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Review Article

National Information Systems of Natural Crises in Some Countries

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Abstract

Context: The natural crises national information system (NISNC) has a key role in promoting natural crisis management by analyzing and understanding the situation, managing and allocating the resources, coordinating actions and supporting of decision making and exchanging of information. The purpose of this paper is to examine the NISNC general and technical characteristics and functional capabilities in Germany, the Netherlands, Romania, and Turkey.

Evidence Acquisition: This comparative study was conducted using databases like Google Scholar, Science Direct, PubMed and Scopus in the period from 2000 to 2017. The following featured were under the focus: being nationalized and computerized and availability of information. From among the 41 available studies, 24 were examined among which 12 belonged to Germany, 6 to the Netherlands, 3 to Romania and 3 to Turkey. Finally, the information obtained from different countries was compared on the basis of comparative tables.

Results: In all countries, the Interior Ministry was in charge of NISNC and NISNC is used in the entire cycle of crisis management (the Netherlands is used only in the reaction phase). This system has a modular design, distributed database, and mirror server. Synchronization allows the data recording in a system gets registered in other systems. NISNC is designed for static and dynamic data collection, with offline access allowed only in the Netherlands. The most common functional capabilities of the NISNC in selected countries were resource management, communication and reporting, status management and geographic information system.

Conclusion: NISNC leads to the improvement of cooperation, information exchange and coordination in the management of natural crises through providing methods, terminology, information formats, and standard operating procedures.

Keywords: Crises, Natural Crisis, Crisis Management, Information System, National Information System

1. Context

Crisis Management and Information Systems

Appropriate and efficient management of natural crises requires the coordination of the activities of various organizations to employees, business cultures, diverse technical systems and expertise [1] that is subject to the cooperation of the members of the national organizations and multiple local teams that work together to perform specific functions [2]. This puts organizations in need of communications [3 and 1] and sharing the information [5], which depends heavily on information management due to the complex information environment of crisis [6].

National Information System of Natural Crises (NISNC)

Crisis information management will be enhanced by the use of a proper information system that supports the data and information flow in crises [7]. The various information systems are used in crisis management while the new approach in this field is using integrated and national systems in crisis management [6]. National information system of natural crises (NISNC) paves the path for crisis management promotion through understanding and analyzing the location [6], managing resources [8], supporting decision making, coordinating the actions and supporting the exchange of information [9]. This system offers an effective and efficient structure for communication and coordination between agents and national and local organizations and helps problem-solving [7].

The system should be capable of supporting things like controlling and commanding, cooperation, identifying organizational roles, communication, information security, preventive measures, alerts management, performance, and evaluation of compliance with the rules [10]. In short, these systems seek to provide appropriate information for the right people, in the right format, in the right place and time [11].

NISNC database covers data on the risk assessment, vulnerability assessment, demographic distribution, critical infrastructure, support routes, human resources, equipment, communication facilities, damage assessment, and relief and is used in all stages of crisis management [12]. Several factors should be noted in NISNC development and design such as social, economic, institutional, political, cultural and technological factors. However, all of them are used in all crisis management items, but their level or weight is different, based on various events and each country's properties [13]. The organization's internal management, external policies, information coordination, and support are these systems' critical success factors [14].

The most important requirements for the NISNC design and development includes support for various functional areas, support for available infrastructure, using an agreed terminology and existence of interoperability [11]. A NISNC is effective and useful when system users, time, format and information distributing mechanisms are exactly specified and when its data is reliable, valid and access to it is easy and fast [15].

NISNC in Different Countries

The crisis management is one of the government's great roles and responsibilities and because of its sensitivity, the Interior Ministry, which is in charge of handling domestic special and great issues is the work operator. Ministry of Interior performs these tasks through the establishment of independent central crisis management in all studied countries (Germany, the Netherlands, Romania, and Turkey). National Crisis Management Center has the country divisions, with its corresponding centers created in provinces. This center is the best option for the development and maintenance of crisis information systems due to its expertise, resources and legal tools. At first, in the design of this system, the political power structure and the responsible institutions and organizations, and the way of their cooperating and coordinating with each other are noted; then, the attention is given to the system designing or architecting and developing [16-18]

Efforts have been made in Germany to organize available federal and state networks and systems in the form of a federal system rather than designing a completely new network or system. This results in reduced costs and better users' reception and increased efficiency and system productivity. In the field of architecture, deNIS II plus has considered two separate systems one of which is used

in public informing and the other one for information management. This results in taking into consideration management and security issues and preventing from increasing system traffic and its related problems due to people's visitings besides public education and promotion of popular culture in the face of crises and appropriate informing in crises [17 and 19].

In the Netherlands, measures have been taken to access the system in offline form because of the system focus on information exchange during the crisis, [20]. This is of great importance due to the possible damage to communication infrastructure, since the destruction of infrastructure, Internet outages and information exchange problems can have a devastating impact on crisis management.

There are three different operating levels of systems in Romania. At the lowest level (focused level on data), collection, processing and suitable dissemination of data are considered. The focus on helping commanders and managers is for conducting crisis management operations at the operational level. At the highest level (level of the decision making) attempts are to use decision support tools in order to improve the decision-making process output [21].

The studied system in Turkey is part of an e-government big project and is coordinated fully with other national information systems. There have been no national standards for data management in Turkey, so international standards have been used to ensure the flow of information between different centers [20]. Unlike the other countries, Turkey has tried to use open source standards in order to prevent problems associated with the copyright which impede easy use of the system by different institutions and associations. It has also used financial, technical, and foreign scientific support [22].

Developing NISNC needs an exchange of experiences and information with other countries and use their experiences in the development of such systems. As Iran is one of the top ten world countries in the field of natural crises, this study aims at investigating the overall system, technical features and functional capabilities in different countries through a comparative study.

2. Evidence Acquisition

This comparative study was conducted in 2017. To this aim and by use of keywords like "information system, crisis management, disaster management, natural emergencies management, national information system, natural crisis, crisis information system, disaster information system," the authors searched the Google Scholar, Proquest, Science Direct, PubMed, Scopus, Springer and Embase databases and NISNC was studied in different countries in line with research targets (general and technical features and functionalities). Three main criteria were used to select the countries. As the first criterion, the relevant information system had to be computerized. Consequently, as Canada [23] and Denmark [16] had a radio system, they were excluded from the study. The second criterion was comprehensiveness and nationality of the crisis information system. As a result, Australia (with local and state information systems for disaster management) [24 and 25] and Spain (which had a resource management information system in crisis) [26] were excluded.

Due to the confidentiality of crisis management data in many countries, the third criterion was the availability of sufficient and accurate information. America, New Zealand, and India were excluded according to this criterion. Finally, four countries, namely the Netherlands, Germany, Romania, and Turkey had all three relevant criteria and were studied.

Choosing the studies and evidence was fulfilled by two researchers to avoid bias. The two inclusion criteria in selecting studies and evidence were to see if they had discussed architecture and natural crisis

information systems. The exclusion criteria were studies investigating crisis management systems (not crisis information systems) and studies that focus only on simulation or training.
Finally, 41 documents were found among which 2 cases had little to do with architecture, 3 cases were duplicate or overlapping with each other, 5 cases had noted crisis management while referring to data management and 2 cases were excluded due to failing to report useful information. Finally, 24 documents were used in the study among which 12 cases were related to Germany, 6 to the Netherlands, 3 to Romania and 3 to Turkey.

3. Results

In this section, according to the research objectives, the findings are presented in three parts: general aspects of the NISNC, technical issues, and functionalities of NISNC.
In all studied countries, the system is used by every involved individual (first responders, operators, administrative staff and operational, central and excellent managers). Due to security issues, the system is designed in such a way that only native users can access it, even related webs which usually receive and give information could merely access it in the national language. Table 1 shows the general features of NISNC in the selected countries.

Table1. NISNC general features in studied countries

Country / Public features	Germany	Netherlands	Romania	Turkey
Authority	Ministry of Interior	Ministry of Interior	Ministry of Interior	Ministry of Interior
System name	deNIS II plus	LCMS	EMIS	MIL-EMIS
Application	The full cycle of crisis management	The reaction stage	The full cycle of crisis management	The full cycle of crisis management
Availability	Internal Only	Internal Only	Internal Only	Internal Only
language	German	Dutch	unclear	Multilanguage
Country coverage	Full	80%	Full	Full
How to use	Semi-optional	Optional	Optional	Optional
Fund	Internal	Internal	Internal	The World Bank

These systems have a platform due to the critical value of information exchange during the crisis so it can access the system through computer and laptop and mobile and tablet. Table two demonstrates the technical features of NISNC.

Table2. NISNC technical features

Country / Technical features	Germany	Netherlands	Romani	Turkey
Design structure	Modular	Modular	Modular	Modular
Database type	Distributed	Distributed	Distributed	Distributed
Platform	Mobile-computer	Mobile-computer	Mobile-computer	Computer
Availability	Online	Offline - Online	Online	Online
Mirror server	Present	Present	Present	Present
Synchronization	Present	Present	Present	Present
Data type	Static-dynamic	Static-dynamic	Static-dynamic	Static-dynamic
Data exchange type	Automatic	Automatic	Automatic	Semi-automatic

These systems have functionality that determines the system's actions and operations. Table 3 shows the functionalities of the system.

Table 3. NISNC functionalities in selected countries

Country / Functionality	Germany	Netherlands	Romani	Turkey
Resources management	√	√	√	√
Decision support	√	√	√	-
Communication	√	√	√	√
Reporting	√	√	√	√
Simulation	√	-	√	√
Maneuver and training	√	-	√	√
Status management	√	√	√	√
Command	-	-	-	√
Control	-	-	-	√
Spatial data	√	√	-	√
Geographic information system	√	√	√	√
Geographic information mapping	-	√	-	-

4. Discussion

In all studied countries, NISNC was used in the full cycle of crisis management, but in the Netherlands, the system is only used to respond to the crisis. This could be due to the specialized approach to managing different phases of the crisis and the existence of information systems for managing other phases. In Germany and the Netherlands, the national language is used for the presentation and display of information [17 and 20],but Turkey also provides information in English [22] so that international experts working in Turkey but not fluent in Turkish can access it. In general, Turkey has taken an international approach because it has used foreign funds to develop the system and has used an international language to display and report information.

All of these systems have a modular design, but they differ in type and connection between modules. The most common modules are communication, planning, resource management, and geographical information system but each country uses different modules and functionalities according to its crisis management processes. For example, the documents exchange modules, tasks, and advertisement were used in the Netherlands[20], the situation management module belonged to Germany[17], modules of creating the task force, budget, rescue, and hazardous materials management modules existed in Romani[21] and administrative and decision-aid modules were used in Turkey[22]. Online access was available in all countries, but offline was also available in the Netherlands .This is especially important in the event of crises that disrupt access to data and quick decision-making.

Some of these systems functionalities (such as communications, management, and geographical information system) act as essential tasks of crisis management and usually exist in all relevant systems; but the other functionalities will be determined based on need assessment studies and overall structure of the crisis management in each country and its requirements. For example, Turkey also uses this system for command and control [22] or in the Netherlands Geographic information mapping is used to convert geographical information from different structures and terminologies [20]. This means that each system can have different functionalities based on their environmental and field conditions.

5. Conclusion

In all studied countries, the highest authority for internal affairs is responsible for NISNC development and implementation. They have applied similar strategies with different approaches in order to meet their local needs according to a comprehensive scientific model. In technical aspects, these systems approximately were similar across countries, all of which emphasized standardization of data, used the same structure and architecture, and emphasized wide and reliable accessibility. The crisis management structure, the rate of gravity, the information technology infrastructure and the level of access to spatial technology are factors that determine the capabilities of the system.

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Conflict of interest

The authors declare no conflict of interest.

References

1.Association for Information Systems. Building a Better World Through Information Systems. Proceedings of 35th International Conference on Information Systems. 2014; Auckland, New Zealand.

2.Datt G, Bhatt A K, Kumar S. Disaster Management Information System Framework using Feed Forward Back Propagation Neural Network. International Journal of Advanced Research in Computer and Communication Engineering. 2015; 4(3): 510-514.

3.Boin A, Busuioc M, Groenleer M. Building European Union capacity to manage transboundary crises: Network or lead-agency model? Regulation & Governance. 2014;8(4):418-436.

4.Hiltz S R, Van de walle B, Turoff M. The Domain of Emergency Management Information. In: Van de walle B, Turoff M, Hiltz S R, eds, Information Systems for Emergency Management. Advances in Management Information Systems. Armonk, NY: M.E. Sharpe; 2010. Vol.16 P. 3-20.

5.Hristidis V, Chen S, Li T, Luis S, Deng Y. Survey of data management and analysis in disaster situations. The Journal of Systems and Software. 2010; 83: 1701–1714.

6.Ramete M G, Lauras M, Benaben F, Lamothe J. A collaborative information system supporting decision and coordination in the transport crisis context. Proceedings of the 9th International Conference on Modeling, Optimization & simulation, 2012 Jun 6-8; Bordeaux, France.

7.Dorasamy M, Raman M. Information Systems to Support Disaster Planning and Response: Problem Diagnosis and Research Gap Analysis. Proceedings of the 8th International ISCRAM Conference. 2011; Lisbon, Portugal.

8.Kienzle O, Guelfi N, Mustafiz S. Crisis Management Systems A Case Study for Aspect-Oriented Modeling. In: Katz S, Mezini, M.editors. Transactions on Aspect-Oriented Software Development. volume VII.Berlin, Springer Berlin Heidelberg. 2010; p. 1-22.

9.Meum T, Munkvold B. Information Infrastructure for Crisis Response Coordination: A Study of Local Emergency Management in Norwegian Municipalities. In: Comes T, Fiedrich F, Fortier S, Geldermann J, Müller T, editors. Proceedings of the 10th International ISCRAM Conference. 2013; Baden-Baden, Germany p. 84-88.

10.Hallberg N, Hallberg J, Granlund H, Woltjer R. rational for emergency management systems for local communities: a need assessment. Proceedings of the 9th International ISCRAM Conference. 2012; Vancouver, Canada,

11.Schryen G. Risk Reduction in Natural Disaster Management Through Information Systems: A Literature review and an IS design science research agenda. International Journal of Information Systems for Crisis Response and Management.2014; 6(1): 38-64.

12.Tad S, Janardhanan K A. The Role of Information System in Disaster Management. International Journal of Management and Social Sciences Research. 2014; 3(1): 16-20

13.Ozceylan D, Coskun E. Defining Critical Success Factors for National Emergency Management Model and Supporting the Model with Information Systems. Proceedings of the 5th International ISCRAM Conference – 2008 May; Washington DC, USA p. 376-383.

14.Chen Y. The Empirical Analysis Model on Critical Success Factors for Emergency Management Engineering Information System. Systems Engineering Procedia. 2012; 5: 234 - 239.
15.Ajami S. A Comparative Study on the Earthquake Information Management Systems (EIMS) in India, Afghanistan, and Iran. J Edu Health Promot. 2012; 1: 27-35
16.Rivera L C. Data Interoperability Solution at Stakeholders Emergency Reaction From 2012-02-01 to 2015-01-31. 2015; Available from http://www.disaster-fp7.eu/. Accessed May 29, 2016
17.Corr B. deNIS IIplus – computer-assisted crisis management system. Kerntechnik. 2007; 72(4): 236-239.
18.Hofmann M, Sackmann S, Betke H. A Novel Architecture for Disaster Response Workflow Management Systems. In: Comes T, Fiedrich F, Fortier S, Geldermann J, Muller T, eds. Proceedings of the 10th International ISCRAM Conference. 2013; Baden-Baden, Germany p.338-343.
19.Neuhaus C, Geibel D, Hannappel M, Farfers S. crisis management systems in Germany- a status report about current functions and developments of private and public crisis management systems in Germany. Proceedings of the 9th International ISCRAM Conference. 2012; Vancouver, Canada. P. 1-5.
20.Casado R, Rubiera E, Sacristan M, Schütte F, Peters R. Data interoperability software solution for emergency reaction in the Europe Union. Nat. Hazards Earth Syst. Sci. 2015: 1563–1576.
21.Ratchev V, Tegarev T, Minchev Z. Romania: Capabilities, Organizations, Policies, and Legislations in Crisis Management and Disaster Response, IT4sec Reports 121. 2015. Available from: http://dx.doi.org10.11610/it4sec.0121. Accessed Feb 8, 2016
22.Eraslan C, Alkis Z, Emem O, Helvacı C, Batuk F, Gümüsay U, et al, System design of disaster management information system in Turkey as a part of e-government. XXth Congress International Society for Photogrammetry and Remote Sensing,2004; p.284-289.
23.Communications Interoperability Strategy for Canada. Public Safety Canada. 2015. Available from: http://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ntrprblt-strtg/index-eng.aspx. Accessed Nov 02, 2015.
24.Power R, Robinson B, Mark Cameron M, Nick N. The Pilot Impacts Portal: experience in building an emergency management information sharing tool. Australian Journal of Emergency Management. 2013; 28(4): 20-28.
25.Power R, Robinson B, Wise C, Cameron M. Information Integration for Emergency Management: recent CSIRO case studies. Proceeding of 20th International Congress on Modeling and Simulation, 2013 December 1–6;Adelaide, Australia P.2061-2066.
26.Montells L, Montero S, Diaz P, Aedo I, de Castro J. (2006). SIGAME: Web-based system for resources management on Emergencies. Proceedings of the 3rd International ISCRAM Conference, 2006; Newark, USA p. 1-5