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Procedia Engineering 69 (2014) 1475 – 1480

Procedia Engineering

www.elsevier.com/locate/procedia

24th DAAAM International Symposium on Intelligent Manufacturing and Automation, 2013

Contribution to Logistics of Catastrophes in Consequence of Floods

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Abstract

The flood is considered to be a phenomenon that consists of different, interlinked stages or phases. Each stage of flooding from flood hazard, through course itself up to after-rehabilitation actions, can be solved by methods of risk management and crisis. The methods propose systematic procedure of identification, analysis, risk assessment and proposal planning process to avert catastrophic situations. Each proposal contains design of logistic processes consisting of specific logistic elements and logistics processes of catastrophes. Catastrophic scenarios reflect the threat rate of protected interests by development of the risks rate that can be observed in the development curve of the life cycle of assessed risk and the development level of safety due to their causal relationship. Quick response to the catastrophic development is conditional to identification rate of the environment in which the catastrophic scenario is gradually enacted. Therefore visualization of threatened objects by geoinformative system instruments including the development of actual geodatabases is imperative.

Key words: Flood; risk; crisis management; threat; security; catastrophe logistics; life cycle; geodata

1. Introduction

Floods can be considered to be catastrophes that are characterized as a serious disturbance of society function causing loss of lives, property or the surrounding environment beyond the capability of population to handle with it by its own resources. Viciousness of catastrophes is that their place and intensity of the destructive power cannot be predicted or planned. In case of catastrophes´ formation, catastrophes logistics (CL) solves a very large complex of protection and retrieval processes of the general protected interests of the

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doi:10.1016/j.proeng.2014.03.144

society. Competent investigators are government bodies and local authorities, Integrated Rescue System (IRS) and the army with all available sources. They include material, technical, energy, personnel, information, financial and other sources. The main task of CL is to select, integrate, coordinate and harmonize information flows of above mentioned competent bodies. This actually means effective application of risk management techniques and crisis management within CL processes from the aspect of prevention or minimizing protected interests´ losses that represent life, health, property or other values that are protected against damage, destruction, theft, or other way of disturbance. The basic premise of prevention and minimization of losses is knowledge of the current state of hazard arising from the observation of the risk development in dependence on time. The actual level of risks and the actual level of safety, as a continuous causal relationship presented by an information flow, generated by means of accessible information and communication technology including available database, are actually evaluated [1,5].

2. Risk management within the CL process

A new look at risk management is resulting from the process characteristics, which seeks solutions concept for the causal relationship between the risk levels and safety in dependence on time by rating the risk life cycle trend line. Time, as a very important parameter, is determined in terms of an in time response principle to negative activities that affect the stability of the safety system, and thus the level of risk development. Practice shows that negative activities which signals are reflected in the in-time response zone are tolerable. Negative activities are needed to be paralyzed in the coincidence of the time period of reaction and attack. In the period of delayed reaction time it is needed to set in all available resources to establish the system stability [1].

Linear shape of the curve in Figure 1 shows an extremely progressive growth of the risk rate, which ends in a catastrophic scenario. The curve shows stages of latent, acceptable, fatal, brutal and reverse, manageable risk (Tab. 1).

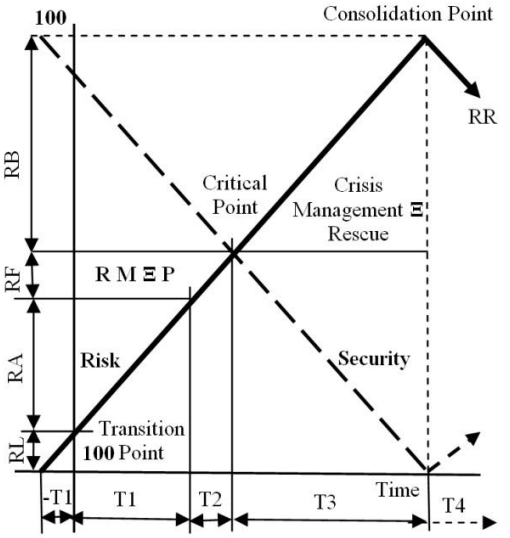

Fig. 1. Causal reliance risk \ safety and time. Legend: RL – latent risk, RA – accepted risk, RF – fatal risk, RB –brutal risk, RR – Reverse Risk, R M Ξ P – Risk Management Ξ Protection

The zone of the latent risk to the transition point is characterized by an indeterminate probability that the phenomenon leading to a catastrophe will occur. At this point, on the basis of implied parameters of morphological changes of streams channel, the likely level of risk at the transition point can be determined.

Table 1. Characteristics of the risks and impacts on security [2]

Risk	Characteristics	Impacts on security
Latent RL	difficult to identify and determine stage level up to the point of transition	point of transition to active zone (time, place and degree of the risk intensity)reduces the potential of relative security
AcceptableRA	identifiable, evaluate, adjustable stage levels	security potential outweighs the risk rates and guarantees the prevention of protected interests losses
Fatal RF	passive idle response of risk managementto an identifiable negative progress of risk (threat) level	security potential has a slight predominance, protected are the protected interests byorganizational - technical measures
Brutal RB	risk level has reached massive destructive nature with extensive damages	potential safety is 0, protected interests retrieval is carried out by catastrophic scenarios by components of the integrated rescue system invasion
Reverse risk RR	risk rate is decreasing	security potential adequately increases, retrieval ofprotected interests passes to the stage of damage remediation

Within the acceptable risk zone, CL monitors the progress, which does not anticipate the threat of catastrophe. According to the degree of flood activity the tolerable level of risk may be moved to the level of precaution, which in practice means that the river level is rising and approaching the bank line.

In the following zone, according to the fatal risk rate, i.e. the state of emergency, we respond to the water level in the river bed, which has a growing tendency after exceeding the bank line. CL carries out salvage works, focusing on averting the catastrophe. Dams from sandbags are built, including works to avert the predicted catastrophe according to the current scenario of flood protection.

Salvage works are performed in the last development stage of the life cycle, so in the brutal and reverse, that is a manageable risk. Its course is from the transition point (consolidation point) descending. In terms of flood activity, the threat risk occurs and manifests by dam leaking and debarking from the river bed of the watercourse, which may cause damages[8] CL is involved in the preparation and implementation of works related to minimizing the loss of general protected interests, including the general rehabilitation of the flooded area.

Stages of risk and crisis management consist of identification and risk analysis, catastrophes prevention, intervention units' invasion and remediation of damages after the catastrophe. Within the process management, primary role is performed by information flow of relevant data from relevant sources to relevant users. Relevant data sources are institutions that provide hydrological and meteorological forecasts and warnings, weather analysis, weather history, emissions, air quality, further information that inform about states and flows in water resources. Relevant users are all flood commissions including crisis management institutions and IRS, relevant authorities of local bodies, insurance companies and others [2,3,8]

3. Particularities of CL

CL is evaluated as a specific area of logistics, which in structure and content varies not only from the general logistics used in the civil sector, but also from a related military logistics. Despite the differences, they have a common basis, which is declared by the term, objectives, principles, requirements and application areas below:

• Concept and objectives of CL summarize the activities of planning, organizing, coordinating and managing all resources that are necessary for effective protection against catastrophes, for the comprehensive assurance of conditions of effective logistical support, including optimization of necessary material, technical, human and other resources deployed in the stages of protection, rescue and recovery of adverse effects of the catastrophe at a specific place and time to the protected interests.

• Principles of CL prevention can be divided into the following categories [2,4,5]:

- The principle of effective protection and survival: the requirements and conditions for the effective protection and catastrophe survival must be met and created in the stage of preparation to avert the catastrophe.
- Principle of resources creation: the necessary material, technical and human resources need to be adequately formed to the expected risk rate and the level of expected performance (efficiency) of resources within intervention.
- Principle of capacities harmonization: under the actual legislative standards it is necessary to align provided resources at all levels of civil service and local governments including offered domestic and international capacities.
- Principle of flexibility: it is necessary to create a comprehensive, harmonized unit of resources, which can be used flexibly on any type of catastrophe.
- Principle of resources creation: creation of necessary resources needs to be in accordance with the actual state's economic potential and to the potential of the armed forces of the state.

• Structure of CL requirements of catastrophe prevention includes the following elements:

- Integration capability is an essential requirement of centralized logistical support. Practice shows that at present each intervention unit of the IRS uses its own logistics system. This disharmony causes inefficient use of its own material, technical and human resources.

It often happens that a unit has an excessive number of capacities, which could be moreeffectively used by another unit within the intervention. In order for logistic support to meet the requirements of rational and efficient central management, it is necessary to integrate diverse types of logistics without losing its own sovereignty. The requirement of integrated management is enforced by using synergies effect and application of project management in intervention processes. Rationality of retaining its own sovereignty by logistic system of intervention units is reasoned by the fact that if these units intervene separately, logistical support is drawn and effectively used out of its own resources on the basis of the current intervention tactics management.

- The requirement of continuous operational reliability and safety of all sources during the intervention may not be, under any circumstances, influenced by the diversity of catastrophes´ types.
- The requirement of maximum flexibility of logistical support is emphasised by the fastest change in the structure of resources and technology in place and time according to the actual state of intervention effect development and the type of disaster.
- Cooperation is the requirement that encourages the involvement of various (subsidiary) logistic systems outside the established core of logistical support created from ingredients that are determined by government regulations. These systems, within the cooperation, can contribute by their own capacities to eliminate urgent problems with resources scarcity (transport and operating equipment, clothing, food, medication, etc.) of intervention logistics core units.
- Requirement for planning and economic efficiency is, despite stray occurrence and type of catastrophes, justified in terms of providing the necessary resources and economic processes of intervention.

As logistics is the science of flow management, this requirement may be met by consistent methodology application used by the classic logistics, starting with the estimate, procurement, storing up to distribution of required resources. Within planning, modern methods of applied mathematics and expert systems to manage flows and resources from their entry into the logistics system to output in the place of intervention can be used. In order to monitor the economic efficiency of resource it is necessary to connect an accompanying flow of costs that can be evaluated at any place and time, and thus control the spent costs and subsequently economic effectiveness of the intervention.

• Application fields of CL are as follows:

- Supplying, which is aimed at planning and implementation of accommodation provision and complete provision of all human resources (local authorities, government, deployment forces, IRS, and others.) involved in the rescue of disaster-stricken subjects and objects of protected interests.
- Material security, which aim is plan, provision and distribution of protective equipment (PE), chemical PE, civil clothing including equipment, ordinary household appliances, food, information and communication technology, fuels, oils and lubricants.

- Technical support includes planning and security implementation of necessary equipment and packaging, including assurance of their reliable operation for all resources involved in the rescue of disaster-stricken subjects and objects of protected interests.
- Storage provides planning and implementation of processes of procurement, storage and preparing sets and various parts of materiel and equipment, materials and substances needed for effective protection and preservation of the area affected by the catastrophe, including intake, storage and preparation of domestic and foreign humanitarian help.
- Management of donations and humanitarian help includes destination in which intake, recording, storage, and coordinated distribution for disaster-stricken people are ensured.
- Transportation, which aim is planning and implementation of passenger and goods transport of all emergency units including evacuation of disabled people and their property, personnel, material and equipment to determine the damage
- The aim of management is planning and realization of the budget for logistical support of complete and specific action against the catastrophe and its effects. All planned and implemented processes must be deliberately and with maximum efficiency and tangible personal responsibility provided with the necessary financial resources and similarly with maximum efficiency they must be used to cover accrued costs. The utmost care must be taken to finance of reserves acquisition and inventory management of non-recurring coffers obtained from domestic and foreign funds.
- The aim of health care system is to set up a harmonized cooperation with emergency medical service within the logistics of catastrophes, which would perform a complete treatment for the wounded, the catastrophe affected persons and members of the intervention units (registers psychology).

4. The concept of the GIS application in the CL system

The CL management centre dispose of extremely short time for an overview of a continuously and rapidly changing situation, for selection of the most appropriate method of protection and rescue, for examination of the number and type of resources for specific activities to avert the catastrophe [4].

In order to be able to harmonize all available resources coming from outside the territorial scope of the IRS and in order to avoid redundant efforts to protect and rescue, the requirement to build modern building of automation control system of CL on the basis of the application of geo-information system (GIS) is justified and in place. The main segments of the applied system are [4,6,7,8]:

Consistent, current database, which contains different types of logistics capabilities and resources. This database is naturally based on already existing database products, which through systems analysis of functional properties of present capacities convert to databases structured according to their applicability in different situations of standardized flood situations of protected interests protection and preservation.

Managing the database and special features providing software by which in the actual activity involved party, resp. to it connected sources, can be filed, the roles of deployed intervention resources can be defined, their implementation may be observed, and allocation and disposal of resources by emergency (disaster) scenarios and a list of current tasks can be smoothly enforceable.

Means of communication based on internet for territorial self-acting rescue groups. This means of communication, for example through current reports, of automatically maintained database allows access to maps to each user, which contain and display the necessary actual information of the current intervention, including the tasks performed by each intervention units.

Related information interface GIS with other support systems, such as water forecasting system, management systems in the deployment resources, remote communication systems in the terrain and so on.

5. Conclusion

Practical experience show that a prerequisite for preventing and minimizing losses at the flooded area is knowledge of the current state of risk, which results from the observation and evaluation of risk development versus time. The current risk level and the current level of safety as a continuous causal relationship presented by the information flow, generated by means of accessible information and communication technology, including available data base of CL resources are evaluated .

Floods have a geographic nature. Creation of maps and geographic analysis are not new, but with the support of GIS these tasks are better and faster in comparison to the traditional manual methods. GIS in flood areas greatly helps in the operational management of CL by creating forecasting flood maps.

Harmonized database of GIS and LP systems, including developed software package, make the decision-making process of the IRS in solving prevention, flood protection, including the rescue of protected interests in the flooded areas more effective.

Acknowledgements

This project is financially supported by European Regional Development Fund, the CBC Programme Hungary - Slovak Republic 2007-2013and Ministry of Agriculture and Rural Development of the Slovak Republic No. HUSK/1001/2.1.2/0009 , Flood modelling and logistic model development for flood crisis management

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