Information System for Remote Management of Crisis Situations

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Abstract. Nowadays in crisis management there are more and more information systems used as support tools for creating contingency plans and dealing with crisis. The application of these tools for the dealing with crisis situation in practice is limited not only because of the inappropriate structure of planned measures but also because of the lack of feedback. In addition, none of the known systems support automated monitoring of fulfilment tasks in crisis management. Therefore, the risk of incorrect operational decision approval on the higher management level is being significantly increased. Lack of necessary information about the state of situation has also resulted in a lack of awareness of other cooperating stakeholders, misrepresentation of risk in the media and panic in the public. For this reason, the aim of this paper is to describe the development and the functionality of a new automated information system for remote management of crisis situations.

Keywords: crisis situation, crisis management, information system.

1 Introduction

The issue of critical infrastructure is high on the agenda worldwide. The current European security science prefers bringing solutions for the areas of power industry, transport and information technologies. The authors and their workplaces participate in a number of projects focused on three above-mentioned sectors of critical infrastructure. Solving the issues in transport sector is significant, because rail transport as a subsector of critical infrastructure plays a significant role in Central Europe.

The project VG20122015070/Ministry of Interior of the Czech Republic on the "Complex Automated Information System for Remote Management of Crisis Situations in Rail Transport with Focus on Critical Infrastructure", called KISDIS, started in 2012. The goal of the KISDIS project is to develop an expert information system, which would effectively combine crisis management of rail transport with regional crisis management. The currently used systems have been developed in

different departments as autonomous systems and at present they do not enable users to share information on an emergency situation effectively and quickly. Therefore experts on rail transport and regional crisis management co-operate in the project.

The system represents the improvement of technologies and techniques for decision-making of crisis managers and evaluating impacts of crisis situation. Thanks to this technology, crisis managers get more accurate information about the state of the performed tasks. Created information system allows automated trigger of procedures for dealing with the crisis based on control code sent remotely. After the procedures activation, information system sends notification about the start of dealing with the crisis to all scheduled management resources of forces. Subsequently distributes inventory and schedule of all planned tasks for which management resources of forces are responsible for. Information system allows detection of the real status of performed tasks by the help of smart phones in possession of forces management resources. Based on the information about the actual state, the system can adjust the relevant crisis operating plan in real time and distributes its updated tasks to all management resources of forces. The information system also allows sharing the current state of crisis operating plan to other remote information systems and selected remote users.

2 The Object and Goals of the Project

The object of the project is the design and implementation of a comprehensive information system for the remote management of crisis situations with the emphasis on critical infrastructure. The information system will enable to implement the feedback into the process of solution of crisis situations. During the solution it will develop a methodology for the creation of type and operating procedures which will be suitable for automated and remote solution of crisis situations. A sample data test, which will be the part of methodology, will support a practical implementation of the information system

The basic goal of the project is to create a comprehensive model and the information system which will enable to activate the processes for the solution of crisis situations automatically based on remote sent control code. After activation the information system will send a note about starting of solution of crisis situation to determined crisis managers. After that it will send the inventory and schedule of all planned tasks for which crisis managers will be responsible. The information system will enable to find out the actual state of realized tasks with the assistance of crisis managers' smart mobile telephones. Based on information about the actual state the system will modify a relevant emergency operational plan in real time and will send actual tasks to all crisis managers. The information system will enable to share the state of a current emergency operational plan to other remote information systems and selected remote users. The information system will consist of the information system KISDIS Windows and KISDIS Internet.

The project was designed for four years (from 2012 to 2015) with a steady volume of activities. Every year of the solution of the project the sub-goals were filled. The basic processes were identified for each sub-goal; the sub-goal was fulfilled by their

realisation. Within these processes individual activities were identified and these activities were subsequently assigned to individual researchers. The processes are visually represented by (5) with the help of BPMN diagram (Business Process Model and Notation).

The first stage included the information analysis of available materials abroad with the aim to find similar projects carried out in particular European countries. The outcomes of the analysis confirmed that the electronic support for the management of crisis situations in rail transport has not been solved in any of the countries included in the survey.

The second stages of the project in 2013 are aimed at developing the methodology which will exploit earlier defined types of hazards in the area of rail transport of the Czech Republic. With regard to the overall goal of the project it was necessary to define a functioning data set, which will be the basis for the future expert information system. The outcomes of initial stages are very original. The proposed methodology has been tested in the conditions of rail transport and it is assumed that it will be certified on a national level. The outcomes of initial stages have become a real basis for the functioning of future complex information system for remote management of crisis situations in rail transport.

The goal of the project in 2015 is to create the mentioned software tool and a certified methodology of crisis management with the help of KISDIS. On hand the methodology will describe the general principles for risk analysis and the creation of procedures for dealing of crisis situations; on the other hand it will describe specific guidelines for the creation of operational plans and automated solutions of crisis situations with the use of KISDIS.

The emphasis in the creation of methodology will be placed on the area of critical infrastructure. The part of methodology will be a data set of chosen type threats and procedures, sample threats, sample operating procedures and sample solutions of crisis situations. This data set will be usable as basic information content for automated remote management of crisis situations in railway transport. The methodology will be certificated by ta competent state authority, after its approval it will be implemented in practise.

3 The methodology of solving of the project

The methodology of solving of the project is based on the standards ČSN ISO/IEC 15288 System Life Cycle Processes (1) and the standards ČSN ISO/IEC 12207 Software Life Cycle Processes (2). It was also taken into account the recommendations of unofficial standard processes of software development called The Unified Software Development Process by Jacobson, Booch and Rumbauch (3).

A standardized language for analysis and design of object oriented systems known as UML (Unified Modelling Language) was chosen for the representation of models. The language UML was created by the company Object Management Group. The methodology is based on the version 2.1.1. (4). The methodology of solving of the project was initiated by the modification of mentioned methodologies according to the rules of the project.

The analytical model of realisation of the use cases presents the first look in the internal structure of objects which realize the use cases. The purpose of the model is to recognize the basic types of tasks in short time. During the creation of the model it was based from the model of use cases. Every use case was analysed from the point of view of internal functionality. The basic classes were identified. They were divided into the classes, according to the functionality, representing interface, management and data handling.

The model of use cases presents the view of the functionality of information system from the point of view of a user. The task of the model of use cases is to transform all requirements from the model of requirements to individual use cases. One use case presents one basic functionality of created information system.

After the analysis an updated model of use cases is based on the model of use cases according to the requirements which were done in previous year of solving of the project. This model clarifies and expands the previous model of use cases. Missing use cases were filled. The use cases were structuralized, their scenarios were updated. An updated model of use cases is represented by UML diagram of use cases according to the analysis.

4 Analysis for the Methodology of Selecting and Processing the Type procedures

The initial analytical phase has been focused on updating a large information base. The procedure of activities according to the methodology represents the first step in the process of planning the measures for managing the crisis situations.

The following assumptions have been considered by a project team for the selection and processing of general type procedures.

Generally, type procedures for the management of crisis situations may be processed as:

- general procedures for management (approach to management) of any crisis situations,
- general procedures for the approach to management of a crisis situation in traffic,
- general procedures for the approach to management of a crisis situation on railway,
- partially specific procedures (e.g. for a location train – train station – railway).

The general procedure should ensure the elimination of possibly even the most serious consequences, and in case the real consequences will not be so far-reaching, the prepared procedure will be finished in the phase which will not occur and the next step will not be taken.

The development of consequences of an emergency depends on the following:

- the intensity and duration of a cause,
- the place and time (period) of occurrence of an emergency,
- the readiness of organization for managing an emergency (summary of preventive measures including mainly personnel and material support).

The primary purpose of preparation of procedures has to be the effort to prevent the impact (development) of causes, or eliminate their chaining.

At first a general type procedure has been elaborated and then concretization of individual procedures followed. The development of a general type procedure assumed the fact that common procedures for managing crisis situations had already been introduced in an organization. Therefore the outcomes have not been verified at this stage. In case of general procedures it was not necessary to set the limits under which a problem was not tackled. The list of 41 type procedures altogether has been compiled as the basis for further research.

Table 1 General type procedure.

Serial No	Procedure – general type procedure
1.	Reception of a report about the occurrence of crisis situation
2.	Record into a "diary"
3.	Verification of the report and collection of additional data
4.	Initial assessment
5.	Issuance of necessary instructions
6.	Coordination with basic elements of integrated rescue system
7.	Call a crisis staff (starting the automatic system)
8.	Activation (call) of own emergency forces and equipment
9.	Information to a superior
10.	Information to co-operating organizations on the change of situation
11.	Preparation of the 1st meeting of crisis staff
12.	Meeting of crisis staff
13.	Send a reconnaissance (task, composition, equipment)
14.	Assessment of where and how the source of crisis situation is effective
15.	Measures taken in order to prevent the development of crisis situations
16.	Activation of other element of integrated rescue system
17.	Call for other forces and equipment
18.	Selection of suitable (necessary) regulation measures
19.	Notice on regulation measures
20.	Information for own employees
21.	Information for public (media)
22.	Invitation of experts from own resources
23.	Invitation of experts working out of the system
24.	Employment of specialists
25.	Start of rescue clearance work
26.	Issue of protective aids
27.	Cover of live force
28.	Conduct of evacuation
29.	Clarification of the impact of crisis situation
30.	Clarification if and when a crisis situation may develop
31.	Declaration (request for declaration) of a state of crisis
32.	Contingency (contemporary) solution dealing with restoring the operation of a system

33.	Check-up of functionality of own resources for managing a crisis situation
34.	Request for the release of emergency supplies
35.	Organizing the export of supplies to a stricken area
36.	Enquiry about causes
37.	Initial estimate of damage and losses
38.	Permanent elimination of consequences
39.	Measures taken to prevent similar situations
40.	Definite numerically expressed damage and losses
41.	Possible liability for offenders

After that a general type procedure has been subdivided into three groups related to preventive, rescue and clearance activities. Then a particular general type procedure has been developed for each group (preventive, rescue, and clearance). If it is information on the possibility of occurrence of a crisis situation, it will be a preventive procedure. A real crisis situation will be managed according to a rescue procedure. General clearance type procedure follows the previous activities connected with an imminent rescue of human lives and properties.

Information has been updated on the protection of critical infrastructure in the transport sector in Germany, Poland, Austria and the Slovak Republic. Information was also collected on the critical infrastructure hazard assessment in the above mentioned countries. Attention has been paid to the changes of support for restoration and reconstruction of damaged railway lines and facilities in the neighbouring countries. Special attention has been paid to the current outcomes of the projects within the 7th EU Framework Program aimed at improving the long-distance control of rail transport and the information support of crisis management. Extensive analyses have been the basis for setting the further procedure within the KISDIS project. The principle precondition for work with the methodology selecting the hazard types is the fact that rail transport is considered to be a compact system. For the needs of the research the rail transport infrastructure is divided into individual railway lines and stations. When appropriate parameters are acquired the railway lines (or their parts) may be considered as being of certain type. Standardized documentation, which is elaborated for such a type, can be distinguished in a particular situation only by a number and name of station. Similarly, if the railway stations are classified into five categories, it is sufficient to elaborate documentation for one type of station and distinguish different stations by different names in operational documentation.

The procedure of activities according to the methodology represents the first step in the process of planning the measures for managing the crisis situations on rail and requires a good knowledge of the assessed railway line, terminology of transport, logistic and construction guidelines of the Railway Infrastructure Administration (hereinafter RIA). The methodical instructions enable not only the selection of hazard types from the list provided by the railway controller crisis information system. The methodology is logically ordered in compliance with the definition of hazard as one source of risk. Prior the final determination of particular type of hazard it integrates the completed analyses into one table in the order which is introduced in the KISDIS program software environment.

The KISDIS program enables its users to repeat the selected procedures in compliance with the development of a real situation up to the state, when lives and

properties are not threatened and the rescue operations eliminate the causes of crisis situation.

5 Evaluation of elements of critical infrastructure

In the project KISDIS the elements of European critical infrastructure are not solved. The attention of researchers was focused on the elements of national critical infrastructure. In the professional groups the methodology of vulnerability (criticality) of elements of critical infrastructure is accepted. Two views are used –severity of the loss of function and time loss of function, the results are presented in the matrix of critical elements of critical infrastructure, see the table 2, by Fuchs et el., Transport Infrastructure as an Element of Critical Infrastructure of State (13).

Table 2 Matrix of elements of critical infrastructure

Time loss of the function [h]	**Severity of the loss of the function**				
	0-2 = 1	3-4 = 2	5-6 = 3	7-8 = 4	9-10 = 5
10000 (> year) = 1	N	V	E	E	E
1000 (>month) = 2	N	S	V	E	E
100 (4 days) = 3	Z	N	S	V	E
10 (shift) = 4	Z	Z	N	S	V
1 (h) = 5	Z	Z	Z	N	S

Legend: E – unacceptable, V – High, S – Medium, N – Low, Z – negligible.

Note: – from the point of view of disruption of critical infrastructure the time loss of the function is presented in the maximum extend (more than one year). In further evaluations the upper limit is defined by a higher time value. The probability value is replaced by the corresponding point value for other calculations. The severity of the loss function is divided into the five groups (0-2, 3-4, 5-6, 7-8, 9-10), each of them is replaced by corresponding point value for further calculations. Then the probability value is multiplied by the consequence value and the risk matrix is being created.

6 The Model of System Employment

The KISDIS information system consists of control and monitoring nodes. It includes at least one control node with the KISDIS Windows system (see Fig. 1) and at least one monitoring node with the KISDIS Internet system (see Fig. 2). In case of need a monitoring node of another information system may be added to the KISDIS system.

The main part of the KISDIS Windows system consists of three main components:

- KISDIS Windows Client,
- KISDIS Windows Mobile,
- KISDIS Windows Server.

The KISDIS Windows Client component will serve for inserting and editing the information on the management of crisis situations in the database. The KISDIS Windows Client component will be installed into the crisis manager´s work station.

The KISDIS Windows Mobile component will serve for receiving, displaying and reverse sending of information on the duties of task forces. This component will be installed into the task forces´ mobile phones.

The KISDIS Windows Server component will provide the exchange of information between the KISDIS Windows Client and the KISDIS Windows Mobile components. The information will be stored into the KISDIS database. Each control node will have one KISDIS database.

The mutual independence of all three components has been chosen as the main criterion of functionality of the whole KISDIS Windows system. Thus each component has been operational even in case the other components are not. The following Figure shows the basic employment of individual components of the KISDIS Windows information system and their inter relations (see Fig. 1).

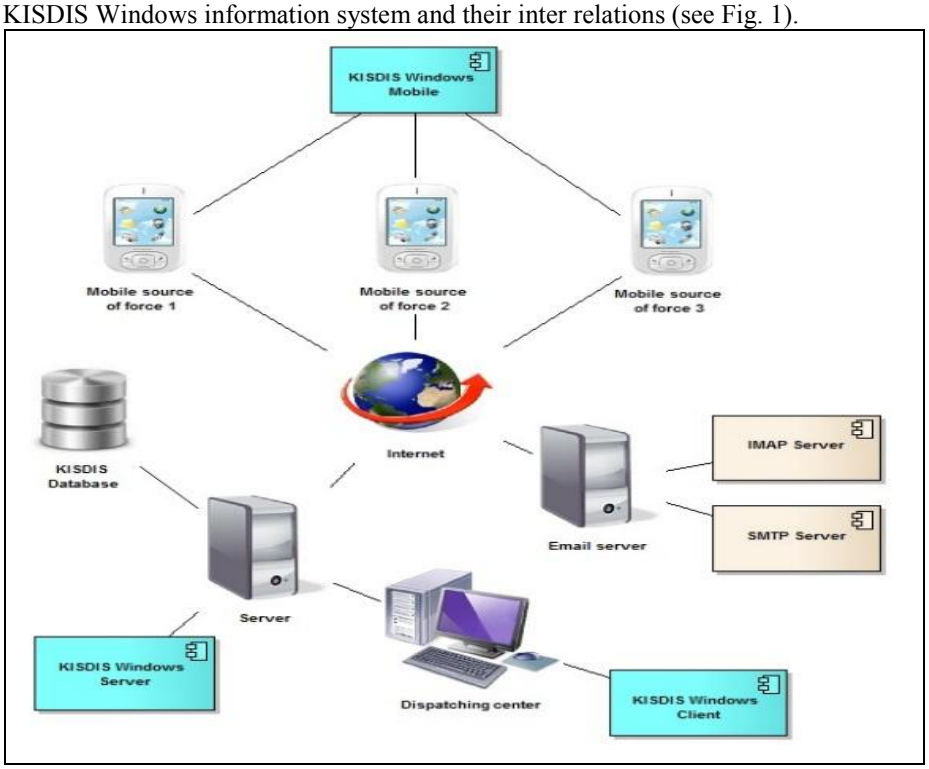

Figure 1 Basic KISDIS Windows model of employment

The surrounding co-operating information systems are standard e-mail servers enabling communication through IMAP and SMTP protocols and database servers or database files. Smart phones and Internet infrastructure are also parts of surrounding co-operating systems.

The KISDIS Internet system consists of the network of servers – nodes of the "KISDIS Internet Server" type and remote users – nodes of the "Remote user" type.

The servers use HTTP server for providing information in the form of web pages. The servers may mutually update their data through the port types of web services. Server also implements the port types for the third parties´ information systems – node "Another remote server" (see Fig. 2).

The remote users cannot communicate directly with each other within the KISDIS network; they are in the role of a client.

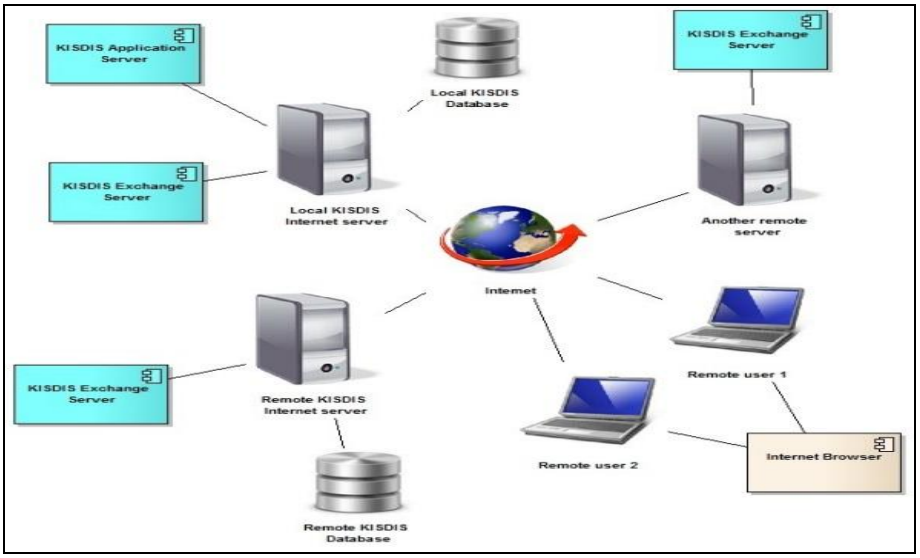

Figure 2 KISDIS Internet – basic model of employment

7 Verification of existing results

The correctness of the proposed solutions and procedures were verified by organizing a model exercise. The aim was to manage export of supplies by forces and resources of the company named Construction and Rehabilitation of Railways to place of fictive crisis situation. For this reason all necessary data were added into the information system. The next step was to prepare operational procedures with all its requirements. At last but not least, it was established a crisis center with computer equipment and information system for remote management of crisis situation.

At the same time the model exercise showed that it is appropriate to complement the software by methodology to facilitate usage of the software in the future. The methodology should describe not only the general principles for risk analysis and the creation of procedures for dealing with crisis situations but also specific guidelines for the preparation of operational plans and automated management of crisis situations using the proposed software. In conclusion it can be stated that proposed software contributes to improving technologies, techniques, processes, procedures and their application in practice leading to effective crisis management at national and also international level. The system also supports decision-making of crisis managers, exchange of experience and information about crisis management.

8 Conclusion

The universal employment of the proposed expert information system in relation to the administrator of critical infrastructure and public administration is a prerequisite for its future employment in the Czech Republic and possibly in other EU countries. The authors of the project believe that other activities of the project will result in the certification of the developer methodology on a national level. The primary goal of the project is to improve the information support of crisis management in two different areas – in rail transport and municipal crisis management.

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