance (shock) lasting one month, all variables in the model exhibit a transitional regime lasting 6 months, after which they enter a stable regime. At the same time, the dependent variables in the model, Sustainability, Human Security (HumSec), Institutional Quality (InstQual), Economic Security (EconSec), and Political Security (PolSec), have a reduction of approximately 20% compared to initial values. This is expected considering the intensity of the disturbance. Control variables Decision Making (DM) and AI-enabled decision making (AI) are at a correspondingly high level, which enables the model to maintain stable behavior over time. In this way, the justification for the selected model parameters based on Serbian empirical indicators is demonstrated.

Performing various simulations in the presented model enables:

- Analysis of internal dynamic processes in a complex system of sustainability,
- Analysis of stability conditions in the model,
- Parameter estimation for various geographical locations (RS, cities, municipalities),
- Analysis of various scenarios in emergencies.

It is also suitable for analyzing policy interventions, AI-enabled governance, and stability of critical socio-economic systems.

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4. Conclusions

The presented research was intended to indicate the potential of artificial intelligence for data analysis in situations where processing of large amounts of data is required in a short period of time. The system dynamics-based model contributed to the objectification and efficiency of the decision-making process. Decision-making based on the quantification of real circumstances and factors that influence the process represents a significant contribution to improving the sustainability of civilization, local communities, and the quality of life of people.

Based on the results of comprehensive research and the quantification of factors influencing the processes, the observed shortcomings can be corrected and a rapid response implemented. Thanks to the strength of the arguments, ideological and interest-based moments that are often used to instrumentalize the system in order to realize goals whose basic criterion of success is profit can be avoided.

Each area has certain specificities, and the research approach should be adapted to the conditions on the ground. Experiences and practices formal-

ized through certain ISO standards should receive their national versions in accordance with local specificities. We believe that the basic principles outlined in international strategies and declarations can be universal in nature, but their adaptation to local conditions is necessary. Therefore, the concept of human security as an analytical framework is useful for optimizing local resources in relation to specific circumstances, using appropriate models and algorithms in artificial intelligence. Certainly, the role of experts as users of tools is irreplaceable. Machines are not yet able to replace human creativity, and as far as is known, they still do not have empathy for humans and the rest of the living world on our planet.

The research indicates the complexity of the sustainability problem and the need to harmonize all elements of the system across different levels of government and geographical regions, as well as to make necessary changes to the paradigm on which modern civilization is based. To begin with, it is necessary to raise awareness of the need to incorporate sustainability into all socio-economic processes. The system dynamics model presented here allows us to see the connections that exist between the socio-economic environment and disaster resilience. Determining the correlation between the state of the areas recognized as significant for the quality of people's lives in the concept of human security and the ability of communities to adequately prepare for and respond to natural and other disasters is the first step in building its sustainability.

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Review article

Earthquake Risk and Insurance in the Banking System

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Abstract

Although sophisticated instruments for measuring the magnitude of earthquakes and their effects exist today, there are still no devices capable of accurately predicting the place and time of an earthquake. It is well known that, among all natural disasters, earthquakes tend to be the most destructive, deadliest, and cause the greatest material damage. Modern society depends on numerous infrastructures without which everyday functioning would be impossible. Developed countries have defined their critical infrastructure sectors, among which the banking sector is included. There is no doubt that the functioning of society is impossible without the continuity of banking operations in the event of an earthquake. Issues related to risk and insurance, as well as the analysis of the vulnerability of the banking sector of the Republic of Serbia in the event of an earthquake, are examined in this paper.

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Keywords

Banking sector, earthquakes, critical infrastructure, risk management, insurance

1. Introduction

Whilst globally the death rate from natural disasters such as flooding and drought has declined dramatically in the past century, the fatality rates from earthquakes have remained persistent. It is a target of the Sendai Framework for Disaster Risk Reduction to reduce the global disaster mortality rate (along with those affected and economic losses) for this coming decade compared to the past decade (Elliott, 2020).

Earthquakes occur due to major movements of tectonic plates in the lithosphere and are among the few natural disasters that cannot be predicted in advance. Although sophisticated instruments for measuring the magnitude of earthquakes and their effects exist today, there are still no devices capable of predicting in advance the exact place and time of an earthquake. However, it is known that, among all natural disasters, earthquakes tend to be the most destructive and deadliest, causing the greatest material damage (Đorđević, 2018).

In addition, the occurrence of earthquakes leads to numerous secondary negative effects that complicate emergency management and prolong the period required for community recovery. Numerous earthquakes around the world during recent decades have killed thousands, and even hundreds of thousands, of people, as in the case of the Sumatra-Andaman earthquake, which claimed 275,000 lives in 2004. Besides the large number of human casualties, stronger earthquakes usually cause damage measured in billions of dollars and disrupt significant economic and business activities essential for normal life and functioning (Ćerčan, Ristanović, Miljković, 2009).

Today, the normal functioning of modern and organized states is unimaginable and impossible without numerous sectors that provide products and services. These infrastructures are recognized as critical, and each country defines them according to its own priorities. However, in almost all developed countries, critical infrastructure systems include: energy, transportation, water and food supply, healthcare, the financial sector, telecommunications and information technologies, and the functioning of state institutions (Škero, Ateljević, 2015).

The functioning of critical infrastructures and their continuous operation are essential for the normal functioning of society and the performance of

everyday activities within a country. The interruption of any of these sectors would have negative effects on society and the state. The interdependence of critical infrastructures makes them even more vulnerable, which is why their protection is a priority in modern societies. According to the American Cybersecurity and Infrastructure Security Agency (CISA), the protection of infrastructures defined as critical sectors is considered an obligation because it is clear that disruption or malfunction of these sectors, especially in times of crisis, would have significant negative effects both on other critical infrastructures and on the state as a whole (CISA, 2019).

The banking sector is defined as a critical infrastructure system whose functioning is essential for normal life and work. In addition, the banking sector plays a major role in the development and functioning of the overall economy (Golubović, 2016). Today, all business entities operate in a dynamic and uncertain environment, making risk almost inevitable. The banking sector, as part of the financial sector, is primarily exposed to financial risks and therefore invests great efforts in managing this type of risk (Tadić, 2018).

However, the devastating effects of natural disasters around the world have damaged or disabled numerous critical sectors, including financial ones, preventing their further operation. Such a scenario usually leads to disruptions in community recovery, the inability to restore normal functioning, threats to the operation of other sectors, and ultimately endangers national security (Zhang et al., 2021).

In the banking sector, as in other sectors, risk management is carried out based on risk identification and assessment (Matić, 2007). When it comes to earthquake risk management, the process is very complex. Earthquakes cannot be predicted, the damage caused by earthquakes depends not only on their intensity but also on protection measures and resilience, and earthquakes most often cause numerous secondary negative effects. The banking sector, especially institutions located in seismically active areas, should have a detailed natural disaster risk management plan, particularly for earthquakes. This, of course, requires significant efforts, adequate assessments, and control functions. Another form of business protection in the banking sector is earthquake insurance and business interruption insurance. Although these measures cannot prevent earthquakes, they can significantly mitigate their negative effects (Savić, 2019).

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2. Earthquakes: Concept and Impact on Critical Infrastructure

Seismic hazards are generally considered among the most terrifying natural forces precisely because they occur suddenly and cause enormous disasters. In just a few minutes, an earthquake can completely alter the landscape, bury existing lakes and create new ones, change entire river courses, and even completely wipe out an entire city (Ćerčan, Ristanović, Miljković, 2009).

In certain regions of the Earth's crust, stronger or weaker tremors, that is, earthquakes, occur very frequently and are usually short-lived. According to the most widely used definition, an earthquake is "any form of ground oscillation caused by natural factors" (Arabadži, Miljeničuk, 1998:19). Earthquakes are actually caused by the movement of tectonic plates, which generates waves capable of traveling enormous distances and manifesting on the Earth's surface. When these waves reach the surface, they can cause incredible destruction. Violent shaking may last for several minutes and often occurs in a series, leading to the destruction of buildings, bridges, and most other critical infrastructure facilities (Cvetković, Milojković, Stojković, 2014).

There is no more terrifying natural disaster than a powerful earthquake. According to statistical data, more than 9,000 earthquakes occur on Earth every year, of which around 115 are strong and about 110 are destructive. This means that, on average, an earthquake occurs somewhere in the world almost every hour. Fortunately, most of them are very weak and can only be detected by seismographs, which are sensitive even to the slightest vibrations of the Earth (Marković, 1956:22).

The modern era has brought an increase in challenges, risks, and threats, making it clear that it is impossible to protect everything at all times. For this reason, it became necessary to determine which infrastructures are critical, that is, of essential importance, and why. It is clear that critical infrastructure refers to those segments that are significant for human and national security. However, the changing perception of threats and the growing interdependence of different infrastructures have caused critical infrastructure to become broader in scope and more complex (Milosavljević, Vučinić, 2021).

Natural threats are most commonly understood as any negative climatic impacts, meteorological, geological, and geographical hazards, or more broadly, natural disasters. For example, the earthquake that struck Kobe, Japan, in 1995, which claimed a large number of lives and was the strongest in magnitude in the previous 1,200 years, caused severe damage to almost all critical infrastructures. Some were completely destroyed, while others became incapable of functioning. The main highway was heavily damaged,

which disabled road transportation, while the main port in Kobe (the largest port for import and export by water transport) was rendered inoperative. The chemical and steel industries suffered major losses and equipment damage, forcing them to suspend operations for a long period. Nuclear power plants within a radius of several hundred kilometers were shut down. Following the earthquake, fires broke out, destroying more than 150,000 buildings, while 300,000 people were left homeless. The economic loss resulting from this earthquake was estimated at 200 billion dollars (Holzer, 1995).

When it comes to the vulnerability of critical infrastructure to natural disasters, the strength or intensity of the event plays a crucial role. In general, high-intensity disasters have enormous potential to cause destructive consequences for people and their material assets, including critical infrastructure. Therefore, the greater the intensity of the disaster, the more likely the negative consequences for critical infrastructure become.

The consequences of natural disasters for critical infrastructure should also be considered from the perspective of the duration of the disaster. For example, a natural disaster may last only a few seconds (such as an earthquake or landslide), several hours or a day (as is often the case with hurricanes), several days (in the case of floods), or even several years (in the case of droughts). Accordingly, in addition to the intensity of the disaster, there is also a correlation between the duration of the disaster and its consequences. This is particularly devastating for older and already damaged infrastructures, which are unable to withstand negative impacts for extended periods of time (Cvetković, 2014).

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3. Banking System – role and function

Banks play a leading role in providing all types of financial services. The banking industry consists of thousands of private institutions, as well as state-owned institutions, and it has the greatest influence on the development of all other economic activities (Rose & Hudgins, 2005). The central bank is a state institution, or it operates under the supervision and influence of the state. It is responsible for the stability of the national currency, financial discipline, the control and regulation of money circulation, as well as the liquidity of the banking system, both domestically and in relation to foreign countries (Milojević, 2003).

3.1. Importance of the Banking System for the National Economy

The financial system plays a key role in resource allocation and holds a special place in the modern market economy. From an institutional perspective, the financial system includes financial organizations, primarily banks and non-bank financial intermediaries, which, by acting as financial intermediaries between economically surplus and deficit entities, collect and allocate financial resources. The existence of the financial system enables the creation of appropriate instruments and mechanisms for holding and safeguarding assets of entities and for organizing efficient payment transactions. By performing these functions, financial institutions influence the level of economic activity, lead to changes in the economic structure, contribute to increased employment, and so on (Golubović, 2016).

The importance of payment systems is manifested through their extremely significant role in every market economy. Payment systems are primarily seen as a vital component of the financial infrastructure of the economy, an essential channel for the successful management of the economy, particularly through monetary policy, and they are also important as a means of improving its efficiency (Rose, Hudgins, 2005).

The payment system affects the amount of money required. If the payment system in a country is inefficient and slow, this leads to an increase in demand for money, meaning that a larger amount of money is needed to carry out payments normally. The payment system also has a significant impact on a country's financial stability. If disruptions occur in the functioning of the payment system, this would cause a breakdown in the settlement of obligations among participants in the payment system (Sredojević et al., 2018).

4. Earthquake risk and banking system insurance

Today, all business entities operate in a highly dynamic economic system, which means that risk is always present and unavoidable. From a financial perspective, particularly in financial institutions, risk always represents the possibility of loss. Market changes, developments in banking and politics, as well as the global economic crisis that severely affected the banking sector in 2008, have led to increased attention on the impact of risk and ways to properly manage risks in the banking sector (Tadić, 2018).

Risk is the possibility of an adverse event occurring. It is understood as any possibility within a specific system that, with a certain probability, can cause an unexpected change in quality, or lead to a change or loss of the system. In this sense, it is necessary to undertake appropriate measures and

actions aimed at adequate risk management, including: preventive action, risk neutralization, reduction of negative effects of risk, transfer, and acceptance of risk depending on its form, duration, and intensity of manifestation (Keković et al., 2011).

In modern conditions of global business, banks face numerous risks that threaten individual banking operations, as well as the functioning of the entire banking system in cases of large-scale extraordinary events. Risks most commonly considered in the banking sector refer to the possibility of capital loss or loss in business performance, as well as a reduction in the bank's ability to achieve its goals and strengthen its business and financial position. Important determinants of risk are that it is possible, causes material damage, and is uncertain and random. Accordingly, two main groups of risks to which banks are exposed are distinguished (Matić, 2007):

- financial risks related to the bank's role as a financial intermediary (primarily liquidity risk, as well as credit risk, market risk, and interest rate risk);
- non-financial risks, which are not specific only to financial institutions and are the result of inadequate procedures, the human factor, as well as external factors.

Due to the potential losses that both types of risks may cause, the banking sector in every country must calculate and allocate the required capital as an optimal defense relative to aggregate exposure. In this regard, in addition to risk identification, monitoring, and control, exposure analysis is also very important. In other words, without measurement there is no adequate risk management (Matić, 2007).

It is therefore of crucial importance for the banking sector to investigate all risks arising from the environment as well as from its own operations, in order to determine the level of risk it can bear and control, and thus keep it within realistically acceptable limits. For this reason, bank management must identify, assess, and control risks. Preventing and eliminating high risks that may cause losses in the bank or lead to operational disruptions is one of the priorities of banking management. In other words, in order for a bank to successfully defend itself from challenges, risks, and threats, it must develop various defensive strategies (Jovanović, 2018).

For the successful functioning of society today, the operation of the financial system is essential. The financial system is considered a critical infrastructure system, and its interdependence with other critical infrastructures creates the need to establish adequate protection. Today, more than ever, a dynamic, proactive, and strategic approach is required in planning the pro-

tection of critical infrastructure in conditions of various types of crisis and emergency situations (Škero, Ateljević, 2015).

By maintaining its operational capacity, i.e., by ensuring normal functioning, the banking sector enables the functioning of the entire financial system in a country, thereby influencing economic growth. The United States experienced, albeit temporarily, the effects and consequences of the collapse and disruption of the banking sector in its daily financial system functioning when, on September 11, 2001, a tragedy struck the nation's leading financial center, New York. The destruction of the World Trade Center temporarily shut down all major financial operations of several leading banks and securities companies, creating uncertainty among thousands of investors regarding the time needed to recover their investments. This had a direct negative effect on economic activity, and a shortage of money circulation was felt in almost every sector (Rose, Hudgins, 2005).

For successful functioning, the banking sector must, among other things, manage various risks to which it is exposed. Traditionally, banks have focused mostly on financial risks (Matić, 2007). However, increasingly frequent natural disasters that disable numerous sectors introduce much more complex questions regarding risk management. Of all natural disasters, earthquakes have the potential to be the most destructive, both in terms of loss of life and material damage (Savić, 2019).

Natural disasters affect financial sector activities in various ways. They directly threaten or completely interrupt operations due to loss of life and destruction of facilities and equipment, and indirectly through their impact on transactions. After the catastrophic earthquake of March 11, 2011, with a magnitude of 9.0 on the Richter scale, almost all households, businesses, and companies in the Tohoku region of Japan experienced some form of material damage. A study conducted in Japan in 2012, one year after the catastrophic earthquake in the Tohoku region, showed that after the earthquake, companies primarily sought bank loans or requested the withdrawal of deposited funds in order to repair the damage they had suffered. The study confirmed that about 65% of companies in the Tohoku region suffered direct damage from the earthquake, while 35% suffered indirect damage because their suppliers, partners, or clients were affected. A large number of these companies stated that, after the earthquake, banks were their most important source of financing in order to resume normal operations as quickly as possible. Many companies submitted loan applications, and some requested the withdrawal of their deposits from their main banks. However, the banking sector did not have the capacity to finance a large number of clients, as it also suffered significant losses. Due to these financial constraints, companies were unable to resume normal operations within an optimal timeframe, investment financ-

ing declined, and export volumes decreased significantly. The economic consequences were felt throughout almost the entire country (Miyakawa, 2014).

4.1. Possibility of earthquake insurance in the banking sector

According to the broadest definition: "insurance is an institution, i.e. an insurance company, that compensates damage to economic entities and individuals caused by the action of destructive natural forces or accidents" (Stojanović, Krstić, Janjić-Baduli, 2016:143). It is therefore a matter of risk transfer, i.e. potential loss, from the insured to the insurer, and the agreement itself is defined by an insurance contract. In this way, individuals, companies, and organizations transfer certain risks to an insurance company by paying an insurance premium. In the event of an insured event occurring, the insurance company pays the insured sum to the insured party (Taylor, 2012).

Today, insurance is a highly developed service activity that protects individuals, economic entities, and their property from the consequences and effects of numerous risks. The main function of insurance is security, that is, the creation of a situation of safety for both natural and legal persons exposed to certain types of danger that may cause damage. Insurance is, in this sense, a form of protection, and today it can also be considered an economic necessity for anyone concerned with safety in both business and everyday life and work (Stojanović, Krstić, Janjić-Baduli, 2016).

In western economies, insurance is the primary method of mitigating possible financial losses caused by unwanted events. In most cases, insurance does not directly reduce the causes themselves, as, for example, flood prevention plans do. Its role is to compensate the insured for financial damage once the negative effects of the insured risk have occurred. Risks of natural disasters cause tens of thousands of victims annually and damage measured in tens of billions of dollars each year. Insurance against natural disasters has been available for many years, and the first insurance payouts related to natural disaster risk were made in 1906 after the San Francisco earthquake. At that time, the insurance company "Lloyd's," based in the United Kingdom and also the first established insurance company, was ordered to pay the full amount of damages to all insured parties. The San Francisco earthquake claimed 3,000 lives and caused multimillion-dollar damage and is still considered one of the deadliest natural disasters to have struck California. This payment of insured sums created long-term trust in the insurance market and insurance companies as providers of catastrophe coverage (Taylor, 2012).

Earthquakes, as natural disasters, have the potential to cause enormous losses. Infrastructure worldwide is vulnerable to collapse or damage in the event of seismic activity, resulting in human casualties and major economic losses. Numerous studies and experience have clearly shown that building collapse is the main cause of deaths and injuries, as well as the primary driver of economic damage. As early as the beginning of the 20th century, more developed countries began designing earthquake-resistant structures. However, most residential and commercial buildings were constructed before seismic design standards were introduced, and in many less developed countries construction is still carried out without adequate seismic assessment (Zhang et al., 2021).

In the banking sector, besides financial risks to which it is most exposed and which it primarily insures against, it also recognizes pure risk and cumulative risk. In banking operations, pure risk refers to uncertainty and consequences of unforeseen and independent harmful events (such as destruction of buildings or property due to natural forces like floods, earthquakes, etc.). Cumulative risk (risk accumulation or catastrophic risk) refers to the accumulation of losses caused by a single unwanted event such as an earthquake, flood, storm, etc. (Stojanović, Krstić, Janjić-Baduli, 2016).

Insurance against natural disasters may cover a single peril (one type of natural disaster) or multiple perils. Such insurance is usually concluded as additional coverage. In other words, in addition to other types of property insurance, the insured also concludes a contract for protection against specific natural disasters as supplementary insurance. Through such "insurance packages," insurers aim to avoid adverse risk selection, and only clients located in high-risk areas would purchase insurance. Insurance against natural disasters may be voluntary or mandatory. Voluntary insurance is chosen by those aware of risks and their consequences. Legal entities that properly manage risks should include such insurance in their risk management strategies. Mandatory insurance, on the other hand, is prescribed by law and aims to reduce pressure on the state budget after disasters (Doganjić, Paunović, 2021:47).

In China, authorities have raised the issue of mandatory earthquake insurance in the banking sector. Earthquakes frequently occur across China and can cause severe material damage. Banks and other enterprises are exposed to significant losses in such events. Risks in the banking sector include damage to assets and the risk of business interruption and credit risk. The Chinese government has recognized that banks lack adequate tools for managing catastrophic risks such as major earthquakes. Therefore, mandatory earthquake insurance has been identified as a potential protective mechanism for risk management in the banking sector (Xing, 2018).

In addition to natural disaster insurance, business interruption insurance is also an important form of protection in the banking sector. Emergency events can disrupt organizational functioning at any time, and organizations must be able to respond and resume operations as quickly as possible (Stojanović, Krstić, Janjić-Baduli, 2016). Business interruption insurance aims to cover losses when an insured event occurs (such as fire, infrastructure failure, or natural disasters like floods and earthquakes). Damage to property and equipment affects not only assets but the entire functioning of a legal entity. After major events such as earthquakes, fires, or pandemics, the issue arises of how to maintain business continuity. Business interruption leads to temporary cessation of operations, while costs remain but revenue stops. This can result in greater losses than the physical damage itself. Such insurance compensates for lost profit and fixed operating costs during the interruption period (Belanić, Baretić, 2021).

5. Vulnerability of the banking sector of the Republic of Serbia to earthquakes

In developing countries, such as Serbia, governmental organizations and a large part of critical infrastructure are most often located in large cities, which are usually also the most densely populated. In this sense, major damage to critical infrastructure systems in such cities would have a significant negative impact at the national level. For this reason, it is necessary to set priorities for protection and recovery (in the event of risk occurrence). It is important to define the difference between the vulnerability of critical infrastructure and the vulnerability of its individual parts (sectors). In this context, earthquake protection measures and adequate risk management are of crucial importance, because infrastructure with minimal to moderate earthquake damage may continue to function or, in the worst case, suspend the operation of certain parts for a short period. On the other hand, critical infrastructure with severe damage will not only be unable to function but will also endanger the operation of other critical infrastructure sectors whose functioning is essential, especially in emergency situations such as earthquakes (Manić, Lukić, Prokić, 2013).

It is well known that the functioning of the economy today cannot be imagined without banks and other financial institutions. Banks, as intermediaries in financial transactions, issue various financial instruments that are further allocated into appropriate investments. In this way, banks influence the level of economic activity, employment levels, and overall economic stability (Golubović, 2016). In the Republic of Serbia, financial and

banking systems are recognized as critical infrastructure, whose disruption or interruption would have negative effects on the functioning of the state. The interdependence of critical infrastructures is even more pronounced in smaller countries and transition economies. The functioning of such sectors becomes even more important in emergency situations. Issues of protecting such systems from operational disruptions are a priority in natural disaster risk management (Škero, Ateljević, 2015).

In the Republic of Serbia, a legal entity develops its own risk management plan after identifying and assessing the risks to which it is exposed. Insurance against natural disasters for legal entities in Serbia is still voluntary. The majority of banks manage risks by taking into account the characteristics of the specific environment in which they operate (political, economic, geographical factors, climate conditions, population, etc.).

Although Serbia is not considered a highly seismic area, meaning that large-scale seismic hazards are not expected, the risk is still present. Many risks cannot be prevented, but through adequate management and protection measures, their consequences can be minimized. Recent history shows that natural disasters such as earthquakes, storms, and floods frequently occur even in areas that are not considered high-risk (Radovanović, 2018).

6. Conclusion

In developed economies, the banking sector is defined as critical infrastructure. Alongside energy, transport, healthcare, food production and distribution, and water supply, the banking sector is essential for the normal functioning of society. The disruption of any of these sectors would endanger the operation of others and produce significant negative effects on the functioning of society, ultimately manifesting as a threat to national security (Škero, Ateljević, 2015).

A large number of natural disasters worldwide, as well as their negative effects, have demonstrated the importance of critical infrastructure, i.e. the extent of additional consequences that their damage or destruction can cause. Since critical infrastructure systems are necessary in almost all countries for normal functioning, and their importance increases even further in times of crisis, the protection of these sectors is imposed as an obligation in all states.The banking sector holds a special place in national economies, and its functioning is not possible without banks as financial intermediaries. For this reason, banking operations must be protected from all forms of threats, both external and internal (Rose, Hudgins, 2005).

War has long ceased to be the dominant security threat, and its place has been taken by natural disasters, terrorist attacks, pandemics, and cyberattacks. All these new types of risks undermine security and threaten citizens, economic entities, the state, and even entire regions. In recent decades, natural disasters have taken a particularly important place among security threats. Earthquakes, among all natural disasters, cause the highest number of fatalities and the greatest material damage (Đorđević, 2018).

Numerous devastating earthquakes around the world have caused the deaths of a large number of people, inflicted enormous material damage, disabled critical sectors, and in some cases led to consequences from which communities have been recovering for years. Earthquake risks are ubiquitous, even in countries that are not considered highly seismic regions. Given the impossibility of predicting them, great emphasis is placed on adequate earthquake risk management. Numerous experiences following natural disasters, including earthquakes, have shown that recovery and the restoration of normal functioning in all sectors depend on previously implemented protective measures. In order to minimize the consequences of earthquakes and reduce their impact on business continuity, economic entities must manage earthquake risks.

In the banking sector, this primarily involves risk identification and assessment, followed by the adoption of plans and strategies. Above all, risk understanding is necessary. The banking sector, especially in seismically active areas, should consider earthquake risks as primary risks, immediately after financial risks. In earthquake risk management, it must be taken into account that such events cannot be predicted, meaning there is no optimal time for preparation before the occurrence of an unwanted event. For this reason, it is crucial to establish the most effective course of action during the occurrence of an earthquake (Đorđević, 2018).

Protective measures play a significant role. Most buildings in almost all countries were designed before seismic resistance standards were introduced. Today, older buildings can be reinforced using special seismic insulation and similar techniques, while new buildings must be designed in accordance with standards appropriate to their seismic zone.

The banking sector must also take into account that, after the occurrence of negative effects of earthquakes, the majority of enterprises, companies, and individuals turn to banks for assistance in the form of credit and similar financial support. The normal functioning of the banking sector during and after a disaster is of great importance for the re-establishment of normal economic activity (Stojanović, Krstić, Janjić-Baduli, 2016).

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Application of Location-Based Services as Part of an Integrated Natural Disaster Risk Management System

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Abstract

This paper examines the role of location-based services within the framework of integrated natural disaster risk management, with a particular focus on their application in the telecommunication and geospatial guidance and tracking of fire-rescue units, specialized civil protection units, and the civilian population in crisis situations. Integrated natural disaster risk management is intrinsically linked to the availability of geospatial information, which suggests that such information should be regarded and utilized as a decision-support resource — both within integrated risk management systems and at the individual level, in the context of directional guidance and self-evacuation. The fundamental premise advanced in this paper is that technical and technological infrastructures — specifically, platforms supporting location-based services that are publicly available and widely adopted — can serve as a source of relevant orientation and navigation information, playing a significant role in integrated natural disaster risk management by providing users with access to pre-standardized geospatial data, such as

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geospatial zones affected by natural disasters, evacuation routes, and checkpoints, in appropriate formats. The objective of this paper is to provide a scientific description of the possibilities for the active integration of LBS, primarily for professional purposes through current platforms, as well as through alternative commercial solutions, and to explore the potential for incorporating the civilian population into the integrated natural disaster risk management system by utilizing location-based services as a tool for crowdsourcing and the dissemination of personalized alerts. To this end, the methodological approach is based on content analysis of existing literature on location-based services and natural disaster risk management, as well as on the conceptual synthesis of geospatial and information models. The results indicate that such integration of location-based systems can contribute to enhanced collective and individual situational awareness, improve the monitoring and communication processes of professional personnel within the integrated risk management system, as well as of the civilian population in geospatial areas subject to risk — thereby creating conditions for more effective and efficient resource allocation in order to maximize operational outcomes.

Keywords

Location-based services; geospatial information; integration; tracking; civilian population guidance; resource allocation

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1. Introduction

Given that this paper addresses location-based services (LBS) within a specific context, namely, the application of LBS in integrated natural disaster risk management systems it is important to define the relevant terms and clarify that the subject matter pertains to Automatic Vehicle Location (AVL) systems and personnel tracking, specifically applied to fire-rescue units and specialized civil protection units. The essence of this application lies in the continuous and permanent monitoring of units based on real-time geospatial information, delivered through appropriate technical and technological solutions designed for this purpose.

The practical value and significance of LBS is reflected precisely in its capacity to provide geospatial information, which in turn enables adequate coordination of activities, resource allocation, and informed decision-making within the integrated natural disaster risk management system, thereby underscoring the importance of LBS implementation in this context. LBS represents an applied domain of Global Navigation Satellite System (GNSS)

technology, augmented by geoinformation and telecommunication technologies, whose practical utility lies in decision support through the provision of high accuracy positional data (2–5 metres) on personnel and vehicles in real time (Milojković et al., 2014).

For the purposes of this paper, LBS will be examined from the general to the specific — that is, through its constituent elements followed by a discussion of the hardware components and the user interface. The research objective is to highlight the significance of LBS implementation, examine current solutions and system limitations, and substantiate the premise that the application of LBS in integrated natural disaster risk management constitutes a constitutive element of the system that, in accordance with advances in technical and technological capabilities, offers new modalities of application. In support of this, it is necessary to describe the system architecture (Figure 1).

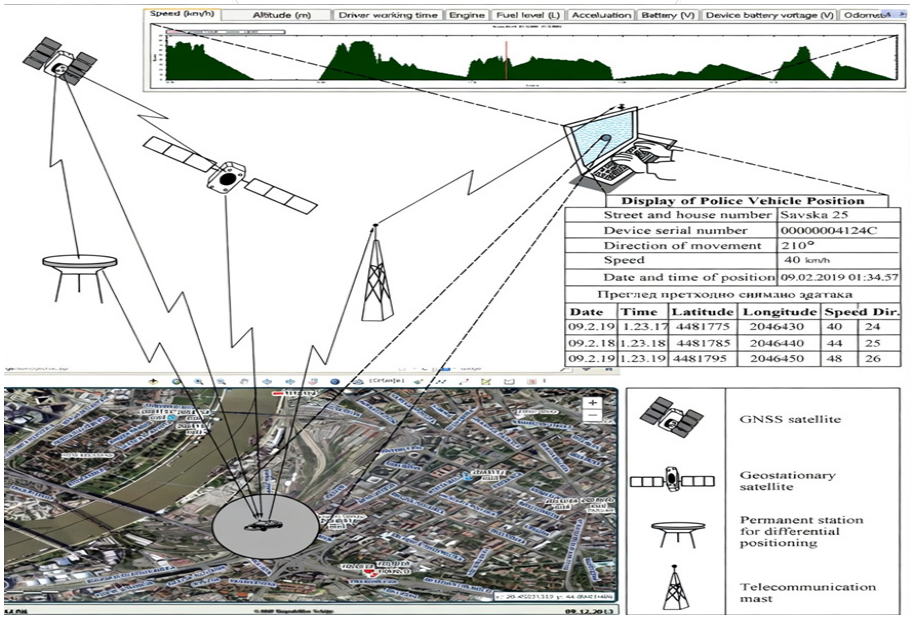


Figure 1. *Architecture of the LBS system* (Adapted by the author)

As previously noted, LBS is an applied domain of GNSS, which consists of satellites positioned at approximately 19,000 to 23,000 kilometres in Medium Earth Orbit (MEO). The most widely known and adopted GNSS systems are GPS (USA), GLONASS (Russia), Galileo (Europe), and BeiDou (China) (Kaplan & Hegarty, 2017). The fundamental principle is based on the method of trilateration, that is, the use of satellites as reference points for determining a position in geospace. This theoretically requires three satellites, though in practice four are needed to obtain data on coordinates and altitude.

It is also important to mention geostationary satellites, which are located at approximately 36,000 kilometres in Geostationary Earth Orbit (GEO). Although they appear fixed above a single point as observed from Earth's surface, they in fact travel at a velocity equal to the Earth's rotational speed. Their role within the Satellite Based Augmentation System (SBAS) is to enhance precision and availability at the local level within systems covering a defined geospatial area (WAAS for the USA, EGNOS for Europe, SDCM, BDSBAS, and others for Asia, etc.).

Furthermore, and of equal importance, is the Differential GNSS (DGNSS) ground station. Located on the Earth's surface, its primary function is to compare a calculated position against a precisely known ground position, thereby improving accuracy and correcting potential errors. As noted above, the communication element — that is, the communication infrastructure responsible for transmitting geoinformation data obtained through the aforementioned methods constitutes another essential component of the overall system architecture. Recent research in the context of LBS communication has introduced Low Earth Orbit (LEO) satellite networks as an alternative or complementary solution to existing approaches, a topic that will also be addressed in a subsequent section of this paper.

Additionally, the user interface must be adapted to real operational needs in order to facilitate purposeful integration. This requires a structured approach to the presentation of data, with particular attention to the graphical load imposed on the selected geotopographic material on which the data are displayed. In the context of research on the application of LBS in natural disaster risk management, it is necessary to address questions concerning technical characteristics, advantages, and the practical limitations and trade-offs among the various implementation options that LBS affords.

Given the aforementioned components of handheld and vehicle-mounted receivers, it is important to consider various aspects of use in order to arrive at an optimal conclusion regarding the application of LBS within integrated natural disaster risk management systems. GNSS receivers used in these systems are divided into vehicle-mounted units (integrated into a Mobile Logic Unit; MLU) and handheld (personal) units. The MLU is capable of providing a wide range of data, including fuel consumption, total operating time, fuel tank level, and other parameters. Several researchers have highlighted the requirements placed on vehicle-mounted receivers in terms of construction, arguing that such receivers must demonstrate high resistance to vibrations, temperature fluctuations, and electromagnetic interference, along with stable power supply and integration with vehicle sensors (Portillo, 2008). Handheld receivers, intended for members of fire-rescue units and specialized civil protection units engaged in rescue operations, must be

compact, lightweight, and energy-optimized to ensure sustained field operation (Lee et al., 2022).

Since the spatial scope of this paper and of the LBS application itself pertains to the territory of the Republic of Serbia, it is important to note the TETRA system (Terrestrial Trunked Radio), which is in active operational use within the integrated natural disaster risk management system to meet communication requirements, where trunking refers to the use of a reduced number of channels to serve a large number of users (Vratonjić, 2010). With regard to LBS in the Republic of Serbia, the AVL system operating over a conventional radio network consists of equipment installed in vehicles or carried by personnel, as well as equipment located at the dispatch centre.

From the perspective of straightforward implementation and low material resource expenditure, one of the most viable solutions for the needs of the Ministry of Internal Affairs of the Republic of Serbia is the TETRA system, used in conjunction with the Portable TETRA AVL application, an appropriate software solution developed by practitioners within the Ministry of Internal Affairs of the Republic of Serbia. Its primary function is the display of positions and monitoring of movement on selected geotopographic material, necessarily in digital format, thereby fulfilling the requirement for a functional user interface. The development of the Portable TETRA AVL software application encompassed several phases, including the elaboration of a conceptual design, development of the technical solution, its realisation, system implementation, and subsequent functional testing.

Handheld and vehicle-mounted TETRA radio station models feature integrated GNSS receivers, thus eliminating the need for additional external positioning devices. The recorded coordinates are then transmitted wirelessly via an RS-232 connection to the operations centre in the form of Short Data Service (SDS) messages. Upon receipt, the coordinates are converted and processed using the Portable TETRA AVL software application, enabling the display of positions and the tracking of vehicle and personnel movement on digital geotopographic maps of the relevant area. In this way, the dispatcher at the operations centre is able to monitor the disposition and movement of personnel and vehicles in real time and, in accordance with operational needs, to direct and regroup them effectively and efficiently (Milojković et al., 2014).

In 2019, a study was conducted on TETRA SDS performance and positioning accuracy. The system offers multiple communication modes over the TETRA network operating in trunked mode, including intra-cell communication, where the calling and responding terminals are within the same base station, inter-cell communication, where terminals are served by different base stations, as well as stationary and mobile real-use scenarios. Two

field experiments simulating real rescue operations were conducted, and the results clearly indicate that SDS service performance in terms of message transmission delay depends on the size of the transmitted data packet. In addition to the data transmission component, the authors also analysed the accuracy of the GPS receivers integrated into TETRA handheld radio stations. Field measurements revealed that positioning accuracy is limited, particularly in comparison with modern smartphones, which employ more advanced GNSS chipsets and support for a greater number of satellite systems (Umlauft & Raffelsberger, 2019).

To place these technical findings in context, it is important to consider the actual operational requirements as well as the capabilities offered by current systems along their development trajectory. In order to meet practical needs and demands, ETSI is developing TEDS, essentially an enhanced version of TETRA, known as TETRA Release 2, which represents an improvement, though not an optimal solution. Considering current capabilities and contemporary requirements, and given that data transmission in these systems is measured in kilobytes, the use of TETRA in combination with LTE offers significant advantages: with data transfer rates exceeding 50 megabytes per second, it enables rapid delivery of photographs and video calls, which in the context of integrated natural disaster risk management can be of considerable operational value (Esmaeilifar, 2025).

Beyond advances in hardware, it is important to note progress in software platforms, as these constitute an integral component of the system that consolidates all information in a single operational environment. Having addressed the Portable TETRA AVL system in the context of rapid-response force tracking, it should be noted that such platforms can also serve other purposes of critical importance. For instance, during the 2010 Haiti earthquake, platforms such as Ushahidi, CrisisCamp Haiti, OpenStreetMap, and GeoCommons were used for crowdsourcing, that is, for obtaining information from the civilian population on a voluntary basis, which significantly supported and facilitated the functioning of the integrated natural disaster risk management system by providing relevant and timely geoinformation that enabled a realistic operational picture of conditions on the ground (Zook et al., 2010).

On the other hand, two-way communication is also possible through personalized messages, which can be tailored according to defined parameters and delivered to a targeted number of individuals, a measure that may contribute to, and to a degree relieve the operational burden on, fire-rescue units and specialized civil protection units by reducing the number of disaster-affected civilians through timely risk notification (Chan, 2023). In such situations, the content of the message plays a significant role in enhancing

self-evacuation capacity and raising the individual's situational awareness. In addition to content, the form of the notification delivered to the civilian population is equally important (Carlson, 2024).

Accordingly, the potential applications of LBS are broad and numerous; however, certain limiting factors exist, including the destruction of infrastructure in geospatial areas affected by natural disasters, which fundamentally highlights the necessity of identifying one or more alternatives with respect to LBS. In recent research, satellite communication via Low Earth Orbit (LEO) satellites — positioned at altitudes of 160–180 to 2,000 kilometres has become an increasingly prominent topic. Although 160–180 kilometres represents an approximate minimum threshold, most LEO constellations orbit at altitudes of at least 500 kilometres. Satellites operating below 500 kilometres are referred to in the literature as Very Low Earth Orbit (VLEO) satellites, a distinction that is partly conditioned by the fact that at altitudes below 500 kilometres, stronger and continuous propulsion is required. LEO satellites are primarily employed for telecommunication purposes, where their principal advantages over traditional geostationary satellites in terms of implementation include potentially lower costs, lower latency, and higher bandwidth (McMahon, 2025).

2. Methods

This paper presents a qualitative study grounded in the theoretical content analysis of relevant scientific and professional literature, descriptive and exploratory in character, directed towards an assessment of the capabilities of current technical and technological solutions in the domain of location-based services, as well as alternative solutions and prevailing research directions. All of the above pertains to the possibilities for applying LBS within integrated natural disaster risk management systems, along with an examination of the potential for implementing certain alternative, widely available solutions.

Content analysis of secondary data sources and deductive reasoning enable the interpretation of relevant scientific knowledge with the aim of better understanding and presenting the solutions currently in use within the Ministry of Internal Affairs, the possibilities for their upgrade, as well as the implementation of new, alternative solutions. The research was conducted in accordance with the methodological standards applicable to the study of security phenomena, examined through the lens of geoinformation technologies with a focus on LBS. The analysis of available literature was carried

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out through qualitative content analysis, which required the identification of relevant literature, the selection of sources based on scientific reliability and thematic relevance to this study, the comparison of specific technical and technological solutions and architectures described in the paper, as well as the extraction of key elements pertinent to LBS.

3. Results

The results of the content analysis indicate that, although TETRA devices can provide basic user location information, limitations in the quality of integrated GNSS receivers and the lower frequency of position updates may lead to significant positional deviations relative to reference devices. Despite the high reliability and security of the TETRA system, which continues to justify its place within integrated natural disaster risk management systems, its data transmission and positioning capabilities remain considerably limited. For this reason, contemporary systems are increasingly considering the integration of TETRA networks with broadband communication technologies, such as LTE or 5G networks, which enable higher data transfer rates and more precise user positioning (Umlauft & Raffelsberger, 2019). An additional limitation of the TETRA system is the fact that the geospatial territory of the Republic of Serbia is not fully covered by the network signal (Milojković et al., 2015). Furthermore, focusing on the relationship between message transmission intervals and message loss rates, it has been established that the message loss rate is largely negligible when messages are sent at intervals of 1.5 to 2 seconds, whereas at a shorter transmission interval of 1 second and a message size of 190 bytes, the message loss rate can reach approximately 1.6% (Esmaeilifar, 2025). TETRA is designed for use on land, as well as on bodies of water, including rivers, lakes, and at sea at distances of up to several tens of kilometres from the shore and in the air at lower altitudes, which for helicopters means up to 4,000 metres, as well as for vehicles operating at limited speeds. Among its noted advantages is Direct Mode Operation (DMO), which enables communication between two terminals without the use of network infrastructure, although the effective range of DMO is largely conditioned by geospatial factors. In open terrain, it can enable communication between terminals at distances of up to 5 kilometres; however, the range is substantially determined by the terrain profile and its configuration. The construction requirements for MLU and handheld terminals were previously addressed; however, when considering the AVL and personnel tracking system, it must also satisfy specific functional requirements. These primarily relate to the ability to display the precise position of a vehicle on selected digital geotopographic material, the provision of a panic button that is readily accessible for sending an emergency message in any situation involving

threat or danger, and the capacity for efficient alerting in cases of vehicle theft, zone boundary violations, and similar events. In addition, the system must transmit other vehicle data to the control centre, such as low engine oil levels, excessive speed, odometer readings, and related parameters. It is further necessary that the control centre be able to issue commands to the vehicle enabling it to be immobilised through fuel cut-off or similar mechanisms. The system must also support the exchange of short messages between the vehicle and the centre, as well as comprehensive vehicle movement analysis, encompassing location and duration of stops, deviations from assigned routes or designated zones, data on road segments where speed limits were exceeded, and other relevant parameters (Milojković et al., 2014).

In the context of the aforementioned vehicle movement analysis, it should be noted that the individual responsible for fleet monitoring must have the capability to track all vehicles in a fleet on selected digital geotopographic material, while also being able to utilize textual, graphical, and tabular reports to facilitate the most comprehensive analysis possible, both at the fleet level and for each individual vehicle separately. In practice, such capabilities exist and are in commercial use, fulfilling a portion of the aforementioned requirements. In addition to the capabilities already described, the telecommunication modem can also be used for voice communication and messaging with the driver. Beyond basic parameters (speed, heading, acceleration, battery voltage, ignition status, odometer reading), the system can monitor a wide range of additional telemetry parameters, including fuel level and consumption, door open/close events, engine RPM, hydraulic system operation, cargo compartment and coolant temperature, the presence of co-drivers and passengers, and other relevant data (Vojinović, 2012).

With regard to satellites, in addition to the advantages and limitations of deployment in the aforementioned orbits, recent research indicates that beyond the capabilities widely known to the general public, there exists the possibility of employing algorithms that enable the detection of flooding, even under conditions of significant cloud cover, using limited computational resources aboard small satellites. In this approach, rather than transmitting large volumes of raw imagery, the algorithm autonomously generates a flood mask of the affected area, substantially reducing the volume of data that must be transmitted (Mateo-Garcia et al., 2021). From a telecommunication and real-time positioning standpoint, LEO satellites offer advantages that derive, among other factors, from their considerably closer proximity to the Earth's surface. As a result, the signal propagation path is shorter and there is less opportunity for interference in signal transmission. Furthermore, LEO satellites travel at higher orbital velocities, which means that the observation angle continuously changes, thereby enabling more complete and precise determination of the user's position (Foreman-Campins et al., 2025).

4. Discussion

This paper analyses the findings of research on the application of LBS within integrated natural disaster risk management systems. The primary subject of analysis is the LBS platforms currently in active operational use in the Republic of Serbia and beyond, namely, TETRA. The research findings unequivocally indicate that this system remains in active use principally due to the balance it offers between meeting basic positioning and telecommunication requirements on the one hand, and operational efficiency with respect to material and technical resources on the other. Taking into account the significance of integrated disaster risk management as a mechanism for the protection of the population, the environment, and material assets, the author holds that it is insufficient to merely strive towards satisfying minimum requirements.

The results point to the need to combine TETRA with newer LTE/5G technologies. This direction is well justified, particularly given that it is unacceptable for technical and technological solutions in widespread civilian everyday use to feature more capable integrated GNSS receivers and faster geoinformation transmission capabilities. There is little reason to limit development to the strictly necessary, especially when certain authors have noted the possibility of integrating additional sensors, in the context of personally issued equipment, enabling the monitoring of health and other physiological parameters (Lee et al., 2022). In this regard, it is important to consider the use of commercial alternative solutions in the domain of LBS, as well as the development of structural solutions modelled on such alternatives, taking into account real operational geoinformation and telecommunication needs. In the context of such solutions, Garmin may be cited as a provider offering several relevant capabilities. Although this research primarily concerns the tracking of personnel and vehicles, a similar principle can be applied to search-and-rescue dogs, where collar-integrated GNSS receivers enable real-time positional tracking of the animals, along with the display of the handler's own position. With regard to satellite communication, the inReach technology merits mention, as it leverages the Iridium LEO satellite constellation to enable two-way text communication and SOS transmission with coordinate display, that is, real-time positioning data, all within a highly compact form factor, thereby fully satisfying the previously stated requirements for portability and minimal device dimensions. Although it does not fulfil all functional requirements, the implementation of this technology may serve as a useful alternative. Other, denser satellite constellations also exist, such as Starlink, whose advantages relate primarily to high-speed satellite internet with data transfer rates reaching up to 400 megabytes per second. Although at the time of writing this paper the Starlink service is not available for the

territory of the Republic of Serbia, it is important to highlight the potential offered by satellite constellations, as the telecommunication component is severely limited without such access — being contingent upon the survival of ground-based infrastructure. In the context of this paper, with regard to two-way communication with the civilian population, in addition to the standardized alerts that are transmitted, consideration should be given to the possibility of planning and delivering personalized navigation routes. This does not imply that the routes included alongside the textual component of the notification should themselves be standardized; rather, the relevant file should be converted into an appropriate format to accompany the textual notification. In terms of content, such a file should contain predefined checkpoints, with navigation to those checkpoints facilitated through one of the widely available commercial navigation services.

This research also has certain limitations. First and foremost, the security aspects of integrating the aforementioned technologies have not been fully addressed. Furthermore, the material and technical component has not been taken into account, nor has the time required for implementation — which includes, among other elements, planning, procurement, the availability of financial resources for the undertaking, equipping, the allocation of training resources in terms of both time and personnel, system-wide optimisation, and related considerations. These matters should be addressed in future research, with a view to the continuous improvement of LBS and its application within integrated natural disaster risk management systems.

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5. Conclusions

The Location-based services are not merely a navigational tool; they enable the real-time tracking of personnel and vehicles, thereby fulfilling, among other functions, a decision-support role. LBS is today widely accessible and is employed across the majority of mass-market platforms. Its significance lies in the availability of geospatial information, which is of considerable importance — a fact reflected in the broad integration of LBS into widely available technical and technological devices, with particular relevance to contemporary integrated natural disaster risk management. In light of the exponential development of technical and technological platforms and telecommunication infrastructure, the implementation of LBS is necessary in order to enhance both the efficiency and effectiveness of operations across all fields of security.

It is essential to continue with the implementation and integration of new scientific solutions alongside existing ones, in the interest of the continuous

improvement of integrated natural disaster risk management systems and the maximisation of their operational capabilities. There is a clear need to meet the highest standards with respect to LBS, given that natural disasters demand the pursuit of the highest standards in the execution of necessary actions — an objective that is difficult to achieve without modern technical and technological platforms for LBS deployment. Naturally, real limiting factors exist, pertaining to personnel and material constraints. It is necessary either to find means of overcoming these limitations, or to continuously seek a balance between meeting genuine operational needs and minimising the margin for error, which, in the context of this paper, refers to the existence of geospatial areas lacking signal coverage, thereby precluding positioning and communication with fire-rescue units, specialised civil protection units, and the civilian population, who may frequently serve as a source of relevant geospatial information and who are often the subject of rescue operations in the event of natural disaster manifestations.

The paper has also addressed the context of commercial navigation and telecommunication solutions. The key point is that certain limitations exist in this domain as well, and these must be duly acknowledged; however, the very fact that a solution to a given problem exists and is commercially available should serve as a positive and motivating factor in overcoming the barriers to the implementation of such a solution within an integrated natural disaster risk management system.

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Review article

The Role of the Media in Shaping the Perception of Terrorism

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Abstract

The paper analyzes the role of the media in shaping public opinion on terrorism in contemporary society, with a particular focus on how media reporting contributes to the construction of risk, fear, and moral panic. Starting from the theoretical framework of the risk society, based on the works of Ulrich Beck, Anthony Giddens and Zygmunt Bauman, the paper examines how terrorism is transformed through media representations from a security phenomenon into a permanent social problem and a symbol of a constant threat. Special attention is paid to the analysis of media mechanisms such as sensationalism, framing, and agenda-setting, which are selectively highlighted and interpreted in relation to certain events, thereby influencing perceptions of insecurity and legitimizing restrictive security policies. The paper also points to the importance of cultivation theory, emphasizing that long-term exposure to violent content contributes to the normalization of fear and a sense of permanent vulnerability. The paper analyzes the role of the media in shaping public opinion on terrorism in contemporary society, with a particular focus on how media reporting contributes to the construction of risk, fear, and moral panic. Starting from the

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theoretical framework of the risk society, based on the works of Ulrich Beck, Anthony Giddens and Zygmunt Bauman, the paper considers how terrorism, through media representations, is transformed from a security phenomenon into a permanent social problem and a symbol of constant threat. Special attention is paid to the analysis of media mechanisms such as sensationalism, framing, and agenda-setting, through which certain events are selectively highlighted and interpreted, thereby influencing perceptions of insecurity and legitimizing restrictive security policies. The paper also points to the importance of cultivation theory, emphasizing that long-term exposure to violent content contributes to the normalization of fear and a sense of permanent vulnerability.

Keywords

Media, terrorism, risk society, public opinion, moral panic, culture of fear, security, media reporting.

1. Introduction

In modern society, the media are among the most important factors shaping public opinion, social attitudes, and risk perception. The development of mass and digital media has enabled the rapid dissemination of information but has also changed the way individuals experience social threats, insecurity, and violence. Among the phenomena that occupy a special place in the modern media space, terrorism stands out, with its media representation going beyond mere information to become an important social and political factor.

Although most citizens have no direct experience with terrorist attacks, the perception of terrorism is largely shaped through media discourse. Continuous reporting on violent events, dramatization of content, and intense visual presentation of terrorist acts contribute to the creation of a sense of insecurity and social anxiety. In this way, the media not only influence the public's awareness but also shape a collective sense of fear, risk perception, and attitudes towards security policies.

The modern media system is characterized by the speed of information flow, market competition, and the need to attract the audience's attention, which is why violent and dramatic events often take center stage in the public space. In such circumstances, terrorism becomes not only a security prob-

lem, but also a media-constructed social phenomenon that influences political decisions, public reactions and the everyday sense of security of citizens.

A particularly important issue relates to the way in which the media, through sensationalism, framing and agenda-setting, shape the perception of terrorism and contribute to the creation of moral panic and a culture of fear. Long-term exposure to violent content can lead to the normalization of the feeling of permanent vulnerability, making fear an integral part of modern social life.

Starting with the importance of the media in modern society, the paper analyzes their role in shaping perceptions of terrorism, with particular attention to the mechanisms of media representation of violence, the construction of social risk, and the consequences of such reporting for public opinion and security policies.

2. Methods

The paper is based on a qualitative analysis of relevant domestic and foreign literature across sociology, media studies, criminology, and security studies. The research employed a theoretical-analytical method to examine the role of the media in shaping perceptions of terrorism and the social sense of fear in contemporary society.

The analysis relies on an interdisciplinary approach that connects theories of risk society, theories of media effects and contemporary approaches to the study of terrorism. Special attention is paid to the theoretical concepts of Ulrich Beck, Anthony Giddens and Zygmunt Bauman, as well as the theories of agenda-setting, framing, cultivation and moral panic.

The methodological approach of the paper is based on the interpretation of scientific literature, the analysis of the theoretical positions of relevant authors, and the comparative consideration of different approaches to the relationship between media and terrorism. The research aims to determine how the media influence the construction of perceptions of risk, insecurity, and fear, and how these perceptions, in turn, influence public opinion and contemporary security policies.

The data analysis was conducted through an interpretative and comparative approach. After collecting the literature, a selection of relevant theoretical positions and a classification of key topics related to the media representation of terrorism were made.

The analysis process included identifying dominant patterns in the scientific literature, comparing different theoretical approaches, and interpreting

their significance for understanding the contemporary relationship between media and terrorism. A special focus was placed on how the media influence the perception of risk, the construction of social fear, and the legitimization of restrictive security policies.

The findings obtained were interpreted within the framework of the theoretical concepts of risk society, reflexive modernity, culture of fear, and moral panic to enable a comprehensive understanding of the phenomenon under analysis.

3. Discussion

3.1. The role of the media in modern society

The ubiquitous and widely accepted view that the media significantly influence the formation of public opinion is rarely questioned; that is, few people question it. For this reason, in the context of the topic of the relationship between journalism and the formation of public opinion, the very concepts of public and public opinion should first be defined.

In sociology, numerous theories of the public have been developed, among which the two most important are the democratic and utilitarian conceptions. The most prominent representative of the democratic approach is Jürgen Habermas, a German philosopher and sociologist who defines the public as a space where citizens, through reasoned discussion, can question authorities and imposed truths. This understanding of the public develops within the framework of modern society, where critical thinking is a key factor in shaping public opinion. At the same time, the mass media play an ambivalent role - on the one hand, they enable the spread of different attitudes. On the other hand, they influence the shaping of ideological frameworks within which these attitudes are articulated (Habermas, 2013, p. 136).

The media and large non-governmental organizations are replacing the old institutions of the public sphere. Public opinion is therefore manipulative, and increasingly critical. In other words, the critical potential, which is stated at the core of the public, is now lost in the imposition of ready-made views in a wide area of the public, which includes not only the media, but also the education system, and even colloquial speech and customs (Habermas, 2013, p. 161).

On the other hand, the utilitarian approach to public opinion starts from the assumption that the process of its formation is complex and heterogeneous, and that the isolated influence of individual factors cannot explain it. In this sense, public opinion is viewed as a phenomenon that can be researched

and analyzed using quantitative methods, to predict its movements mathematically and statistically. However, it is also characterized by the ability to self-regulate, including complete calming down or a transition to silence, as indicated by Elisabeth Noelle-Neumann (Noelle-Neumann, 1948, p. 48). According to this model, the public is formed through a complex process of legislation, or it is stabilized in certain social situations. For example, during elections, public opinion is stabilized by forming a dominant position on specific issues.

The development of media research is usually divided into three main phases. Initially, the dominant understanding was that the media have a strong and direct influence on the audience, which was especially significant in the context of wars and the emergence of totalitarian regimes. Later research, influenced by social psychology and new methodologies, showed that the effects of the media are nevertheless limited and that the audience is not a passive recipient of messages. Modern approaches emphasize the mutual interaction between the audience and the media - the audience actively interprets messages, and the way they are received depends on the social and cultural context (Pooley & Park, 2008, p. 27).

The development of traditional mass media, primarily the press as the initial mass medium, and later radio and television, fundamentally changed the relations of social communication (Obradović, 2023, p. 1).

A similar point of view is held by Zoran Slavujević, who emphasizes that mass media are the primary channel through which individuals acquire and disseminate knowledge about the world, including the political sphere. Regardless of whether the media faithfully reflect reality, to a certain extent shape it, or even distort it, their key role lies in cognitive function. The emergence of each new medium also expands individuals' ability to learn about phenomena beyond the limits of their immediate experience and perception (Slavujević, 2009, p. 44).

The media play a significant role in further shaping already-adopted social attitudes, especially in identifying and articulating social risks. They influence the formation of public awareness and perception of danger, but at the same time contribute to the reproduction of existing social patterns. Their function is not limited to transmitting information but also to actively shaping how society understands and interprets crises and threats. Through the selection of topics, the manner of reporting, and the frequency with which certain events are presented, the media influence the collective consciousness, as well as citizens' sense of security or insecurity. It is precisely because of such an influence, especially in the context of terrorism, that it is of particular importance to examine in detail how modern society perceives and interprets terrorist threats.

3.2. Media and the formation of risk perception

The perception of certain phenomena is often more important than their objective characteristics and actual extent. Given the limited possibilities of direct insight and understanding of such phenomena, individuals are referred to indirect sources of information. In this context, media content is a dominant channel for acquiring information on topics of interest (Ilic, 2021, p. 309).

Constant risks and uncertainties characterize contemporary society, and the media play a key role in how these risks and uncertainties are perceived and interpreted. To understand how risks are constructed and perceived, it is necessary to consider the theoretical frameworks of the risk society offered by Beck, Giddens, and Bauman.

According to Ulrich Beck (2001), the process of modernization, in addition to undeniable benefits and progress, also generates new forms of risk. Unlike earlier eras, in which dangers predominantly originated from the natural environment, contemporary risks increasingly arise from social and technological processes, making modern society extremely vulnerable. In other words, modernization also involves the release of potentially destructive forces that are difficult to control fully. While risks in the premodern period were predominantly transcendental in nature, generated by nature, which science sought to subordinate to the interests of civilization, in the contemporary context their effects cannot be viewed in isolation. Although natural risks still exist, their effects are inextricably linked to the complex network of modern life (Bek, 2001, p. 35).

After the collapse of the utopia of creating a world society, in the context of new world antagonisms, class mobilization, which determined the global political scene in the last century, remains in the background. Instead, solidarity of fear appears (Beck, 2001, p. 73).

Ulrich Beck connects the modern risk society with the transformation of the media's role, emphasizing that the media no longer serve only as a channel of information but as a key producer of perceptions of danger and insecurity. In the context of globalized risks, such as terrorism, economic crises, or migration, the media contribute to the creation of a "global community of fear", in which the feeling of threat extends beyond the individual's immediate experience and becomes part of everyday social reality. Continuous reporting on crises and security threats contributes to an atmosphere of uncertainty, which further strengthens what Beck calls "solidarity of fear" (Beck, 2001).

Similarly, Zygmunt Bauman (2006), in his concept of "liquid modernity," argues that modern man lives in a state of permanent insecurity due to the weakening of stable social institutions and collective identities. In this context, the media play an important role in reproducing feelings of anxiety and social fragmentation, as they daily place content that emphasizes dangers, crime, conflicts, and social threats. According to Bauman, the culture of fear is becoming a basic characteristic of modern society, with media discourse significantly shaping the perception of the "other" as a potential threat and the acceptance of restrictive security measures (Bauman, 2006).

In this context, the media become key intermediaries in shaping the perception of risk. Through reporting on events and potential dangers, they create frameworks in which the public interprets risks. Terrorism, as an example of manufactured risk, becomes visible to the public primarily through media representations, which directly affects the way individuals experience danger and shape their reactions. In this way, the reflexive nature of modern society, as described by Giddens, also includes the media's active role in informing and interpreting risks.

The modern risk society shows that terrorism is not an isolated phenomenon, but part of a wider network of global risks. Terrorism within a risk society is a phenomenon that demonstrates how global threats do not originate only from natural or economic processes, but also from socio-technological networks. In this context, the media articulate and visualize terrorism, transforming abstract global risk into immediate public perception, thereby directly shaping social perceptions of danger.

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3.3. Perception of terrorism in modern society

The media, as the dominant channel of information and interpretation of contemporary risks, play a crucial role in shaping public awareness of terrorism. Since most citizens have no direct experience with terrorist attacks, their perception of this phenomenon largely depends on the way it is presented in the media discourse. Although direct exposure to such events is relatively rare, terrorism has a strong potential to cause anxiety and fear in the general public. The mere possibility of its execution often has a stronger influence on the formation of perception than an objective assessment of the actual risk. Intense media interest and frequent reporting on terrorist acts contribute to the creation of dramatic and disturbing images in the collective consciousness, which are most often associated with the sudden suffering of a large number of innocent people, often bystanders (Ilic, 2021, p. 210).

Understanding the link between media consumption and fear of terrorism is crucial, given its importance for policymaking and political responses (Guler & Piazza, 2024, p. 2).

According to Srdanović (2002), at the beginning of the 20th century, the international community sought to define terrorism as a crime that threatens general security (p. 18). Later definitions, such as Hoffman's (2000), emphasize that the key characteristic of terrorism is the use of violence for political purposes (Hoffman, 2000, p. 34).

According to Jean Baudrillard, the difficulties in precisely defining terrorism arise from its diffuse nature in the postmodern context. Unlike earlier forms of terrorism, in which violence was grounded in specific ideological goals that served as a kind of justification, contemporary terrorism is characterized by a logic of reciprocity, or the principle of "terror as a response to terror". In such circumstances, violence no longer requires a clear ideological foundation, nor does it necessarily seek to change the political order. Instead, as Baudrillard (2007) points out, terrorism in contemporary society functions as a self-perpetuating mechanism, in which violence generates new violence, creating a spiral that becomes its own justification and reflects the brutality of the contemporary world (Baudrillard, 2007, p. 62).

Contemporary terrorism as a phenomenon has a complex structure in which ideological, social, religious, ethnic, psychological, and other elements are intertwined (Marinov, 2021, p. 159).

The media shape not only the topics the public thinks about but also how these topics are interpreted. As McCombs and Shaw (1993) point out, the media may not tell us what to think, but they are extremely successful in showing us what to think about and how to understand this information. In this context, the media select information, emphasize dramatic events, and often use a sensationalist tone, thereby enhancing the sense of urgency and fear. The continuous emphasis on terrorism as a dominant theme in the context of threat, risk, and insecurity contributes to the formation of the perception that terrorism is one of the most important social issues (McCombs & Shaw, 1993, p. 65). In this way, it can be seen how the theory of agenda setting, combined with framing, explains the media's influence on public perception of risk.

The violence profile is a set of indicators that monitor aspects of the television world and the conceptualization of social reality that television programs seek to shape in viewers' minds. Long-term exposure to such depictions of violence, including terrorist events, according to the cultivation theory of Gerbner & Gross (1976), shapes the perception of reality and increases the feeling of fear and insecurity in viewers, showing how media content

indirectly influences the attitudes and feelings of the audience (Gerbner & Gross, 1976, p. 184).

Contemporary research further emphasizes the complexity of the perception of terrorism. In this context, Jiang and Wilson (2025) point to a "symbiotic relationship" between terrorism and the media, with the media playing a key role in shaping public perceptions of these events. Although the importance of the media for terrorist actors is obvious, this relationship is reciprocal, since the media also derive certain benefits from terrorism. Namely, media organizations tend to report on content that attracts audience attention, and terrorist attacks, due to their dramatic nature, are often among the most attractive topics. Accordingly, reporting on such events may align with the commercial interests of the media (Jiang & Wilson, 2025, p. 3).

3.4. Media reporting on terrorism and its effects

The perception of certain phenomena often exceeds the significance of their objective characteristics and real scale. Given the limited possibilities for direct insight and understanding of such phenomena, individuals rely on indirect sources of information, among which media content occupies a central place. Terrorism is one of the phenomena that is unknown to most citizens through personal experience, and its image is largely formed based on media reporting. Although direct exposure to terrorist attacks is relatively rare, this phenomenon has a pronounced potential to cause anxiety in the general public. The very possibility of its execution often has a stronger influence on the formation of perception than an objective assessment of the risk. Intense media interest and emphasized reporting on terrorist events contribute to the creation of dramatic and disturbing images in the collective consciousness, which are most often associated with the sudden suffering of a large number of innocent people, often bystanders (Ilić, 2021, p. 310).

One of the most important authors in this field – Paul Wilkinson, emphasizes that terrorism is the systematic use of injury, killing and destruction, or the threat of them, to create a climate of terror, popularize the cause and intimidate the wider target into accepting the goals of the terrorists. Similarly, Brian Jenkins suggests that terrorism refers to the use or threat of violence to create an atmosphere of fear and alarm and, thus, lead to a political result (Ilić, 2021, p. 310).

Our image of terrorism, like our image of security, is shaped by both subjective (media, political discourse) and objective (data, facts) factors. These two approaches must not differ significantly (Ilić, 2021, p. 315).

Terrorist organizations differ from one another in the target audiences they seek to influence and the messages they aim to convey. Some groups aim to provoke state structures in order to encourage indiscriminate repressive measures, thereby undermining citizens' trust in government and further legitimizing the use of violence. Others, however, use terrorist acts to demonstrate their ability to inflict serious blows on their opponents, thereby seeking to consolidate support from existing ones and attract new supporters. In this context, media attention is a key channel of communication between terrorist actors and their audiences, which is why many groups seek to influence not only the volume, but also the manner and tone of media coverage of their activities (Archetti, 2013).

Terrorist attacks vary significantly in the degree of media attention they receive, with a large number of them remaining outside the focus of mainstream media outlets. Understanding patterns in media coverage of terrorism can have a significant impact on national security policies at multiple levels. First, the fact that many attacks do not attract significant attention points to differences among terrorist groups in their ability to design actions that will be noticed by the media, suggesting that control over media coverage is not simple or entirely in the hands of the actors themselves. Analyzing why some attacks attract attention while others remain marginalized can contribute to a better understanding of the political goals, media strategies, and organizational capacities of the perpetrators. Also, deeper insight into the media's motives and constraints can be important for designing more effective public relations and public diplomacy strategies for institutions responsible for combating terrorism.

As discussed in more detail below, some argue that the media have incentives to provide overly extensive coverage of terrorist attacks. This coverage can provide terrorists with a means to convey their political messages to a wide audience, and it can also distract the public from understanding the difficulties of preventing terrorist attacks and the steps that governments are taking to achieve this goal. Research in this area has begun to systematically investigate the conditions under which the media are more or less likely to devote significant coverage to terrorist attacks rather than to other topics or other aspects of counterterrorism. Third, the structure and competitiveness of the news industry appear to influence the media's attention to terrorism. As the media landscape becomes increasingly decentralized and competitive, news outlets may attempt to maintain market share by devoting more attention to terrorist attacks that employ novel tactics or are particularly violent. Such developments could pose new challenges for national security agencies' media relations by distorting the public's perception of the terrorist threat and reducing the ability of governments to explain their policies and contextualize the issue of terrorism. Fourth, existing research is beginning

to explore how the tone of media reporting on terrorism affects the attitudes and behavior of the general public, including voters as well as potential sympathizers of terrorist movements. There is considerable evidence that reporting on terrorism increases fear and anxiety, and that these emotional changes influence the propensity of some members of the public to adopt forceful counterterrorism policies. This can make it more difficult for governments to respond to terrorist attacks with other types of policies, even if those policies may yield better results. It is sometimes argued that terrorists are effective at manipulating media coverage to convey their message to a mass audience and gain sympathizers and supporters (Walsh, 2010, p. 2).

3.4.1. Moral panic in relation to terrorism

Moral panic is a concept widely represented in academic research on crime, deviant behavior, and the role of the media. Although this phenomenon has been discussed more intensively only in the last few decades, a development associated with the emergence of social and media conditions that enabled its more pronounced manifestation, this does not mean that similar patterns did not exist in earlier historical periods. However, the limited capabilities of the media forms of that time did not allow for the rapid and widespread dissemination of public reactions to phenomena perceived as a threat to the dominant value system, which is today one of the key characteristics of moral panic (Ilić, 2017a, p. 78).

Moral panic is a social phenomenon that arises and persists to serve the interests of those who have an interest in it. The goals can differ, and so can the list of potentially interested actors who participate in the process of creating moral panic (Ilić, 2017a, p. 110).

In order to understand the phenomenon of moral panic, or the stages through which it arises, it is necessary to consider several theoretical approaches based on the criterion of the source of moral panic, or the subjects from which it originates. It distinguishes three main ways of interpreting moral panic: as a reaction that arises spontaneously in the general public, as a phenomenon shaped by political and social elites, or as a product of the actions of interest groups and movements (Ilić, 2017b, p. 298).

An important aspect of moral panic is its social function, so in this sense it is important to consider the role that various social factors play in its emergence. In this context, the actions of moral activists, as well as representatives of formal social control bodies, are particularly emphasized. Given that different views have been expressed regarding the role of moral activists in the emergence of moral panic, an analysis of these approaches has identified

situations in which moral activists can play a crucial role in creating moral panic (Ilić, 2020, p. 73).

Public concern and consensus regarding terrorism have often reached seismic proportions after attacks. Supported by its violent and unpredictable nature, and further fueled by the volume and intensity of media and political discourse, terrorism produces a "culture of fear," a dynamic that is evident in public opinion polls, news reports, official warnings, security checkpoints, warning signs, armed guards, concrete barriers, and other signs of a siege mentality (Walsh, 2016, p. 6).

Terrorism aims to produce and exploit the very conditions—high anxiety, intense outrage, and excessive punitive response—that define moral panic. By employing violence that is horrific, unexpected, and directed at everyday spaces and infrastructures, terrorists seek to induce affective states of extreme fear and intense psychological and social disruption. Moreover, in doing so, terrorists exploit the propensities of the two most important institutions implicated in the eruption of moral panics: the media and the state's institutions of social control. To gain notoriety and amplify perceptions of vulnerability and imminent danger far beyond their actual capabilities and material influence, terrorists rely on the expected publicity from a media eager for spectacle. In addition, disproportionate responses from security-obsessed states represent an important resource for terrorist organizations. By eroding legitimacy and generating support for their cause, the collateral consequences of indiscriminate and clumsy retaliation are a central means by which terrorists amplify their influence, mobilize resources, and gain and maintain their power (Walsh, 2016, p. 15).

3.4.2. Fear of terrorism

There are numerous definitions of terrorism in academic discourse, but the root of the term lies in the Latin word "terror", which means "fear" or "horror" (Schmid, 2012, p. 158). In an effort to establish a universally accepted understanding of terrorism, Schmid proposes the following definition to capture the fundamental aspects of terrorist acts: "Terrorism refers, on the one hand, to the doctrine of the presumed effectiveness of a particular form or tactic of violence that induces fear and coercion, and on the other hand, to the conspiratorial practice of calculated, demonstrative, direct violent actions without legal or moral restrictions, directed mainly at civilians and non-combatants, carried out for their propaganda and psychological effects on various audiences and parties to the conflict" (Schmid, 2012, p. 158).

Vulnerability theory states that fear depends on three interactive factors: exposure to risk, loss of control, and expectation of serious consequences (Killias, 1990, p. 105). According to the assumptions of vulnerability theory, when people understand the seriousness of the consequences of terrorist attacks and feel their inability to control the situation, they feel vulnerable to terrorist incidents and their consequences (Skogan, 2009).

Fear is one of the most important means by which public opinion about terrorism is shaped. Although individuals experience it personally, it always arises within the broader social and political environment. The culture of fear is built through media narratives, political discourse, and collective memories, and personal feelings of insecurity are shaped through these broader processes (Jackson, 2013, p. 274; Biess, 2022, p. 99). In other words, fear of terrorism is not only the result of real dangers, but also the social constructions that give it meaning and power.

Media reporting on terrorism shapes not only the perception of danger, but also social and political responses to it. Through mechanisms of moral panic and the rhetoric of fear, the media reinforce the sense of threat and normalize restrictive policies. This paradoxically puts societies that seek to defend their democratic values in a position to undermine those very values. This leads us to a final consideration – to what extent the media shape perceptions of terrorism and how these perceptions are reflected in contemporary security policies.

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4. Conclusion

The role of the media in shaping perceptions of terrorism is an important issue in modern society, especially in the context of global insecurity, the rapid flow of information, and the development of digital communications. Although terrorism is statistically less common than many other forms of violence and crime, its presence in the media space is disproportionately large. For this reason, the public's perception of terrorism is often not based solely on objective risk indicators but largely depends on how the media present and interpret such events.

The analysis of theoretical approaches has shown that the media do not act only as transmitters of information, but as active participants in the construction of social reality. Through mechanisms such as agenda-setting, framing, and sensationalist reporting, the media influence not only which topics the public perceives as most important but also how they are understood. Long-term exposure to violent and dramatic content contributes to

the creation of a sense of permanent threat, with fear becoming an integral part of everyday social experience.

A particularly important aspect relates to the phenomenon of moral panic and the culture of fear, which are further intensified by the continuous media presentation of terrorism as an immediate and omnipresent threat. In such circumstances, the public often develops a perception of risk that goes beyond the realistic scope of the danger, which can strengthen social anxiety, stereotypes, and support for more restrictive security policies. In this way, media discourse becomes an important factor in shaping political decisions and social reactions to contemporary security challenges.

At the same time, the analysis indicates a complex, reciprocal relationship between the media and terrorism. Terrorist actors use media attention to expand the symbolic effect of their actions. In contrast, the media, driven by market logic and the need to attract an audience, often favor content that provokes strong emotional reactions. This establishes a kind of cycle in which media exposure contributes to the spread of fear, while fear further increases the public's interest in such content.

In a modern risk society, the media's responsibility goes beyond simply informing the public. Professional, ethically based, and balanced reporting can contribute to a more rational understanding of terrorism, reduce moral panic, and strengthen social resilience to fear manipulation. Therefore, developing a critical attitude towards media content is of particular importance to preserve the balance between the public's right to information and the need to prevent the creation of an atmosphere of permanent social insecurity.

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The Role of the Faculty of Security Studies in Educating Future Professionals for Contemporary Integrated Risk Management

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Abstract

Security risks in modern society are so closely interconnected that protection models in which fire protection, occupational safety and health, civil protection and private security develop as separate fields no longer deliver satisfactory results. Drawing on foreign experience and practice, this paper argues that a new generation of professionals able to think about risk holistically is needed, and examines the role the Faculty of Security Studies can play in educating them. The paper is designed as a review study that combines a qualitative comparative analysis of study programmes and professional standards in Germany, the United Kingdom, Slovenia, Australia and the United States with the authors' systematised observations from many years of work in fire protection and civil defence. The analysis shows that all the models examined, despite organisational differences, rest on the same premise: protection works only when technical knowledge, sound organisation

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and the human factor are in balance, and specialisation is built on a common technical foundation. Field observations support this, as professionals trained in a single field find it difficult to cooperate in complex situations and lack a shared conceptual framework for assessing risk. The paper proposes that the Faculty of Security Studies continue modernising its programmes towards the technical and technological sciences by introducing common core courses for all security tracks, strengthening the engineering component (fire protection engineering, occupational safety and health, critical infrastructure management), establishing formal partnerships with emergency services and the labour inspectorate, and developing a long-term accreditation strategy aligned with European standards. Such an approach would produce professionals capable of applying theory to contemporary threats, contributing to the resilience of society and to the standing of a security profession grounded in science and rigorous technical standards.

Keywords

Integrated risk management; fire protection; occupational safety and health; private security; safety engineering; higher education.

1. Introduction

In Serbia, as in many other countries, safety and security have long developed along separate lines. Fire and rescue units deal with fires and rescue operations, occupational safety and health officers deal with workplaces and the working environment, security services protect people and property, and civil protection is activated in emergencies. Each of these fields has its own legislation, its own system of licences and professional examinations and, most importantly for this paper, its own educational pathway. While risks were relatively separate, this arrangement made sense. That is no longer the case. A fire in an industrial facility is at the same time a matter of worker safety, business continuity, environmental protection and, frequently, the functioning of critical infrastructure (Cvetković, 2026).

The need for a broader approach is clearly expressed at the international level. The Sendai Framework for Disaster Risk Reduction 2015–2030 recognises that the State has the primary role in reducing disaster risk, but that this responsibility should be shared with local government, the private sector and other stakeholders (UNISDR, 2015). Shared responsibility assumes that people from different sectors can work together, which is hard to achieve if they are trained in separate systems from the outset. Theoretical approaches

to safety send a similar message. Rasmussen (1997) treats risk management as a problem of a dynamic socio-technical system in which decisions at one level affect all others. Reason (1997) shows that major accidents can rarely be explained by the error of a single individual or service, but rather by a chain of organisational weaknesses. Leveson (2011) and the authors of the resilience engineering concept (Hollnagel, Woods, & Leveson, 2006) go a step further and treat safety as a property of the system as a whole. ISO 31000 (ISO, 2018) likewise requires risk management to be integrated into all organisational activities rather than existing as a set of isolated functions.

Even so, the education of safety and security professionals in Serbia still largely follows sectoral lines. The legal framework reinforces this, since fire protection, occupational safety and health, disaster risk reduction and private security are governed by separate laws with separate requirements for practising in each field (Law on Fire Protection, 2009, 2015, 2018; Law on Private Security, 2013, 2015, 2018; Law on Disaster Risk Reduction and Emergency Management, 2018; Law on Occupational Safety and Health, 2023). In the authors' view, the need for an integrated approach is frequently mentioned, yet few papers link the issue to the actual content of study programmes and to what happens in the field.

The Faculty of Security Studies, University of Belgrade, has recently been modernising its study programmes and shifting them towards the technical and technological sciences, introducing areas such as fire protection engineering, occupational safety and health, and critical infrastructure management. In doing so, the Faculty is moving away from a predominantly theoretical and humanities-oriented view of security towards education that gives students concrete engineering skills. This paper seeks to place that change in a wider context. Three research questions were posed:

1. How are integrated education programmes in the field of safety and security organised in selected countries?
2. What does practical experience reveal about the consequences of fragmented professional education?
3. What guidelines follow from this for the further development of the Faculty of Security Studies?

The working assumption of the paper is that education built on a common technical foundation, followed by specialisation, produces professionals who are more effective in complex situations than those trained in a single field.

2. Methods

2.1. Study design

The paper is designed as a qualitative review study drawing on two sources of evidence. The first is a comparative analysis of documents on study programmes, professional standards and relevant international frameworks. The second is systematised practitioner reflection, i.e. the authors' observations from many years of work in fire protection, civil defence and emergency management. A qualitative design was chosen because the subject of the paper is the structure of education and the nature of competences, not the measurement of the effects of individual programmes. The aim was not to rank programmes but to identify common patterns and compare them with what happens in practice.

2.2. Data sources

The literature was searched in Scopus, Google Scholar and ERIC. In addition to scientific papers, the analysis covered publicly available information on study programmes from the official websites of higher education institutions, the standards and programmes of professional bodies (IOSH, NEBOSH), materials from agencies involved in emergency management education (FEMA, AIDR), international documents (UNISDR, 2015) and the legislation in force in the Republic of Serbia. Data were collected in the period [specify period].

2.3. Data collection procedure

Searches used combinations of keywords in English and Serbian, such as *integrated safety education*, *fire safety engineering curriculum*, *occupational safety and health education* and *emergency management higher education*, together with their Serbian equivalents. For each selected programme or system, a comparative matrix was completed along four dimensions: (1) the degree of integration of safety and security sectors, (2) the share of technical subjects, (3) the way teaching is linked to practice and (4) the mechanism of accreditation or professional recognition. Practitioner observations were grouped into thematic categories: incompatibility of knowledge in the field, coordination in crises, design and prevention, emergency management, and labour market demand.

2.4. Selection of units of analysis

Purposive sampling was used. A programme or national model was included if it combined at least two safety and security sectors (for example, fire protection and occupational safety and health), if public information on its content was available, and if it came from a country with a well-developed protection system. Narrow professional courses without an academic component were not treated as separate units, but were used where they illustrate how specialisation builds on core education. Four models were thus identified: German, British, Slovenian and Australian-American.

2.5. Ethical considerations

The study did not involve human participants or the collection of personal data, so ethical committee approval was not required. Practitioner observations are presented in general terms, without naming legal entities, facilities or individuals.

2.6. Data processing and analysis

Data from the comparative matrix were analysed thematically. Each model was described along the four dimensions, and the models were then compared to identify common elements and differences. The ratings in the comparative overview (high, medium) are qualitative and based on the authors' assessment of the documents analysed. Findings from the document analysis were compared with the practitioner observations to check whether the two independent sources led to the same conclusion. No statistical software was used, as the nature of the data did not require it.

3. Results

3.1. Germany: a model of technical integration

The German approach was examined through the undergraduate programme *Brandschutz und Sicherheitstechnik* (Fire Protection and Safety Engineering, B.Eng.) at the Berlin University of Applied Sciences and Technology (BHT Berlin, formerly Beuth Hochschule). The programme has two tracks. Students on the fire protection track study at BHT and at the same time complete firefighter training at the Berlin Fire and Rescue Academy, graduating with a dual qualification: a Bachelor of Engineering degree and eligibility for the higher technical fire service grade. The safety engineering track prepares

students for safety engineering roles in industry and public administration, although it is currently not admitting new students (Berliner Hochschule für Technik, n.d.).

What matters most for this analysis is that the first three semesters form a common foundation for both tracks. It covers physics, chemistry, engineering mechanics, electrical engineering, hydraulics, thermodynamics, hazardous substances and occupational safety. According to the authors' assessment of the curriculum, technical subjects make up more than 60% of the programme. Teaching includes laboratory work and field training, and graduates cover competences that would otherwise require several different specialists. BHT also offers continuing education programmes focused solely on fire protection, such as *Brandschutzbeauftragter* (fire safety officer) and *Fachplaner für vorbeugenden Brandschutz* (specialist planner for preventive fire protection).

3.2. United Kingdom: integration through professional standards

In the United Kingdom, integration is achieved largely through professional bodies. The Institution of Occupational Safety and Health (IOSH) offers shorter, practice-oriented courses for managers and employees, such as *Working Safely*, *Managing Safely* and *Safety for Executives and Directors* (IOSH, n.d.). The National Examination Board in Occupational Safety and Health (NEBOSH) offers more demanding qualifications, from certificates to diplomas, aimed at those working professionally in safety, including specific fire safety qualifications (NEBOSH, n.d.). The difference between the two systems lies not only in duration but also in depth and target group: IOSH provides a basic understanding, whereas NEBOSH prepares professionals for work in high-risk environments.

At the academic level, an example is the *MSc Occupational Health, Safety and Environmental Management* programme at the University of Portsmouth, which links occupational safety and health with environmental management and is designed for people studying alongside their work (University of Portsmouth, n.d.). The British approach is also strongly shaped by the concept of resilience engineering, which views safety systemically, across sectoral boundaries (Hollnagel et al., 2006). Here, professional accreditation acts as the driver of integration.

3.3. Slovenia: the closest example

The Faculty of Criminal Justice and Security (Fakulteta za varnostne vede) of the University of Maribor brings together security studies, private security and criminal justice within a single institution (Univerza v Mariboru, n.d.). This example is particularly relevant for Serbia because of the similar legal and institutional tradition, which means its solutions could be transferred to the Serbian system more easily. Graduates of such a programme move more easily from one sector to another because they share a common knowledge base.

3.4. Australia and the United States: emergency management as the framework

In Australia and the United States, integration is achieved through the field of emergency management. Fire protection, occupational safety and health, civil protection and critical infrastructure are treated as subsystems of a single framework based on an all-hazards approach. In the United States, the Federal Emergency Management Agency (FEMA) directly influences curricula through its higher education programme (FEMA, n.d.), while in Australia a similar role is played by the Australian Institute for Disaster Resilience (AIDR) and its handbook collection (AIDR, n.d.).

3.5. Comparative overview

Table 1 summarises the findings along the dimensions of the comparative matrix.

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Table 1. Comparative overview of the integrated education models analysed.

Model	Degree of integration	Technical component	Link with practice
Germany (BHT Berlin)	High	Strong (over 60%[1])	Mandatory; training at the fire academy
United Kingdom (IOSH, NEBOSH, Portsmouth)	Medium	Medium	Professional accreditation
Slovenia (University of Maribor)	High	Medium	Cooperation with state authorities
Australia and USA (AIDR, FEMA)	High	Strong	Curricula aligned with FEMA and AIDR

[1] Authors' estimate based on the curriculum of the *Brandschutz und Sicherheitstechnik* programme.

Regardless of country or institution, all the models analysed share the same key premise: today's safety and security challenges require professionals with broader, integrated competences rather than narrow specialists who do not understand the system in which they work. The differences concern

how integration is achieved. In Germany it is primarily the technical curriculum, in the United Kingdom professional standards, in Slovenia institutional consolidation, and in Australia and the United States a common emergency management framework (Cvetković, 2025).

3.6. Observations from practice

3.6.1. Incompatibility of knowledge in the field

Firefighters usually assess risk in a building primarily in terms of fire spread and rarely consult its occupational safety and health documentation. Conversely, occupational safety and health specialists, including labour inspectors, are generally unable to assess the condition of fire protection systems on their own. Both sides work conscientiously, but each sees only its own part of the picture.

3.6.2. Coordination in crises

Professionals from different services often use different terms for the same problem. In a crisis, valuable time is therefore spent establishing basic communication, something a professional with an integrated education would take for granted from day one.

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3.6.3. Design and prevention

A fire protection engineer may design an extinguishing system without taking into account the risks to workers when it is activated, for example gas extinguishing systems discharging in occupied rooms. At the same time, an occupational safety and health specialist may analyse workplaces without assessing the fire load. An integrated approach treats these two stages as inseparable.

3.6.4. Civil defence and emergency management

Civil protection plans require coordinated participation of firefighters, occupational safety and health officers, health workers and infrastructure operators. In practice, each of them brings a different conceptual framework and a different way of thinking about risk and decision-making under pressure. The result is the absence of a common operational picture, which has direct consequences in an emergency (Cvetković, 2023).

3.6.5. The safety manager as a real labour market need

Safety management in large organisations requires a person who understands fire protection, occupational safety and health, emergency planning and the organisation's security policy. In practice, this role is usually given to a single specialist who learns the rest on the job. In other words, employers are already looking for a safety manager rather than three separate specialists, while the education system lags behind.

4. Discussion

The comparative analysis and practical experience, as two mutually independent sources, lead to the same conclusion: a partial approach to educating safety and security professionals does not match the nature of contemporary risks. This is consistent with the systems view of safety in the literature (Rasmussen, 1997; Reason, 1997; Leveson, 2011), according to which risk cannot be managed effectively when knowledge about it is scattered across services that do not communicate with one another. The field observations essentially describe what Rasmussen (1997) calls the problem of aligning decisions made at different levels of a system: each service makes reasonable decisions within its own remit, but their sum is not necessarily safe.

The differences between the models show that there is no single correct path. The German model rests on a strong technical foundation and close ties with the operational service, as reflected in the dual qualification of its graduates. The British model shows how much professional bodies and accreditation can contribute to integration beyond the university. For Serbia, the Slovenian model is the most accessible first step because of the similar legal and institutional context, while the German model represents a long-term strategic goal: a technical faculty with engineering accreditation. The Australian-American approach offers a useful conceptual framework, since it treats all sectors as parts of a single emergency management system.

A common objection to integrated education is that it dilutes specialisation. The examples analysed suggest the opposite. Alongside its integrated undergraduate programme, BHT Berlin offers narrowly specialised continuing education in fire protection, and the British system has a clear progression from basic IOSH courses to demanding NEBOSH qualifications. Integration therefore does not mean abolishing specialisation but building it on a common foundation. Figure 1 shows this relationship in the form of the conceptual model we propose.

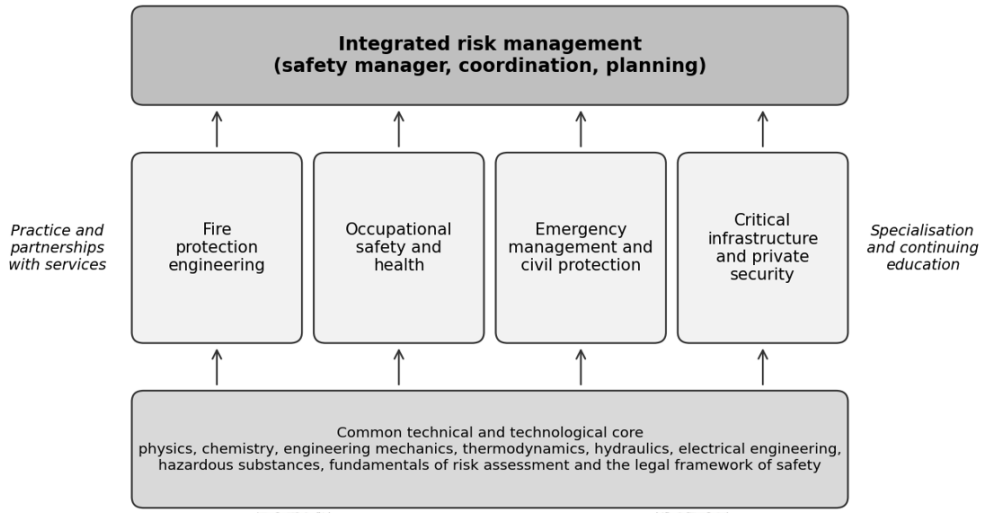


Figure 1. Conceptual model of integrated education: a common technical and technological core, specialist tracks, and integrated risk management as the outcome.

It is also important for Serbia that fragmented education mirrors fragmented regulation. As long as fire protection, occupational safety and health, disaster risk reduction and private security are regulated separately, with separate professional examinations and licences, an integrally educated professional will in practice have to collect several separate authorisations. Changes in education should therefore go hand in hand with a dialogue on how the licensing system could be adapted (Cvetković, 2021). Based on the analysis, we propose the following for the Faculty of Security Studies:

1. introduce common core courses of a technical and technological nature for all security tracks;
2. further strengthen the engineering component of studies, particularly in fire protection engineering, occupational safety and health, and critical infrastructure management;
3. establish formal partnerships with emergency services and the labour inspectorate, covering student placements and joint exercises;
4. develop a long-term strategy for accrediting safety engineering programmes in line with European Union standards.

The study has several limitations. The analysis covers a small number of purposively selected models, so the findings cannot be generalised to all education systems. Programme information was taken from publicly available sources, which may not reflect actual teaching practice. The ratings in the comparative overview are qualitative, and the practitioner observations inevitably bear the mark of the authors' personal experience. Future research

could survey employers on the competences they expect from safety and security professionals, track the employment and career progression of graduates from different programmes, and map in detail the learning outcomes of existing Serbian programmes against the foreign models analysed.

5. Conclusions

Foreign experience consistently shows that integrated education in the field of safety and security is not a passing trend but a response to the real nature of contemporary risks. Many years of practice in fire protection and civil defence confirm the same from the field: professionals trained in a single area are effective in narrow and predictable situations, but it is precisely complex situations that dominate in practice. Modernising the study programmes of the Faculty of Security Studies towards the technical and technological sciences therefore makes sense and should continue, with a common technical foundation, a stronger engineering component, closer ties with the services and a clear accreditation strategy. In this way, the Faculty can educate professionals who know how to apply theoretical knowledge in practice, contribute to the resilience of society and the standing of the security profession, and become a regional leader in integrated risk management education.

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