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ENHANCING SOCIETAL RESILIENCE AGAINST DISASTERS: ENGAGING THE PUBLIC VIA SOCIAL TECHNOLOGIES

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Abstract

Purpose *– The research aims to discuss the importance of introduction of ICTs in the concept of societal resilience building and analyze e-tools engaging the public in safety enhancement.*

Methodology *– The authors of this paper analyzed scientific literature to identify the main elements of societal resilience building, to distinguish the areas in which social technologies could be applied for the purposes of enhancing resilience. Empirical study was focused on the search and content analysis of global, EU, Lithuanian national and local e-tools created to inform the public about imminent and/or actual disasters and emergencies, communicate data among civil protection authorities, and collect from and disseminate among society disaster related information.*

Findings *– Contemporary disaster management is increasingly orienting on preventive activities based on inclusion of society. Evolving the concept of societal resilience focuses on enhancing abilities of communities or society to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner. Consequently, resilience moves from a passive technical concept, relevant to resistance*

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of infrastructures, to a socially active process, supporting the phase of risk prevention. Therefore, it should be present in all phases, from risk prevention to emergency management.

In the Internet enabled society, information and communication technologies (ICTs) could foster building of the capacity of resilience in urban and regional complex systems by informing, warning and directing people for correct actions in case of disasters. There is a number of e-tools designed for exchange of information at different levels (global, EU, national, local, organizational), serving for different tasks of pre-, during or/and post-disaster management. Those could be grouped by their purposes to the following ones: e-tools for warning of communities at risk, based on broadcasting; WebGIS-based crowdsourcing platforms to collect and update user generated content; Open-source ICT platforms Oriented on Public awareness on natural disasters; ICTs for civil protection planning, decision making for response, recovery and allocation of resources in case of disasters.

The most oriented on public engagement are broadcasting and crowdsourcing based ICT tools. However, the empirical research revealed that use of such kind of social technologies by Lithuanians remains relatively vague in terms of public activity: crowdsourcing platforms are mostly uploaded with small-scale problems of everyday life character, and use of the broadcasting services among citizens is not popular enough yet, and some organizational and technological barriers worsen situation even more. This could point to an assumption that Lithuanian society does not percept disasters as real threats for their lives, health, property or environment.

***Research limitations** – The current research is not sophisticated with the comparative analysis of experiences of foreign countries in application of broadcasting and crowdsourcing based technologies for increasing societal resilience. Such analysis could be useful for development of effective means for enhancing public awareness on disasters, consequently – for building safety culture in Lithuania by application of social technologies. Therefore, investigation of good praxis could be considered as a relevant topic for further research.*

***Practical implications** – The paper explores publically accessible ICT means that could serve for enhancing of information and education level of the public on disaster related content, and hence, for rising safety culture.*

***Originality/Value** – The research reveals societal resilience as an active process, supporting the phase of risk prevention, not only disaster response and recovery. The paper assumes the triple role of citizens in all disaster management process. By application of social technologies, society acts as a safety information source (by application of crowdsourcing based e-tools); as information transmitters (when ICTs include information sharing functions); and as information receivers (WebGIS and cell broadcast based ICTs). Therefore, the research implies disaster management authorities to pay more attention for social technologies as potential tools for increasing pro-activity of disaster management and building up societal resilience.*

***Keywords** – societal resilience, ICT solutions for disaster management, disaster management related e-tools.*

***Research type** – viewpoint.*

1. Introduction

For several decades in many areas of the EU, the occurrence of catastrophic events has been increasing (such as earthquakes, landslides, floods, forest fires, etc.) and consequent costs put on the community (local, national and European), both in terms of human life and damage to environmental, social-cultural and economic assets. Volumes of research results discuss tendencies of natural disaster development that require increasing amounts of actions to assure safety of people, infrastructures, and the environment. Coppola (2007) generalized studies in the field and envisaged five main trends: overall number of people affected by disaster is rising; overall, disasters are becoming less deadly; disasters are becoming more costly; poor countries are disproportionately affected by disaster consequences; the number of disasters is increasing each year. A number of costly disasters prove that these statements are applicable also to European countries. Among the events resulting in the largest overall losses were the floods in Central Europe (2002, over EUR 20 billion), in Italy, France and the Swiss Alps (2000, about EUR 12 billion) and in the United Kingdom (2007, over EUR 4 billion); the earthquakes in Izmir (Turkey, 1999, over EUR 11 billion) and L'Aquila (Italy, 2009, more than EUR 2 billion) (EEA Technical Report, 2010). It is clear and agreed by experts that the impact of natural hazards is closely connected with the resilience of complex systems and urban regions.

Contemporary disaster management is increasingly orienting on preventive activities based on inclusion of society. Evolving the concept of societal resilience focuses on enhancing abilities of communities or society to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner. Consequently, resilience moves from a passive technical concept, relevant to resistance of infrastructures, to a socially active process, supporting the phase of risk prevention. Therefore, it should be present in all phases, from risk prevention to emergency management. In the Internet enabled society, information and communication technologies (ICTs) could foster building of the capacity of resilience in urban and regional complex systems by informing, warning and directing people to correct actions in case of disasters. E-tools based on the collection and maintenance of user-generated content and its geographic visualization could serve as means of public engagement, and consequently – instruments for promoting threats awareness. In addition, ICTs could be appreciated as intermediaries helping users to make better decisions facing imminent or actual hazard. Therefore, the research aims to discuss the importance of the introduction of ICTs in the concept of societal resilience building and analyze e-tools engaging the public in safety enhancement.

The research methodology is based on scientific literature analysis and empirical study. First, the authors of this paper analyzed scientific literature to identify the main elements of societal resilience building, to distinguish the areas in which social technologies could be applied for the purposes of enhancing resilience. Empirical study was focused on the search and content analysis of global, EU, Lithuanian national and local e-tools created to inform the public about imminent and/or actual disasters and emergencies, communicate data among civil protection authorities, and collect from and disseminate among society disaster related information. In total, 21 e-tools were reviewed, which are available for the public and limited use in the disaster field. However, the authors selected

only the most visible by Google search open-source platforms and the most important limited access e-tools, which were identified by civil protection professionals.

2. Linking the concept of societal resilience with social technologies

Global and environmental disturbances (including rising numbers of natural and manmade disasters) enhanced the importance of resilience conceptualization. Scientists and professionals discuss and define resilience as a function of rising need for reducing vulnerability in different contexts (Boin, *et al*., 2010). The FP7 project em-BRACE (Building Resilience amongst Communities in Europe, Related to Indicators of Societal Resilience to Disasters) (em-BRACE, 2012) team has systemized literature on resilience and determined five broad areas in which discourses about resilience have raised and proceeded:

– *Psychological resilience* – a multi-level perspective dealing with a diversity of aspects of individual-internal capacity as well as an external capacity (taking into account the influences of social context) to choose from a vital and authentic life (e.g., Wagnild, 2010), resist against stress (e.g., Bonanno, *et al*., 2006, Fergus and Zimmerman, 2005) and recover emotional well-being (Ong, *et al*., 2006). Contemporary psychological resilience includes overcoming of negative effects of risk trajectories and amplifies protective factors that ensure psychological well-being and social functioning and development. Psychological resilience covers not only individual level of resilience, but expands to family, organization and community levels. Therefore, mechanisms to achieve resilience are oriented to all these levels. Protective factors at personnel level include, but are not limited to, perseverance, self-reliance, confidence, sense of community, communication, positive emotions and thinking, problem solving, support systems (em-BRACE, 2012). Emotionality, communication, support, closeness and adaptability are the most influential factors of resilience at family level, while positive command environment and teamwork condition psychological resilience at organizational level. Analyzing community level, cohesion, empowerment, collective efficacy, social justice, connectedness, assess and other elements emerge as key factors influencing psychological resilience at social medium (em-BRACE, 2012). All the levels mentioned above overlap encompassing elements of psychological resilience, such as risk and protective actions perceptions. Therefore, facilitation of individual and social resources, networking and empowerment are important aspects of risk mitigation and preparedness.

– From the *organizational and institutional* perspective, disturbances could rise from any unexpected potential harmful event disrupting routines as well as everyday risks, stress and strain (Voges and Sutcliffe, 2007). Resilience building at organizational level and within networks of organizations aims at maintaining "positive adjustment under challenging conditions such that the organization emerges from those conditions strengthened and more resourceful" (Voges and Sutcliffe, 2007). Mechanisms to achieve resilience include, but are not limited to, sense-making, mistake orientation, organization architectures (centralized vs. decentralization), structural flexibility, redundancy, high-performance relationships, mix-institutional approaches (formal and informal), etc.

Balanced characteristics of the aforementioned factors could "enhance the capacity of organization to deal with anticipated and unanticipated events possibly exceeding their established routines and procedures" (em-BRACE, 2012).

– *Ecological and social-ecological resilience* focuses on capacities of a system (ecological and social, and both coupled) to "absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks" (Walker, *et al*., 2004). The scope of social-ecological resilience building is cross-scale interaction in the complex system while developing a capacity to respond and absorb disturbance, self-organize, learn and adapt. The mechanisms to achieve resilience before a disaster hits include learning, detecting problems, early warning and responses, cooperation, application of the lessons learnt, innovation, etc. After disturbing event, resilience is manifested by release and reorganization, system memory (em-BRACE, 2012).

– *Critical infrastructure resilience* is within topics of interest of many scholars in the geophysics-seismic engineering, safety, contingencies and infrastructures fields (e.g., Bruneau, *et al*., 2003; Boin and McConnell, 2007; Fritzon, *et al*., 2007; Hellström, 2007, etc.). A resilient engineering system is the one that manifests itself as diminishing failure probabilities; reducing consequences from failures (in terms of lives lost, damage, and negative economic and social consequences); shortening time for recovery (O'Rourke, 2007). Critical infrastructure needs to possess features, such as robustness, redundancy, resourcefulness, capability of rapid response "with respect to the four interrelated components i.e. economic, social, organization, and technical" (em-BRACE, 2012).

Overviewing the the above discussed perspectives of resilience, it is obvious that there are some aspects, which crosscut all four types of resilience. Among such common resilience characteristics/resilience building factors are those related with interaction, communication, learning, cooperation, relationships and other factors of social character. Appreciating the fact that in contemporary society a big part of social interaction moved to virtual medium, undoubtedly social technologies could contribute for development of the aforementioned factors in an effective manner.

Notwithstanding the variety of application in diverse contexts, the core elements of the word "resilience" remains constant. For the present research, the definition proposed by Twigg (2009) is applied, stating that social resilience "can be understood as the capacity to:

- anticipate, minimize and absorb potential stresses or destructive forces through adaptation or resistance;
- manage or maintain certain basic functions and structures during disastrous events;
- recover or 'bounce back' after an event".

Such aspects of resilience as "before", "during" and "after" potentially harmful events correspond disaster management cycle. Consequently, analysis of social technologies for building resilience can be expanded to a context of social technologies for disaster management.

3. Social technologies for support of disaster management processes

To guarantee an efficient and sustainable disaster management, it is essential to develop better coordination and cooperation between organizations that are involved in disaster management (authorities, also other policy-makers, public interest groups, civil society organizations and other public or private stakeholders involved or interested in the management and reduction of disaster risk), as well as improved information about populations involved.

Resilience building (especially against a disaster) can only be tackled effectively if all stakeholders cooperate. Additionally, it has to be moved to a multidisciplinary approach, integrating the specific issues of each of the entities involved in emergency management. They will use their own scientific, informational and technological skills to facilitate integrated data management, and efficient and continuous updates. Stakeholders should take into account the necessity to anticipate, plan and implement an appropriate process during an emergency, aimed at dealing with a lack of material, technical or human resources or capacities necessary to maintain basic functions and services until recovery from negative effects and the return to the normal conditions.

The innovations in ICT sector allow us to use many kinds of specific e-tools available for public and limited use in disaster field (see figure below) during all the stages of disaster management (prevention, preparedness, response, recovery). These e-tools are for end users, facilitating social interactions, and for emergency management authorities, which are able to acquire, collect and update sectorial data and return it on maps (i.e., through WebGIS systems). These maps are important tools to show information about hazards, vulnerability, exposure in particular areas, supporting the risk assessment process and overall risk management strategy. They will help public authorities in setting priorities for risk reduction strategies.

Moreover, it should engage people using an "organizational behaviour" approach and to encourage a cultural change shift to an Ecosystem Approach, which is meant as a strategy for the integrated management of land, water and living resources, and promotes conservation and sustainable resource use.

There is a number of types of ICTs, which are applied in each stage of disaster management (see Figure 1):

– During the *phase of prevention,* which aims at mitigation of risks, and the *phase of preparedness* (before a disaster hits), diverse types of ICTs and related geospatial data and information are used. WebGIS-based crowdsourcing platforms, Open-source ICT platforms oriented on public awareness on natural disasters and Social networking websites, which contribute to inform, raise awareness, and thus, make citizens aware (ready to be involved as active actors during such phases), enhancing the ability of a "resilient community". However, in this process the role of experts is important in verifying the truthfulness and reliability of the collected data and information. These data and information (in continuous updating) have to be collected and integrated in an interoperable way in specific WebGIS. This contribute to prevention and preparedness by supporting specific public authorities and policy makers to a correct and sustainable planning, public affairs governance and management (land use, riverbeds, slopes,

underground cavities, coastlines, etc.) of complex systems, enhancing community's capacity in anticipating and preparing for crisis.

– When *preparedness* transits to *response phase*, public warning and information systems (i.e., Cell Broadcasting) are extremely important. Crisis and disaster data and information from social networking websites have to be extracted in real-time through a web-based filtering system (also verifying their accuracy and reliability), supporting emergency planning and allowing a quick, timely and effective emergency response management. For example, *Twitcident*, co-funded by the EUFP7 project ImREAL (http://imreal-project.eu/), is a web-based filtering system that extracts crisis information from Twitter in real-time to support emergency response efforts (Meier, 2012). In addition, the incoming data and information and their exchange management (from operation centre to rescuers) allow the optimization of efforts and resources during this phase. Thus, responsible authorities should work more through social networking websites in order to reach and engage more people, enhancing the ability of a "smart emergency response planning".

– If disaster hits, during *response phase* and at the start of *recovery*, it is crucial that all the institutions involved in rescue operations receive timely, trustful and accurate information required to make right decisions and actions. Therefore, ICTs support acquiring and managing interoperable data and information in order to augment public authorities' crisis management capabilities. In addition, informing harmed and general public social networking websites could serve as communication channel. However, during disasters, use of such tools encompasses some risks related to information overload and disinformation, consequently increasing risk that people make wrong decisions.

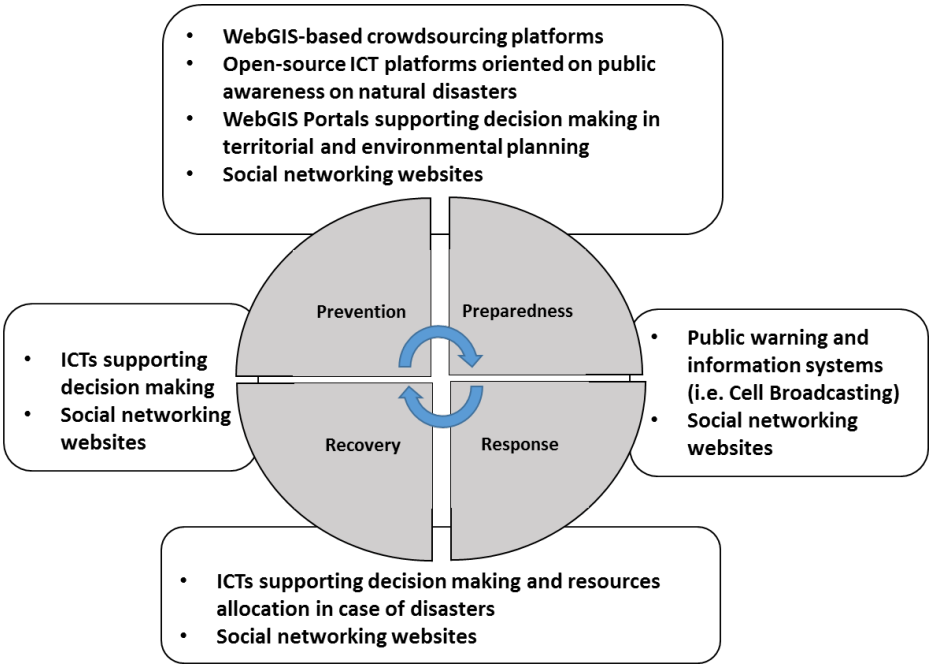

Figure 1. Disaster Management Phases and related ICTs and social media technologies

– When danger has passed, i.e., during *recovery phase* and transiting back to prevention, institutions responsible for ensuring smooth getting back to normal life need diverse information for decision making (e.g., number of disaster victims, damaged properties, buildings and roads, critical infrastructures, sensitive sites, etc.). Social networking websites could serve for search of missed people, informing society on procedures of support for disaster victims, education about dealing with post-disaster stress, providing citizens with a greater role in preparing for and managing crises which will help in resilient communities building.

4. Overview of e-tools supporting societal resilience building

There is a number of e-tools (ICTs) designed for exchange of information at different levels (global, EU, national, local, organizational) that serve for different purposes of pre-, during or/and post-disaster management. In addition, some of these ICTs are publically accessible, while access to other systems is limited to Contact Points or only authorized disaster management actors are able to use them. ICT systems contain the miscellany of information: statistical data, maps, resources tables and databases, activities, special events registration sections, modules of the action plans of the event or scenarios, modules for reports on situations of danger, contact and communication information, etc.

4.1. Public warning and information system

The public can be warned and informed using modern Cell Broadcast Technology by sending messages directly to the mobile phones of residents and foreigners in the territory of a country. In case of Lithuania, Cell Broadcast Technology allows delivering informational messages within a specified territory of the public mobile phone communication network coverage area. Unlike with sending short messages (SMS), cell broadcast messaging does not require search and identification of a subscriber, i.e., messages are simultaneously delivered to all citizens within a specified area, who have the cell broadcasting messaging function activated on their mobile phones, irrespective of the number of residents in that territory and avoiding congestion on public mobile communication networks. The messages can be delivered not only to the Lithuanian residents, but also to foreign citizens in the territory of Lithuania[1].

Despite the fact that the system is assumed to be very modern, it has a few obstacles to overcome. First of all, technical issues can occurr concerning the network used. Messages could be received only by citizens using phones with 2G network, while the most of the smartphones function only in 3G or 4G network. However, the problem has been tackled by extending the functionality of the system. Another barrier that prevents the system from achieving the highest result is the inaction of municipalities. According to the Annual Analysis of Civil Protection System carried out by the Fire and Rescue

1 The Official Website of Public Warning and Information System Using Modern Cell Broadcast Technology. [interactive]. [accessed on 2014-10-03]. <http://gpis.vpgt.lt/go.php/lit/English>.

Department under the Ministry of the Interior in 2013, only two (of 60) municipalities was connected to the system (The Annual Analysis of Civil Protection System, 2014). The involvement of municipalities in this process is of grave importance because the effectiveness of the public warning and information system depends on how fast the information about the imminent or actual emergency is received and how quickly the decision to use the information is made.

4.2. Web GIS-based crowdsourcing platforms

Web GIS-based crowdsourcing platforms are used to collect and update user generated content. These platforms can be exploited in thousand different ways. A significant part of them is used by business companies to pool new fresh advertising ideas (e.g., means for people to support the organization's campaigning activities). However, numerous of successful projects were applied for the improvement of public service or to increase public participation, e.g., a platform for citizens to identify and report non-emergency civic issues (e.g., SeeClickFix or CitySourced), such as public works, quality of life and environmental issues, or a platform to collect data for lost persons (e.g., Katrina PeopleFinder Project), etc.

Boccardo and Pasquali (2012), while analysing the emergency management of Haiti earthquake in 2010, underlined the importance of Web GIS-based crowdsourcing platform. They stated that serious contribution was made by volunteer and technical communities, such as OpenStreetMap, Ushahidi, Sahana and Crisis Mappers, who created open platforms able to manage a huge amount of information that emergency system was not able to process because of the technical limits.

In Lithuania, there is no Web GIS-based crowdsourcing platform specialised for emergency management related issues. However, the content analysis of the platform allowing citizens to report non-emergency neighbourhood issues (http://www.vilnius.lt/lit/Miestoproblemos/29) revealed that the popularity of such web tools is questionable in Lithuania. It could be argued that the promotion of the platforms is needed to ensure the engagement of society.

4.3. Open-source ICT platforms oriented on public awareness on natural disasters

The platforms provide society with the possibility to monitor natural events (Table 1). The most important advantage of the platforms is that the information is presented constantly to ensure coherent interpretation throughout the given territory.

Table 1. The examples of Open-source ICT platforms oriented on public awareness on natural disasters

Name of the platform	Short description	Possible impact on social resilience
MeteoAlarm (http://www.meteoalarm.eu/)	European extreme weather warning system, making available the warnings about the hazardous meteorological and hydrological phenomena in the region	Making aware and, therefore, better prepared citizens in relation to the state of the ongoing alarm by the Local Authorities, in order to reduce the daily activities of unaware citizens
Floods Portal (http://floods.jrc.ec.europa.eu/) European Soil Portal (http://eu-soils.jrc.ec.europa.eu/)	Databases developed by Joint Research Centre of the European Commission bringing together information on river floods and flood risk, and soil data at European level	Improving the vulnerability and exposure knowledge of complex systems and related populations to a better sustainable approach and resources planning for the prevention, preparedness, response and recovery
Seismic Portal (http://www.seismicportal.eu/) The Waveform Explorer (http://145.23.252.222/eida/webdc3/) Verce Platform (http://portal.verce.eu/home) Seismic Hazard Portal (http://www.efehr.org:8080/jetspeed/portal/ The European Archive of Historical Earthquake Database (http://www.emidius.eu/AHEAD/index.php)	E-platforms dedicated to earthquake risk management providing information on historical, actual and forecasted data on seismic events across the EU and worldwide	

4.4. WebGIS portals and platforms supporting decision making in territorial and environmental planning

Geospatial information systems (GIS) are widely used in disaster management to equip decision-making process with geographical information (Table 2).

Table 2. The examples of WebGIS Portals and Platforms Oriented on Collecting and Updating Geospatial Data for Supporting Decision Making

Name of the platform	Short description	Possible impact on social resilience
GeoNode (open source) (http://geonode.org/) ArcGIS (commercial) (https://www.arcgis.com/)	GIS systems capacitate users for recording, storage, analysis and manipulation, management and presentation of geospatial data. GIS tools are integrated in e-platforms, where territory-related information is crucial, including risk and disaster management ICTs	Involved and aware citizens in collecting and updating geospatial data (multidisciplinary) to support experts and specific authorities for decision making in order to reduce social vulnerability and exposure to the risks
HLanData Geoportal (www.hlandata.eu)	A GIS-based Geoportal that uses OGC conform WebMap services to show harmonised Land Use and Land Cover datasets from different sources together in one map to support cross-border decision making. It also links to regional portals in Spain, Czech Republic and Slovakia in the environmental sector	Harmonization of the Land Use and Land Cover datasets in order to have an updated framework to support experts and specific authorities for decision making regarding the interactions between land use and related dynamics (natural and man-made), especially in cross-border areas
CentropeMAP/CentropeSTATISTICS Geoportal (www.centropemap.org)	Cross-border interface for geodata stored in four different CEE-countries (Austria, Hungary, Slovakia, Czech Republic)	Harmonization of data formats and procedures for common data use (Biota, Planning and Cadastre, Transportation, etc.) in cross-border areas to develop common solutions, enhance and improve a sustainable complex systems planning, with a strong know-how transfer
Plan4all (www.plan4all.eu)	The harmonization of spatial planning data, including natural risk data, according to the INSPIRE Directive	Contributing to making data of the urban and regional planning (mainly economic, social, cultural and ecological) more accessible, usable and exploitable to support experts and specific authorities for decision making

Attract-SEE (www.attract-see.eu)	EU-Project on the development of a territorial monitoring framework in South-East Europe	Improving the competence and skills needed to monitor and understand interrelated territorial trends, and to incorporate the acquired knowledge into an integrated policy development process, in order to achieve territorial cohesion and other development goals at all levels (transnational, national, regional and local)

4.4. ICTs applied in the area of natural risks management

The aim of emergency management information system is to assure the management of information flows and communication in case of emergency or while performing daily activities. The system contributes to the tasks of emergency management operation center. This system usually contains contact information, maps, resource table, activities and special events registration table, table of the action plans of the event, table of the reports of the situation, etc. The system can be used at private entity level, municipal level and state level (Table 3).

Table 3. The examples of Emergency Management Information System

Name of the software	Short description	Possible impact on social resilience
CERT-RMM (http://www.cert.org/resilience/products-services/cert-rmm/)	The system that promotes the convergence of security, business continuity and IT operations activities to help organizations manage operational resilience and risk	Establishing the current level of capability in managing resilience, set goals and targets of a community, and develop plans to close identified gaps, developing more maturity and predictability models about how the system will perform under stress
WebEOC (https://www.intermedix.com/products/webeoc/webeoc.php)	The system provides a single access point for the collection and dissemination of emergency or event-related information. WebEOC provides real-time information as provided by the users and can be used during the planning, mitigation, response and recovery phases of any emergency. The system allows for sharing of information in a variety of ways, including document sharing, photo uploading, and displays for map and other GIS information	Building a common repository of information for daily use, allowing users to document comments and recommendations after an event and track the resolution of action items. Routing the received requests to the specific authorities, allowing the experts to plan and manage all crisis management and public safety related activities

The Crisis Information Management Software (CIMS) (http://www.ists.dartmouth.edu/projects/archives/cims.html)	The software found in emergency management operation centres supports the management of crisis information and the corresponding response by public safety agencies. The primary goal of the CIMS is to assist Emergency Management Agencies in comparing and contrasting commercially available CIMS software	Improving the data interoperability for the experts and decision makers, supporting the management of the flow of critical event data in different sectors of the emergency management and response community
NISSSC (http://www.uccs.edu/erosi/what-is-erosi/emergency-management-information-systems.html)	Emergency management information systems encompass a variety of technological tools used while preparing for, responding to and mitigating the effects of natural and man-made disasters. These tools include radios, phones, computers and mobile command units, as well as the software requirements of those tools	Enhancing and improving better preparedness for further similar situations (natural and man-made disasters) to support the management of crisis information and the corresponding response by public safety agencies, in order to limit the damage of similar events already occurred
MERI (http://meri.njmeadowlands.gov/about-meri/objectives/)	The software collects, analyzes and communicates environmental information, provides baselines for assessing environmental improvements in the district. Also, it promotes regional sharing of information resources with district municipalities to help them better manage municipal assets, plan improvements and prepare for and combat emergencies	Enhancing and improving community and regional resilience by collecting, updating and sharing interoperability data, in order to support the experts and decision makers in land use planning and emergency management processes

In Lithuania, well-developed emergency management information system does not exist. However, considering its importance in case of emergency, it is the question of time when responsible institutions will adapt them in their daily routine.

5. Conclusions and suggestions

There is nothing we can do to stop natural (and man-made) disasters but we can help mitigate its impact. The related data and information (verified their accuracy and reliability) should support emergency planning and allow a quick, timely and effective emergency response management, contributing to building of resilience complex systems and communities. Therefore, it would be crucial to consider carefully how social media applications and tools can be incorporated into an integrated crisis management platform for effective crisis management during all phases (prevention, preparedness, response, recovery).

Information is an important key to risk management. ICTs are potentially useful and important tools for all kinds of users and organizations for improving the efficiency, speed, accuracy and optimization to tackle natural and man-made disasters during all phases (prevention, preparedness, response, recovery) of disaster and emergency management cycle. ICTs contribute to disaster management by helping decision makers and experts monitor and manage risks; providing early warning signals; raising awareness and enhancing capacities on disaster risk reduction issues in communities.

Engaging people with the use of social technologies is a good way to educate, raise awareness and make the citizens aware. To tackle this challenge, it is essential to focus and work on the possibility for all stakeholders involved in crisis and disasters management (citizenship, rescuers and policy makers) to have shared ICTs (e-tools, portals, platforms, etc.) that are accessible, usable, exploitable and interoperable, in addition to the multidisciplinary approach. Therefore, disaster management authorities are challenged to pay more attention for social technologies as potential tools for increasing pro-activity of disaster management and building up societal resilience.

The effectiveness of ICTs in reducing disaster risks and enhancing societal resilience depends on how these ICTs are used. This use in disaster management should not be seen as a choice between one type of technology over another. Many communication channels and technologies exist, and each can be suitable in a specific situation. The challenge, therefore, is to identify suitable combinations of technologies, aiming at improving a smart and sustainable resilience building and disaster and emergency management.

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