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Procedia Engineering 192 (2017) 947 – 952

**Procedia
Engineering**www.elsevier.com/locate/procedia

TRANSCOM 2017: International scientific conference on sustainable, modern and safe transport

The use of crisis management information systems in rescue operations of Fire Rescue Service of the Czech Republic

Katerina Vichova^{a,*}, Martin Hromada^a, David Rehak^b

^aTomas Bata University in Zlin, Faculty of Applied Informatics, Department of Security Engineering,
Nad Stráněmi 4511, 760 05 Zlín, Czech Republic

^bVSB - Technical University of Ostrava, Faculty of Safety Engineering, Department of Civil Protection,
Lumírova 13, 700 30 Ostrava - Vyskovice, Czech Republic

Abstract

The article deals with the use of crisis management information systems in rescue and disposal operations of Fire Rescue Service of the Czech Republic. The first part of the article defines the selected information systems. Furthermore, the systems are closely specified and their main use in rescue and disposal operations of Fire Rescue Service of the Czech Republic is described. The second part of the article deals with the heuristic and comparative analysis of the selected information system. All findings are evaluated in the final part.

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Peer-review under responsibility of the scientific committee of TRANSCOM 2017: International scientific conference on sustainable, modern and safe transport

Keywords: Information Systems; Crisis Management; Rescue Operation; FRS

1. Introduction

Over the life, one becomes witness to events that are unexpected and threaten the lives or health of citizens and their property. In today's increasingly modernizing time, a person is encountered with the risks every day. We are daily informed through media about events in which the lives and health of citizens are at risk. Time is relentless; especially, when we get into a situation where is endangered the health and life. We very quickly need to

* Corresponding author. Tel.: +420-576-035-321.

E-mail address: kvichova@fai.utb.cz

call the JRS (Joint Rescue System) units, whether it is fire, traffic accidents or flood.

JRS form an efficient system of links, rules of cooperation and coordination of rescue and security forces. Fire Rescue Service of the Czech Republic (FRS of the CR) is the main coordinator. Simultaneously, the FRS of the CR is also in charge at the site of the emergency (conducts cooperation of units and coordinate rescue, and liquidation work). It is governed by law no. 230 from 2015 on the Fire Rescue Service of the Czech Republic and by the law no. 239 from 2000 on the Joint Rescue System. [1]

In case of emergency or crisis situation, it is important to timely referral all available information to the units of the JRS. For this purpose, it is used a wide range of information systems which are used for vehicle deployment or monitoring of FRS, and it is also used as an information support decision making in crisis situations. FRS is in terms of use of geospatial technologies in the field of crisis management in the Czech Republic at the highest level. It is usually equipped with an information system ArcGIS from company Esri. It allows fast information transfer directly from the event via tablet to other units of the JRS, and also to Operations and Information Centre (OPIC).

2. Fire Rescue Service of the Czech Republic

The main task of Fire Rescue Service is to protect lives and health of the citizens, the environment, animals and property from fires and other emergencies and crisis situations. It is a unified safety force which contributes to the Czech Republic's security and safety by fulfilling and organizing tasks such as fire protection, civil protection, civil emergency planning, joint rescue system, crisis management and other tasks. [2] Simultaneously, the FRS of the CR is responsible for unified system for warning and informing the citizens (technically, operationally and organizationally). Subsequent information is done not only through this system, but also through the mass media. Operators of these media are obliged to broadcast emergency information. [3]

FRS of the Zlin region is one of 14 regional districts that operate on the territory of the Czech Republic. Within the FRS, many information systems are used to support crisis management. These systems are an indispensable support for each level of management. Each of them contains certain resources, links to the available units and equipment, etc.

In case of emergency or crisis situation, it is important for the FRS personnel to have the necessary information to intervene as soon as possible. This information must have comprehensible form. Furthermore, the regional FRS should have updated contacts to the responsible persons. These contacts are part of the Intranet Crisis Management FRS of the Zlin region. This application can also be used in offline mode, thus in case of loss of Internet services and connection, and the system is updated once a week. There is also an adaptation of applications for smartphones and tablets.

Specifically, in Zlin region, these information systems are used - Intranet Crisis Management, ArcGIS, ARGIS, KRIZDATA, RozexAlarm, Map client FRS, and furthermore Czech Geological Survey, Optizon, Humanitarian Aid and others.

From the above mentioned information systems, Intranet crisis management is considered as the most effective. It is used as a solution for emergencies, as well as crisis situations or in everyday work of emergency management authorities and JRS units. The main content is the contacts directory and a directory of units and equipment.

3. Information Support for Crisis Management

Information has an important role in today's hectic world and especially in the case of emergency. Speed, availability, confidentiality and integrity of transmitted information is one of the decisive factors affecting the level of their solutions.

Information support for crisis management is a process (set of information activities) to support information management, decision making and cognitive processes. The goal of information support is to meet the information needs required for the performance of activities related to crisis management. [4]

Information system is any system which is capable of processing and providing information. Crisis management information system is a set of information components and information elements (individual information resources), including relationships and links.

Information systems are useful and indispensable tools providing significant decision making support not only for crisis managers but also for anyone who is involved in the crisis situations. [4]

Description of Selected Crisis Management Information Systems Used by FRS

In the Czech Republic, a large number of information systems to support crisis management are used. We selected and described some of them in further paragraphs.

ArcGIS – geographic information system designed to process spatial data. The system can create and manage data but primarily is able to analyze data and find new relations and clearly visualize them. [5]

ArcGIS, thin FRS map client – FRS of the CR portal primarily used to share information from geographical information system with JRS. This application uses map services provided by ArcGIS server, which does not require software license (cost savings). This server also provides uniform and centralized data management in the geodatabase. [6]

ARGIS – tool of information support system of economic measures for crisis situations (EMFCS). Its main goal is to assist the crisis management authorities from municipalities with extended competencies, through the regional authorities to ministries and other central administrative authorities in fulfilling the obligations provided by law. [7]

KRIZDATA – an application that provides data about necessary supplies or services which recorded suppliers are able to provide to overcome or to dispose the aftermath of the crisis. [8]

4. Case Study on Using ArcGIS by Fire Rescue Services in the Czech Republic

FRS of the CR operates on the map server that is configured bespoke to firefighters, joint rescue system and crisis staffs. The users have a variety of features and also a wide range of topical layers useful during the development

of emergency and crisis plans or solutions to any emergency and crisis situation.

All sorts of technologies and techniques are still developing to ensure the fastest possible assistance. The geographic information system enables accurate and fast decisions aiming to save life, health, property and the environment.

Geographic information system is used by the FRS of the CR PSAPs during the dispatch of units and equipment to the event location and also to support crisis management. [9]

The main positive aspect of this system is the ability to create various data analyzes which have wide application in the area of crisis management. On the contrary, the negative aspect can be considerable financial costs of the license to use the information system.

Information system ArcGIS assists FRS in different areas. The system displays nearby FRS units (e.g. 1 - professional units 5 - local volunteer units) and also there were implemented details from the unified traffic information - road closures, bridges, underpasses, railway crossings and so on.

In ArcGIS, OPIC of regional FRS recorded incident. OPIC enrolled the type of incident (e.g. fire) into the system and chose the equipment that should go to the site (e.g. a fire tank truck, ladder), and FRS units (professional or volunteer firefighters).

After entering all above mentioned data into the system, it will alarm FRS (professional and volunteer) using sirens, sending information via SMS. This will trigger alarm procedure (lights are switched, opening the door, all relevant information to the point of intervention appear on the garage monitor).

The trucks of FRS professional firefighters are equipped with portable technology – tablets on which the dispatch unit can find planned route and navigate to the location of the incident. The planned route takes into account the height of the truck to avoid underpasses and road closures, etc.

Once the FRS unit arrives at the site, commander of the intervention marks in the tablet the operational site which was reflected on the operational center of the FRS, the Czech police, and Emergency Medical Services. This helps to accurately navigate IRS vehicles to the place of the event and also to inform other units about the tasks in progress. The commander designates specific areas (danger zones) that are not allowed to be crossed or zone where should JRS units intervene. For the civilian cars, the system shows detours.

Based on this case study, we can conclude that the system greatly simplifies information exchange between operating and information center and dispatch FRS vehicles. With this system, the FRS vehicles can get to the site faster and more efficiently without necessary complications that can occur on the route to the incident.

5. Comparison and Analysis of Information System ArcGIS

Heuristic analysis of usability was conducted as a part of case study. This analysis is used for the qualitative evaluation of the system through which we get a precise idea about the strengths and weaknesses of the test information system. Based on the statistical study, we chose person, personnel of the FRS in Zlin region, who works with the system and is able to assess its usability. [10]

Based on the mentioned analysis, we conducted an evaluation using the following equation:

$$\text{IS usability} = \frac{\text{total of points} + \text{number of evaluated heuristics}}{2 \cdot \text{number of evaluated heuristics}} \cdot 100\% \quad (1)$$

Within the evaluation of the system, a set of evaluation questions was used. These questions were divided according to various aspects.

General - basic information from a general perspective investigating whether the system works correctly, contains only relevant information, and whether the system can be used without help.

GIS - in terms of geographic information systems investigating whether the system allows measurement and identification, supports tile layers rendering. It was further investigated whether it is possible to use navigation.

Usability – usability of the system in the proper sense, intuitiveness of use, ability to control at specific conditions and a proper display on your mobile device.

Security – verification of latest map contents, credibility and the possibilities of the system disruption.

Content - whether the system contains advertisements, misleading elements, and also relevant titles.

Search - search in terms of evaluated results whether the results match the searched query, whether it is possible to search according to the coordinates and whether the autocomplete is available.

Technology - the suitability of controls, modification and portability of the system.

The evaluation consists in assigning ratings (values) from the predefined set (-1 = do not fulfill; 0 = partially fulfill; 1 = fulfill; an empty field if the question is not relevant) to each answered question (see Table 1).

Table 1. Usability evaluation [10 + own adjustment]

Questions	Results
Control is designed for touch screen.	1
Information is presented clearly.	1
The most important information, features and tools are at the left and top of the screen.	1
The most important tools are available immediately (usually with one click).	-1
The application can be used and operated in specific conditions (in the car).	1
The content is displayed properly on mobile devices.	1
Application can be used in the field.	1
The application is also suitable for users with no previous experience.	1
Users remember how to perform key tasks in application.	/
Structure of the application is logical.	/
TOTAL	6

The following Table 2 shows the results of heuristic analysis. This evaluation clearly shows statistics for each group of aspects in terms of obtained points with subsequent recalculation according to the mentioned equation.

Table 2. Results of heuristic analysis of ArcGIS [10 + own adjustment]

Group of aspects	Number of points	Number of questions	Number of answers	Answer	Score
General	1	8	8	100%	56,25%
GIS	7	8	8	100%	93,75%
Usability	6	10	8	80%	88,00%
Security	2	7	6	86%	66,67%
Content	3	8	6	75%	75,00%
Graphics	5	7	5	71%	100%
Search	6	8	8	100%	87,50%
Technology	3	8	7	86%	71,43%
TOTAL	33	64	56	87,25%	79,83%

Information system ArcGIS – thin map client FRS obtained 79.83% using this evaluation method. This system is, according to analysis, functional, usable and meaningful. There were found no serious deficiencies using analysis.

We are going to mention partial problems in each aspect:

- General - the system is not completely intuitive; all features of the system cannot be fully used without help.
- Usability - the system is not suitable for users without previous experience. The most important tools are immediately available - typically one click.
- Security - reliability and security of applications can be disrupted.
- Content - The system does not contain distinctive, clear and understandable title or headline.
- Search – autocomplete is not available to simplify the search process.
- Technology – the reload is required with every movement.

Regarding the positive aspects of the whole system, the following aspects were evaluated as the best:

- GIS – the system provides basic map functionality (zoom, search). Further includes navigation, the number of steps required to handle the map application is low. The response of map application adequate and sequencing of the individual steps is logic.
- Graphics - all parts of the application have a uniform design, each option and menu item are clearly separated. The matrix map as the main element is horizontally and vertically centered.

Information system ArcGIS - thin map client FRS significantly helps in decision making; thus has great potential for further development.

6. Verification and Recommendations

FRS of the CR uses many information systems to support crisis management. ArcGIS and its thin map client FRS is the most used information system for crisis management. Among systems also used belong ARGIS, KRIZKOM, OPTIZON and many others. These systems have benefits in terms of the possibility of faster decision making during crisis situations leading to more effective intervention and saving lives.

The main positive of the information system ArcGIS is the robustness of the system which offers a variety of features and tools. Conversely, the system is not completely intuitive and therefore requires some knowledge.

In the analysis of information systems for rescue operations FRS of the CR, the ArcGIS were subjected to analysis of usability. This system allows data visualization, positional visualization of traffic information, and search for the closest units or specialized layers (e.g. railway crossings).

From heuristic analysis, the system is functional, usable, and meaningful and no serious deficiencies were found. The identified problems are not so serious thus the system can be still used. It is assumed that Esri will continue

with development and modernization of this system. On the other hand, the GIS application in terms of the basic map functionalities, analysis, measurements and identification are positive side of ArcGIS.

Future step for FRS should be implementation of eCall (see Figure 2) which was approved by the European Parliament. From 2018, this device will have to be in every vehicle throughout the European Union. This innovation yearly saves about 2,500 lives. The system is based on the interconnection between board unit in the vehicle, telecommunication network and the PSAP.

If an accident occurs, the car itself dials 112 and sends its position. The system is activated only after the emergency. Information about the type of car, fuel, time and place of the accident and the number of passengers will be sent to the rescue units. [11]

In the Czech Republic, the information support in each region differs. The long term goal is an effort to unify the entire system in all regions by standardization. This can improve software functions and software itself.

7. Conclusion

Crisis management is a complex area. The main tasks of crisis management are to prevent or minimize loss of property and human lives in case of an emergency. With this difficult issue, a suitable application for decision support can help the JRS.

The aim of the article was to evaluate emergency management information systems in rescue operations of FRS of the CR. Simultaneously, case study was conducted in which was described the use of information system ArcGIS. The effort of the FRS of the CR within the system is to obtain additional thematic layers for the intervention, such as uniform digital technical map. The second part focuses on the analysis and comparison of thin map client FRS from Esri.

In conclusion, we would like to state that currently each Regional Directorate of FRS has a bit different software support. The goal of the FRS of the CR is to unify information support for all regions; however, it is a long term process that would help the FRS to solve crisis situations more effectively.

Acknowledgment

This work was supported by the internal grant IGA/FAI/2017/019.

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