Crisis Management Decision Support System in Railway Infrastructure Company

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Abstract

Railway companies in central Europe were changed. First of all were divided managers of railway infrastructure. Every new managers (Railway Company of Slovak Republic (ZSR) in Slovakia or Railway Infrastructure Administration, state organization (SŽDC) in Czech Republic. Emergence or crisis situations at the regional level have certain peculiarities. One of the major problems is the complexity of communication between managers of railway infrastructure and local authorities. Very often there is an accident on the rail and local authorities become aware too late. In the solving project KISDIS can be this information disharmony decrease. It is believed the use of smart mobile phones and automated information sharing. Preparation of decision support systems requires a multidisciplinary approach and the involvement of experts from various fields. Planned project results will be fully operational information system to support decision-making in regional or residential crisis management.

KEY WORDS: crisis management, decision support system, risk assessment, project KISDIS

1. Introduction

Aim of the author is to introduce up-to-date results of the applied research project which is being solved throughout the period of 2012-2015 within the Safety research of the Czech Republic. Currently, the entrance analytical parts have been elaborated in detail and thereby they allowed the authors to prepare a software device which will contribute to the automatized expert control of critical situations in rail transport and their connection with local and regional authorities.

The practice thus far has revealed serious problems in communication between rail infrastructure administrator, rail transport companies, integrated rescue system, towns, cities and regional authorities. By the formation of extreme situations and crisis situations, there often appears discontinuance in information stream, or vice versa, its duplication or reduplication. [1, 2, 3]

Investigators of 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, focused on the solution of partial problems in the middle part of the solution, which are related to risk analysis. The current aim is to focus the attention on those risk origins which might have a definite impact on the life and health of people in the region and on the functioning of rail transport.

The first stages of the project in 2012-2014 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 unique and original.

2. The Entrance of Risk Analysis Having an Impact on Railway Transport

The precondition for a complex information support on local and regional basis in connection with rail transport is the elaboration of thorough risk analysis. Investigators were gradually solving the multicriterial task focused on the following crucial aspects:

- the determination of hazardous location,
- the determination of risk source,
- the activation of risk source,
- reason why the risk source may be activated,
- event which may occur upon the activation of risk source,
- assumed consequences. [2, 8, 9, 10]

Assessment of risk in rail transport is a very complex problem which needs to follow a whole range of technical norms, specifications, regulations, acts and decrees of the European Union. One of the major documents is the regulation about implementation of Common Safety Methods (next CSM) which was published by European Railway Agency in 2009. It came into effect on 1st July 2012. Up till now, with regard to the complicated process of
implementation, it has not been possible to implement the CSM. Therefore, the fixed deadline was postponed to 21st May 2015.

By the implementation of ISO 31000, investigators had to keep the procedure set by the regulation and at the same time, they had to take the specifications of rail transport into account. These specifications are complicated due to the interlacement of activities of various subjects, institutions and companies (infrastructure management, transport enterprise, transporter, civilian, employee, public passenger and potential assailant). [4, 5, 6, 7, 16]

The risk sources were transferred into particular hazard type names due to the preparation of a model and possible programming. It is registered in one sentence consisting of these parts, i.e. EVENT — RISK SOURCE ACTIVATION – LOCATION – CAUSE, in the following format:

- “name of EVENT” caused by,
- “name of RISK SOURCE ACTIVATION”,
- in “name of LOCATION”,
- caused by “name of CAUSE”.

After the analysis of a particular risk, it is necessary to specify the probability (frequency) of evaluated situation formation and its presumed consequences while following the given norms and CSM. The outcome of all the given variables is inscribed into a matrix of risks. In the matrix of risks, respective risks are inserted into groups - extreme, very major, major, medium, minor, very minor. Depending on the device, suitable precautions for risk reduction are being defined afterwards. [14, 15]

3. KISDIS Information System

Detailed risk examination is the presumption for the formation of mathematical module for software application writing. The KISDIS information system consists of control and monitoring nodes. It includes at least one control node with the KISDIS Windows system. 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.
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. (see Figure 1).

4. KISDIS Case Study

Identification of Event Causes in Railway Transport

Selection of "Causes", separately for each "Location", in relation to "Risk source activation", carry out according to column "Name of cause". To the "Risk source activation", always add only one (initial) cause. If you come to conclusion that there may be more initial causes which lead to the particular risk source activation, it is possible to insert them separately, however, always as a new cause. Column "Content" is used in the selection phase and the examination of particular risk formation.

Identification and Selection of Event Location in Railway Transport

Selection of location events having an impact on maintenance needs to be carried out according to the following schedule. The event was formed:
- on railway infrastructure,
- around railway infrastructure,
- in railway carriage,
- within transport company

Construction of Threat Nomenclature

During the threat nomenclature, for the possibility of its processing in KISDIS, it is necessary to keep the principle of not creating a name with more than 250 signs. The aim is to obtain the names of all possible threat types in the following form:

<table>
<thead>
<tr>
<th>EVENT</th>
<th>RISK SOURCE ACTIVATION</th>
<th>LOCATION</th>
<th>CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alteration of maintenance conditions due to flood</td>
<td>on railway infrastructure</td>
<td>caused by extreme weather conditions</td>
<td></td>
</tr>
</tbody>
</table>

Template for Determination of Threat Name

To prevent omitting any of the names during the identification of threat names, the following template has been created. In the template, all the selected "Risk source activations" (max. 59 signs) are being inserted and gradually, for each selected "Location" (max. 4) one of 14 "Causes" is being inserted repeatedly. Following this method, the listed index (see below) is formed obtaining maximum number of variants which have 59 x 4 x 14 = 3304 lines altogether.

<table>
<thead>
<tr>
<th>EVENT</th>
<th>RISK SOURCE ACTIVATION</th>
<th>LOCATION</th>
<th>CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alteration of maintenance conditions due to maintenance device theft</td>
<td>on railway infrastructure</td>
<td>caused by atmospheric and cosmic disturbances</td>
<td></td>
</tr>
<tr>
<td>Alteration of maintenance conditions due to failure in information device</td>
<td>on railway infrastructure</td>
<td>caused by atmospheric and cosmic disturbances</td>
<td></td>
</tr>
<tr>
<td>Alteration of maintenance conditions due to vehicle immobility</td>
<td>on railway infrastructure</td>
<td>caused by atmospheric and cosmic disturbances</td>
<td></td>
</tr>
<tr>
<td>Alteration of maintenance conditions due to panic of public passengers</td>
<td>on railway infrastructure</td>
<td>caused by atmospheric and cosmic disturbances</td>
<td></td>
</tr>
<tr>
<td>Alteration of maintenance conditions due to bridge damage</td>
<td>on railway infrastructure</td>
<td>caused by atmospheric and cosmic disturbances</td>
<td></td>
</tr>
<tr>
<td>Alteration of maintenance conditions due to fire on railway infrastructure</td>
<td>on railway infrastructure</td>
<td>caused by atmospheric and cosmic disturbances</td>
<td></td>
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</tbody>
</table>

Work of a crisis manager therefore results in a complete index of real threats in KISDIS system which is subsequently implemented into a particular location in the region.
5. Conclusions

Determination of KISDIS project has reached its second half. Currently, the attention of investigators is focused on the formation of software segment of the expert information system. Considering the universality of this determination, the project has a highly international potential. Therefore, its presentation at international conferences is considered being an important part of its determination as well. The possibility to introduce results of applied research in Lithuania belongs to essential opportunities for consequent dissemination.

Within the next stage of project determination, formation of an expert team will be crucial to test particular fragments of the new KISDIS expert system. The aim of the project is a thorough implementation of KISDIS into practical use from January 2016. Considering project range and its targets, investigators assume its further dissemination in Slovakia at least, maybe in other countries as well. [11, 12, 13]

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All papers were reviewed.

The style and language of authors were not corrected. Only minor editorial corrections may have been carried out by the publisher.

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PREFACE

18th International conference Transport Means 2014 takes place at Kaunas University of Technology and Klaipėda University on 23th – 24th October 2014. It continues long tradition and reflects the most relevant scientific and practical problems of transport engineering.

The aims of the conference are to share the latest information on the issues of transport means engineering and transportation technologies, to develop international relations of Lithuanian professionals in the science of transport as well as to get students interested in the transport research.

The reports cover a vide variety of topics related to the most pressing issues of today’s transport systems development.

The main areas covered in plenary session and in the sections are: design development, maintenance and exploitation of transport means, implementation of advanced transport technologies, development of defense transport, environmental and social impact, advanced and intelligent transport systems, transport demand management, traffic control, specifics of transport infrastructure, safety and pollution problems, integrated and sustainable transport, modeling and simulation of transport systems and elements.

In the invitations to the conference, sent five months before the conference starts, the instructions how to prepare reports and how to model the manuscripts are provided as well as the deadlines for the reports are indicated.

Those who wish to participate in the conference should send the texts of the reports that meet relevant requirements under indicated deadlines. Each report must include: a short description of the idea or technique being presented, a brief introduction orienting to the importance an uniqueness of the submission, a thorough description of research course and comments on the results.

The submissions are matched to the expertise according to the interests and are forwarded to the selected reviewers.

Scientific Editorial Committee revises, groups the properly prepared reports according to the theme and design the conference programme.

The Proceedings are compendium of selected reports presented at the Conference.

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