RESILIENCY AND CRITICAL INFRASTRUCTURE PROTECTION

Mária Lusková[*)]

ABSTRAKT

Článok sa zaoberá problematikou výskumu ochrany kritickej infraštruktúry a zvyšovania reziliencie spoločnosti pred prírodnými katastrofami a katastrofami spôsobenými človekom v rámci programu EU Horizont 2020. Prezentuje koncepciu reziliencie systému a infraštruktúry, ktoré sa dostávajú do pozornosti najmä v poslednej dekáde. Konkrétne špecifikuje témy zamerané na ochranu kritickej infraštruktúry, ktoré sú predmetom výskumu v rámci pracovného programu Bezpečné spoločnosti na roky 2014-2015.

Kľúčové slová:
reziliencia, kritická infraštruktúra, bezpečnosť, ochrana

ABSTRACT

The paper is dealing with research issues of critical infrastructure protection and enhancing the resilience of society against natural and man-made disasters within the EU Research and Innovation programme Horizon 2020. It presents the concept of system resiliency and infrastructure resiliency that have been receiving more attention especially in last decade. It specifies the topics focused on critical infrastructure protection that is the subject of research within the work programme Secure societies for years 2014-2015.

Key words:
resiliency, critical infrastructure, security, protection

1 INTRODUCTION

Horizon 2020 is the EU Research and Innovation programme with nearly €80 billion of funding available over 7 years (2014 to 2020). Within the programme

*) Ing. Mária Lusková, PhD. Meno, Žilinská univerzita v Žiline, Fakulta špeciálneho inžinierstva, Ul.1.mája 32, 010 26 Žilina, tel.+421 41 513 6766, fax +421 41 513 6620, e-mail: maria.luskova@fsi.uniza.sk

section “Societal Challenges” a challenge-based approach to research brings together resources and knowledge across different fields, technologies and disciplines, including social sciences and the humanities.

The seventh challenge entitled “Secure societies - Protecting freedom and security of Europe and its citizens” focuses on research and innovation activities needed to protect the European citizens, society, economy, infrastructures and services.

This Secure Societies Challenge concentrates especially on [4]:

- enhancing resilience of the society against natural and man-made disasters,
- fighting against crime and terrorism,
- improving border security,
- providing enhanced cyber-security.

2 SYSTEM RESILIENCY

Resilience is a concept related to a system's ability to perform the critical functions required for its mission efficiently, even in the event of disruptive actions, e.g. natural, accidental or malevolent events. Resilient systems can maintain their performance through [1]:

- prevention or absorption of a disruption impact,
- reconfiguration and adaptation from normal operating procedures to a different set of operations,
- restoration or recovery the system quickly and efficiently.

The term “resilience” emerged particularly from research in ecology and social-ecology. The resilience concept in ecology focused primarily on the understanding of the survival of populations in times of shocks and perturbations. The social-ecological resilience deals also with institutions that regulate social - ecological systems and questions of decision making. The overview of different resilience concepts according to their core characteristics, focus and context is given in Table1.

Table 1 Resilience concepts [2]

Resilience concept	**Charactersistics**	**Focus on**	**Context**
Engineering resilience	Return time, efficiency	Recovery constancy	Vicinity of stable equilibrium
Ecological/ecosystem resilience and social resilience	Buffer capacity, withstand shock, maintain function	Persistence, robustness	Multiple equilibria, stability landscape
Social-ecological resilience	Interplay disturbance and recognition, sustaining and developing	Adaptive capacity , transformability, learning, innovation	Integrated system feedback, cross-scale dynamic interactions

3 INFRASTRUCTURE RESILIENCY

Infrastructure resiliency research has been receiving more attention especially in last decade due to failures of critical infrastructures and the increasing dependency of societal processes on the functioning of the critical infrastructures.

In general, critical infrastructures span a broad field of infrastructures that according to Lauwe and Riegel (2008) can be clustered to in:

- basic infrastructures (electricity, water supply, etc.),
- socio-economic infrastructures (crisis management institutions, health care, etc.),
- socio-cultural infrastructures (media, research, etc.).

Bruneau et al. (2003) says that these infrastructures would be resilient if they were characterized by systems that are:

- robust,
- redundant,
- resourceful,
- capable of rapid response.

The above mentioned properties can be defined as follows [3]:

- Robustness is strength or the ability of elements, systems, and other units of analysis to withstand a given level of stress or demand without suffering degradation or loss of function.
- Redundancy is the extent to which elements, systems, or other units of analysis exist that are substitutable, i.e., capable of satisfying functional requirements in

the event of disruption, degradation, or loss of functionality.

- Resourcefulness is the capacity to identify problems, establish priorities, and mobilize resources when conditions exist that threaten to disrupt some element, system, or other unit of analysis; resourcefulness can be further conceptualized as consisting of the ability to apply material (i.e., monetary, physical, technological, and informational) and human resources to meet established priorities and achieve goals.
- Rapidity: the capacity to meet priorities and achieve goals in a timely manner in

order to contain losses and avoid future disruption

In this regard, assessment of the resilience of infrastructure can deal with four interrelated dimensions: technical, organizational, social and economic issues of critical infrastructure that influence the robustness or capability of rapid responses within these infrastructures and their functioning [3].

4 ENHANCING THE RESILIENCE OF SOCIETY THROUGH RESEARCH IN HORIZON 2020

Enhancing the resilience of society against natural and man-made disasters is one of the primary aims of the Horizon 2020 - Work Programme 2014 – 2015 entitled „Secure societies – Protecting freedom and security of Europe and its citizens“. These issues are included in call „Disaster-resilience: safeguarding and securing society, including adapting to climate change„ that is divided in five parts [5]:

1. Crisis Management and Civil Protection with a view to strengthening prevention and preparedness against natural and man-made disasters by underpinning an all-hazard approach to risk assessment across the EU.
2. Disaster Resilience and Climate Change with a view to developing solutions, for climate change adaptation in areas potentially affected by more extreme weather events and natural disasters, such as for port cities, critical infrastructures, tourism.
3. Critical Infrastructure Protection with a view to building up community resilience and resilience of critical infrastructure, including against cyber-crime and cyber-terrorism.
4. Communication Interoperability facilitating disaster management, notably through communication technologies for crisis response actors and the linking of situational awareness centres.
5. Ethical/Societal Dimension.

The research issues of critical infrastructure resilience are subject of the third part of the call entitled „Critical Infrastructure Protection**“** that includes six topics as follows [5]:

1. Critical Infrastructure “smart grid” protection and resilience under “smart meters” threats - the objective is to analyse potential new threats generated by the massive introduction of “smart meters” on the distribution grid system and propose concrete solutions in order to mitigate the risks, improve resilience and reduce vulnerability of critical infrastructure “smart grid”.
2. Demonstration activity on tools for adapting building and infrastructure standards and design methodologies in vulnerable locations in case of natural or man-originated catastrophes – the objective is to develop methods and tools for adapting building and infrastructure standards and design methodologies in vulnerable locations to climate-related impacts and other natural hazards. This topic is complement of the FP7 research topic focusing on impacts of extreme weather on critical infrastructure
3. Critical Infrastructure resilience indicator - analysis and development of methods for assessing resilience - the objective is to develop a holistic approach to the resilience of critical infrastructure addressing a broad variety of issues including: human factors, security, geo-politics, sociology, economy, etc. and increased vulnerability due to changing threats.
4. Protecting potentially hazardous and sensitive sites/areas considering multi-sectorial dependencies - the objective is to develop and test qualitative methods that involve identifying links between sectors and evaluating how

impacts from a Seveso type accident might affect them (cascades effects) and quantitative methods that evaluate socio-economic impacts of such accidents.

5. Improving the aviation security chain - the objective is to develop solutions for higher levels of security and test their impact and viability, e.g. alternative screening processes and interventions, conditions for the most effective and efficient results of aviation security controls, etc.
6. SME instrument topic: "Protection of urban soft targets and urban critical infrastructures" – the aim is to engage small and medium enterprises in security research and development and to facilitate and accelerate the transition of their developed products/services to the market place. Urban soft targets include e.g. parks, squares and markets, shopping malls, train and bus stations, passenger terminals, hotels and tourist resorts, cultural, historical, religious and educational centres and banks. Critical infrastructure in urban context includes e.g. energy installations, networks, communications, finance, water networks, supply chain and government.

5 CONCLUSION

Resilience has become an important dimension of the critical infrastructure protection. It is rather a new concept that has been intensified, especially due to increasing dependency of societies on critical infrastructure services and in terms of great disasters, e.g. Fukushima disaster. Enhancing disaster resilience of society against natural and man-made disasters is an important factor of reducing the impacts of these disasters on the nation and its communities. But there is no single strategy that will make all infrastructure systems resilient since each system has its own priorities, objectives and resources. Ensuring a sufficient level of resilience for an infrastructure system requires trade-offs [1].

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