# Modelling Programme for Education at University of Defence

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*Abstract:-* The article deals about education and technologies using in the educational process at the Civil protection Department at University of Defence. There are especially two informational systems – Wave and TerEx – described that are used in education in the bachelor and master study programme. These computer programmes represent useful tools that can be used to support of effective decision making of crisis manager in crises management.

*Key-Words: - Civil protection, Crisis management, Education, Information technology, Study programme, University of Defence, TerEx programme, Wave programme*

## 1 Introduction

The times when we are living is characterised by the stately technologies development. These technologies should be making our approach to information easier, especially when they are utilised more effectively.

The computer support for crisis management is involved in many various sectors in human activity. At the present time there are many systems and technologies at disposal which facilitate the formulation of crisis plans, cooperation of the state with private subjects, monitoring of infrastructure and other necessary services for crisis managers in various organisations [1].

## 2 Problem Formulation

Informational systems and technologies are possible to be use both in public administration and private sphere. They can serve for successful solution in crisis situation. One of the spheres where these technologies are used is educational institutions.

Higher education institutions form the highest level of Czech education. They offer accredited study programmes at three levels: bachelor, master and doctoral. Except public and private higher education institutions are in the Czech Republic the state institutions. One of the state institutions is University of Defence which is under the responsibility of the Ministry of Defence.

### 2.1 Education at University of Defence

This university prepares military professionals and other specialist. The scope of work is defined with focus in education, formation and training these professionals as required by the Army of the Czech Republic, and in research projects in favour of the Ministry of Defence department and Public Administrations [2].

University of Defence is university-type higher education institution which offers all types of study programmes (bachelor, master and doctoral) and carries out associated research, developmental and other creative activities.

#### 2.1.1 Professional and educational sight

The University of Defence consists of three faculties: Faculty of Economics and Management, Faculty of Military Technology and Faculty of Military Medicine. From the academic year 2001/2002 was the first year of the study module Civil Protection opened at Faculty of Economics which is guaranteed by Civil Protection Department. This department is focusing on the area of civil protection, crisis management and civil-military co-operation. Furthermore, the department includes solving problems on military and non-military threats. The emphasis is placed on humanitarian aid, environmental security, major accident prevention and risk analysis.

Civil Protection Department cooperates with many institutions, e. g. Population Protection Institute, The Ministry of Interior of the Czech Republic, Nuclear Research Institute Řež plc, Transport Research Centre and other universities not only in the Czech Republic.

Students both in bachelor study programme and master study programme are informed about actual problems of Civil Protection. They pass the subjects of theoretical base (e.g. Economics, Computer Science, Mathematics, Law: Czech National Security and Defence), subjects of applied base (e.g. Economic-Mathematic Methods, Accounting, Enterprise Theory) and profiled subjects (e.g. Crisis Management, Natural

Disasters and Industrial Accidents, Population Protection, Dangerous Substance, Classification and Modelling of Risks, Public Administration Information System etc.).

The department also serves the basis for doctoral study programme and guarantees the programme Force and Civil Protection [2].

### 2.1.2 Aims and scientific activities

The main purpose of this programme is to prepare highly-qualified and specialized experts for basic and applied research, research workers, education and practice of civilian protection in accordance with the requirements and needs of NATO.

Scientific activity is directed at the following areas:

- crisis management in civil protection in non-military crisis situation,
- logistic support of non-military crisis situation especially on a solution of material standard for civil protection in crisis situation and coordination of human aid with utilization of non-profit-making organizations,
- raising of environmental safety at the level of advanced armies of NATO,
- dangerous substances detection at industrial accidents and natural disasters,
- optimalisation of informational and software support for prevention and solution of the consequences of extraordinary events and for simulation of these processes,
- interoperability in the crisis management.

It is possible to say that informational technologies are used in almost all scientific activities.

## 3 Information Technologies used at Civil Department Protection

At the Civil Protection Department students have the opportunity to encounter problems of information technologies in the subjects Public Administration Informatics System I, II. In this subject they can obtain information not only about IT but also information in which its support consists of public and state administrations.

The aim of this subject is to educate students for principal work with chosen informational systems that are closely linked with crisis management. Students learnt to use computer programs for modelling possible impacts and consequences of industrial accidents with the dangerous substances release.

Informational systems are products for effective decision making to support a crisis manager. Geografical Information Systems are especially used for scheduled objective.

The overview of the most important information systems that are divided into particular areas is in the table 1.

Table 1 Information systems in Crisis Management

| **Area** | **Information system** | **Description** |
|---|---|---|
| Civilian Emergency Planning | ARGIS | IS for Planning of Civil Resources which is important for self solution of extraordinary events in the Czech Republic. |
| Monitoring | Monitoring IS (MONIS) | This system monitors critical infrastructure |
| | Prague ecological monitoring system (PREMIS) | This system which is sponsored by the department of informatics of the Prague municipality serves for public information about the quality of the air in Prague. These systems were made especially for Czech market and monitored not only air but also road practicability, river level etc. |
| Modelling | Terrorist Expert (TerEx) | The tool for immediate forecast of explosions and chemical release hazards. |
| | WAVE | Tool for modelling of the dam destruction. |
| Planning | Emergency office (EMOFF) | It is technology to help in emergency planning and management and business continuity. The system integrate software tool for analysis, planning and emergency situation support. |
| Simulation of Emergency Event | Emergency Management Simulator (ESIM) | Simulator for Crisis Management Training and Exercising. It serves for obtaining of staff skill and for prepares to deal with various situations. |
| Analysis | Risk calculator for Managers (RISKAN) | It serves for organization security for governmental and public sector as well as strategic companies from telecommunications, utility and financial sectors. |

The aim of this paper is to introduce two of the above mentioned products that are used for student education in the Civil Protection Department; it is information system WAVE and TerEx.

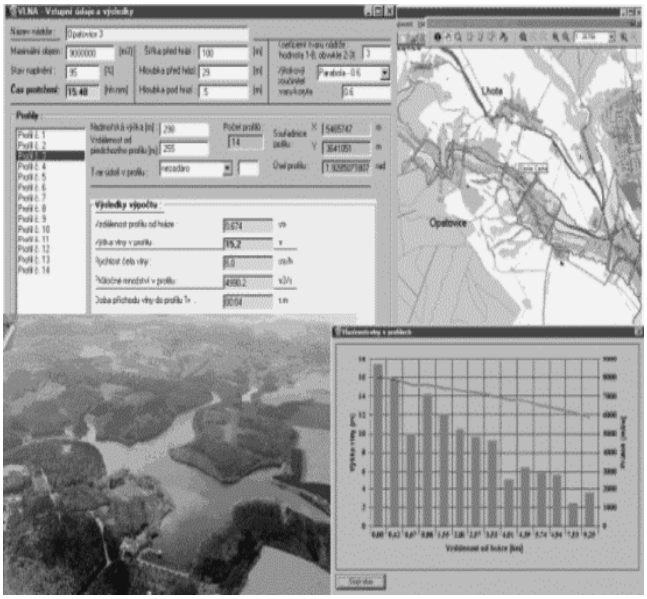
### 3.1 WAVE programme

WAVE is the software to calculate and visualize the flood breakthrough water wave and to model the consequences that resulted from the water dam destruction [4]. The software can be easily used by non-professional people. Thanks to this program it is possible to anticipate the flood effect after destructed water dam with sufficient probability and make necessary steps for civil- and army protection in time.

The core consists of the model designed at our military university. It can quantify the height of the breakthrough water wave depending on the distance from destroyed water dam and on the character of the terrain where the wave proceeds ahead.

In MaGIS Professional Studio it is possible to display 3 D view of affected area and both the profile of the terrain along the river and across the valley of the river. In longitudinal profile it is possible to mark the points with known height of flood breakthrough water wave from previous calculations and to finish calculation in other points by approximation [5]. In 3 D view it is then possible to represent the water level formed by flood wave in particular reach of the river by the curved area consisting of basic model elements. Subsequently, from the area that is obtained this way, it is possible to display into two-dimensional map as it is possible to see on the figure 1.

Fig. 1 Input data and results from WAVE programme



After visualization of the flooded wave it is possible to estimate effect area and make a basic analysis with help MAGIS system:

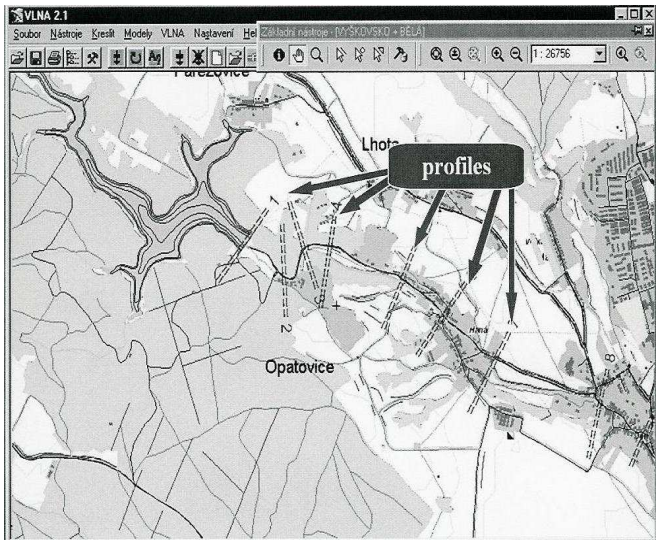
- flooded area range,
- probably flooded municipal territory,
- high of the flooded wave,
- number of the evacuated population,
- farmland affected by flooded wave.

When the program was developing it was assuming that destruction or damage of the dam arise failure wave. This failure wave that advanced down the river is characterized by destructive coming up to water tank volume and dam destruction range. The height of the failure wave can be from a few metres to tens of metres. The calculation of the failure wave depends on these parameters:

- water tank volume,
- width of the dam,
- dam depth in front of the dam,
- dam depth bellow the dam,
- bed slope of the river in the lap between profiles,
- valley shape and its character.

According to the map the river is separated into sections with approximately congruous bed slope, valley shape and forested character. After that it is defined the cross profile for every section. The Cross profile is defined stream cross-section in places where there is bold change direction of the flow. The parameters of failure wave are set in particular cross profile for calculation.

Fig. 2 Map from the programme WAVE with denotation of the profiles




Calculation of the failure wave characteristic consists of these steps.

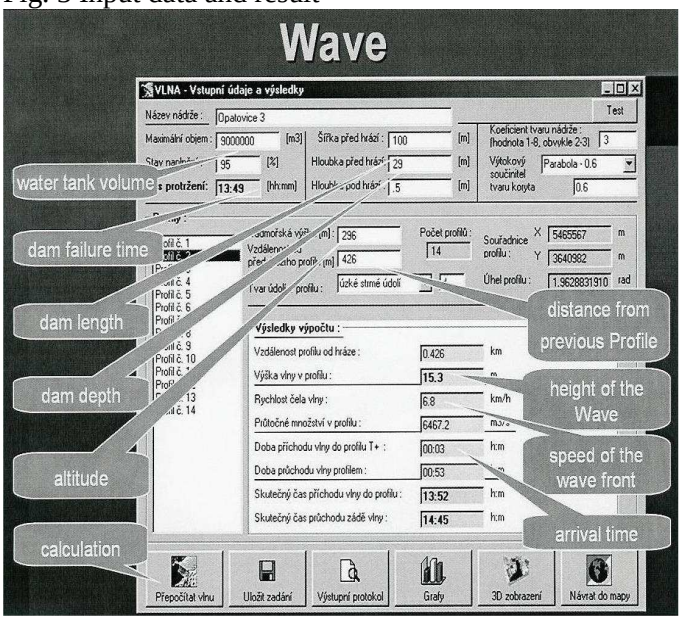
1. Definition and location of profiles.
2. Determination of fall of the river.
3. Calculation of the wave speed and coming of the wave into the profile.
4. Calculation of the high wave in the profile.
5. Calculation of the wave passing time in the profile.

The input data are presented in the table 2 and in the figure 3.

Table 2 Input data of the programme WAVE

| Title of the parameter | Description |
|---|---|
| Title | Title characterized of the dam. |
| Maximum volume | Total volume of the dam [$m^3$]. |
| State of filling | State of the dam filling [%]. |
| Width in front of the dam | For the prediction it is assumed the worst-case. |
| Depth in front of the dam | High of the water-level is derived from percentage of the dam filling. |
| Depth bellow the dam | Depth of the river-basin below the dam. |
| Shape dam ratio | For the calculation it is used value at intervals 1-8. |
| Coefficient of discharge of the river-basin shape | Determine the approximate river-basin shape and valley shape below the dam. The coefficient take these value:<br>- triangle shape = 0,4<br>- parabola shape = 0,6<br>- rectangular shape = 0,9<br>- or other value assessed by estimation = 0,75 |
| Time of disruption | From this time are calculated time characteristic of the wave. |
| Profile | Profile labelling. Consecutive number of the profile is established in the direction from the dam. |
| Altitude | This item is automatic put from terrain digital model [m]. |
| Distance from the previous profile | Clearance from previous profile [m]. |
| Shape of the valley in the profile | Medium speed of the failure wave depends on shape and weigh of the valley, number of forest stand and other barriers. For calculation these factors affect the partition of the territory into four sections. |

Fig. 3 Input data and result




For every profile there are given the output data that are described in the table 3.

Table 3 Output data of the programme WAVE

| Title of the parameter | Description |
|---|---|
| Distance of the profile from the dam | The sum of the clearance of the particular profiles. |
| Height of the wave in the profile | Maximal height of the water-level in the profile during passing of the failure wave. This parameter determines what the proportion of the flooded area is. |
| Arrival time of the wave into profile | Time from the moment of a dam disturbance to arriving of the wave front into profile. |
| Passing time of the wave in the profile | The time when the wave has significant effect. |
| Actual time of the arrival of wave in the profile | Time data derived from the moment of a dam disturbance to arrival of the wave into profile. |
| Actual passing time of rear wave | Time data derived from the moment of a dam disturbance to passing of the wave into profile. |
| Flow volume in the profile | Maximal flow volume in the profile which give insight into destructive of the wave in this place. |
| Speed of the wave front | This speed gives insight into destructiveness of the wave. |

The program WAVE can be especially used for prompt orientation and fast examination of acquisitions which are necessary for warning and other protection.

## 3.2 TerEx programme

TerEx is the tool for quick forecast of chemical materials and tripwire explosive systems impacts and consequences [6]. The model includes connectivity to graphic information system for direct results display on the map.

TerEx is aimed mainly for flexible use by rescue units during the operation to quickly determine the range of area under risk and to manage measures to protect inhabitants. It is possible to use TerEx by the operation commander directly at place or by operation officer in Command and Control Centre. TerEx is also very effective for planning and risk analysis [7].

TerEx provides evaluation of 4 basic incident models that are showed in the table 4.

Table 4 Incident models of programme TerEx

| Title | Model Description |
|---|---|
| TOXI | Evaluates range and shape of cloud which depend on quantity and concentration of released material. |
| UVCE | Evaluate incidental range of blast wave caused by detonation of escaped explosive material mixed with air. |
| FLASH FIRE | Evaluate risk area of heat radiation caused by fire. |
| TEROR | Evaluates incidental range of blast wave caused by detonation of explosive system. |

TerEx Wizard enables to achieve highly reliable results both for specialist and the person who is not an expert in chemistry or pyrotechnics, e. g. crisis manager.

Via simple questions and menus the user is guided to accurate and unambiguous specification. There are three steps to follow:

1. Damaged equipment specification.
2. Incident type specification.
3. Dangerous substance specification.

TerEx calculation results are arranged in a very easy, comprehensive and unambiguous format which helps users to make quick decisions. This effect is achieved by minimizing output items to important ones and by displaying results on the map, as it is in the figure 4.

Fig. 4 Map with the labelling of effected area


In the end it is possible to save model situation into “incident database”.

# 4 Conclusion

Finally, it is necessary to say that all software products assist a crises manager in his or her decision making. All computer programs are only “lifeless” and “thoughtless” products. The crisis manager is featured, especially his knowledge, abilities and acquirements, and many times also his extemporization.

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