

WCLTA 2013

Forensic Science In Higher Education

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Abstract

The paper is focused on the issues of forensic science in civil engineering and the importance of forensic science in civil engineering education, especially in the Master's degree level three-stage system of education. Emphasis is placed on the importance of risk analysis in civil engineering and its practical applications. The importance of risk analysis and use in education is based on the platform of knowledge of forensic activities. The issue is documented in a case study.

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Selection and peer-review under responsibility of the Organizing Committee of WCLTA 2013.

Keywords: Forensic Science, Civil engineering, Education in the Master's degree level three-stage system;

1. Introduction

The Faculty of Civil Engineering, VŠB-Technical University of Ostrava educates civil engineers in several fields [2]. Tuition takes place in bachelor, master and doctoral programmes with an overall number of students 2,500. The study is carried out in the Czech language. The tuition, which is done in English, is aimed at the students studying within the Erasmus programme. These are students from various countries of the world – primarily Europe.

Findings of science and research carried out at the faculty are used for the tuition. One of the results introduced into the instruction are those from an extension field – forensic engineering. It is the field which is not a standard part of teaching. The only exception is basis of forensic engineering. The reason for that is that forensic engineering is an extension discipline requiring more than mere knowledge of the field studied by the student. It requires mainly

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practical experience and practical knowledge, a sense of balance between theory and practice, knowledge of legal regulations and to large extent knowledge of the relations between specializations and fields of study. A forensic expert has to have high moral credit as his decisions have to be just and unbiased.

A forensic expert needs modern, reliable and scientific methods for his work [3], [4], [5], [6]. The “Methods of analysis of risks”, so called risk analysis, definitely belong among such methods.

The use of these methods is based on their application by completely different means than they are known and were originally intended for. The uses are introduced to the students during tuition, and afterwards they can verify their functioning with practical examples. The applications of the methods are developed in up to now unused areas and disciplines in the doctoral studies programme [1], [7].

The students of our faculty work mainly with the method of risk analysis called UMRA (Universal Matrix of Risks Analysis)[1], [7].

2. UMRA Method

The Method UMRA (Universal Matrix of Risks Analysis) was used for the first time around the year 1986 (by Prof. Milík Tichý) for the construction of a tunnel as a whole (from a sketch), which means for the period from the initial idea, through a life cycle to its death. From 2005 to 2013 this method was applied separately for the individual phases of the construction [3], [4]. The method was consequently used also in forensic research and was proved and thus was verified in practice. On the basis of this verification a “certified methodology” was utilized for various dual usages with subsequent integration into instruction.

The possibility of usage (and also an official confirmation of an applicability of this certified methodology) has provided in this case an alternative method of forensic research and for giving proof.

At the same time a way has been opened for the application of other methods of risk analysis in the fields, which these methods were not primarily intended for. It is worth mentioning the use of SWOT analysis for assessing whether an area is suitable for construction (Pavel Vlček [7] – dissertation, FAST VŠB-TUO, Ostrava 2012).

These activities have awakened other student’s interest in the unconventional usage of risk analysis methods such as the usage of the UMRA method in the process of creating a construction project (Silvie Dobiášová, [1] – dissertation, FAST VŠB-TUO, Ostrava 2013.)

2.1. Presented principles of the UMRA method

The UMRA method was originally established for risk analysis, but as it turned out the sphere of application is broader (Miluše Valjentová– dissertation, Faculty of Civil Engineering, ČVUT Praha, 2010). It is a verbally-logical/numerical method. It serves as an identification of danger, alternatively a script of danger, then as an estimation of the seriousness of danger, the estimate of damage or as a source for the creation of risk maps.

The method is based on matrix [3], [4], which assesses the confluence of sources of danger and endangered segments. Matrix-forming is the verbal part of the analysis, filling in the matrix is the logical-numerical part. The method enables the identification of potential danger or the qualification of the relative seriousness of danger. It is important to form a team of experts (the recommendation is from 5 up to 20 people) led by a risk analyst whose role is not only to moderate the execution of the analysis but also to process the expert’s statements.

The UMRA method lays emphasis on the formation of a team of experts, as during the application of this method the following factors are decisive: the qualification and experience of the experts, their perception and ability to estimate the character of concurrences, etc.

The results of the analysis using the method UMRA state the order of the importance of sources, the segments and concurrence from the point of view of an examined process, project or object. They can be used as input data for further analysis using the FTA method in order to create a tree of malfunctions, or they can be further analysed by the FMEA method.

The above mentioned principles were newly applied into two sectors that were mostly dealt with as the issues of a forensic expert in an expert’s report on structures in the case of a lawsuit or building and construction accidents [3], [4]:

- Determination of the order of construction units from the point of view of the assessed structural-technical state.
- Determination of the damage assessment amount and its share in the assessment of a building.

All the general rules and principles of work with this method have remained the same and students have the opportunity to think over how to adjust and alter this method.

2.2. Teaching support of the Ministry of Education

Regarding the effort to support tuition in the field of forensic sciences, which is an extra discipline of the master programme, the instructions are given under the support of the operational programme “Education for competitive ability (OP VK), the area of support 2.3 “Human Resources in research and development” (<http://www.mladi.vyzkumnici.cz/cz/>). The main target of this project also known under the title YOUNG RESEARCHERS is to back up and motivate young academic staff and students in their scientific activities with the help of state-of-the-art equipment, financial resources, and provide an opportunity to take part in conferences abroad as well as in the Czech Republic and other similar events. The aim of the project is to draw and integrate new research workers out of the students of master and doctoral studies into particular research groups.



Fig. 1.

(a) students of working group “Assessment of building construction risks” setting off for the field with technical equipment (b) the presentation of acquired results

The focus of the project is the creation and following support of activities of 11 research groups that are guided by an academic staff member of the Faculty of Civil Engineering and a chosen foreign expert. One of the groups is in charge of providing a thorough assessment of risk, the group is temporarily called “The Assessment of building constructions risks” The target group of the project are the students of civil engineering.(Fig. 1b).

2.3. Work procedure of students

The interest of students in this alternative way of assessing buildings, with the possibility of estimating what is the life-time of a building, is enormous. This information has an importance not only from the forensic science point of view, but also and foremost from the economical aspect. The reason for that is the possibility and mainly justification for potential reconstruction. In other words, it is important to find an answer to the question whether we should reconstruct a building or demolish it and build a new one.

The team of experts evaluates an identified part of a problem (project), which is demarcated by a certain danger – a risk. The number of parts of the problem, evaluated by the team of experts, is arbitrary while various (or the same) parts can be independently dealt with by different expert teams with a varied number of people.

The goal of this expert risk method is to provide the most accurate information about the source of the danger in relation to the consequences of its origin and the anticipated extent of its occurrence, which is directly related to

economic indicators – in the case of construction to investment costs or investment into the reconstruction (rehabilitation) of the building. Graph 2 shows the situation (Fig. 2).

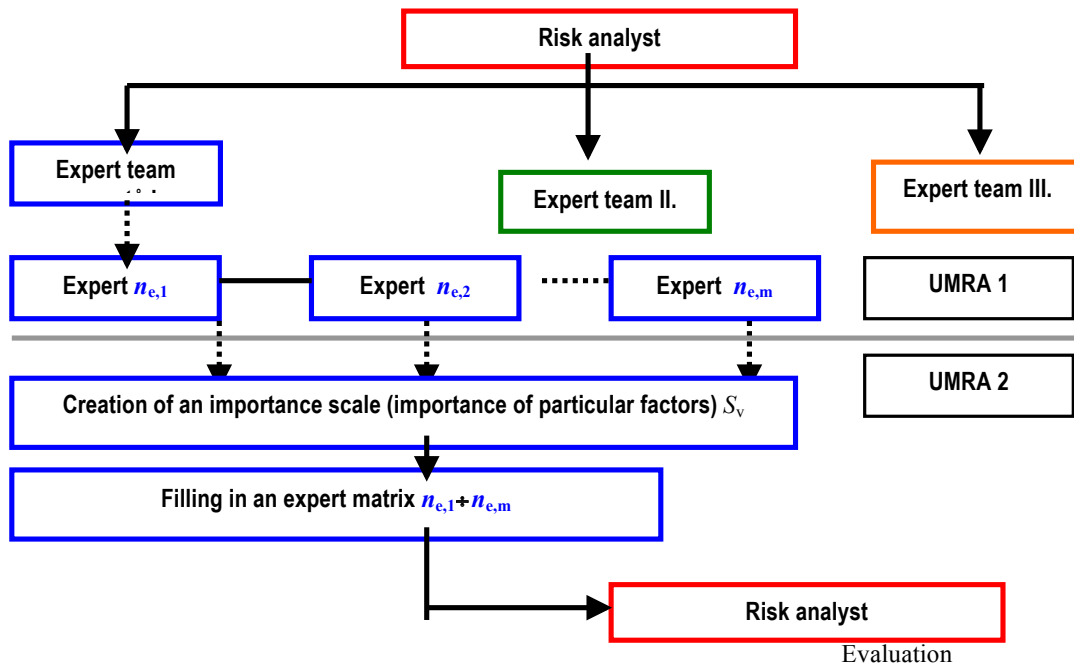


Fig. 2. Process of work of the expert team while analyzing the risk

The team of experts has several members; its number can vary according to the seriousness of the evaluated issue. The easiest alternative is when the team is represented by one person who is the risk analyst at the same time (as it is described above in the case when the person makes the decision whether to proceed to a communication step...)

Work is divided into subsequent phases (Fig. 2). These are called UMRA 1 and UMRA 2. In the first phase (UMRA.1) the risk analyst familiarizes him/herself with the project that he/she is going to manage and which will be examined for risk analysis on the basis of a defined aspect (qualitatively the defined and specified perspective of the project) One example is e.g. “the static qualification for evaluating an object”.

The risk analyst then introduces the experts of an expert team to the core of the method and to the task of the method in risk analysis, for experts are specialists in their profession (in a given aspect) unfamiliar with the details of risk evaluation. The experienced person is in this example the risk analyst. The experts are needed to be introduced to a minimum amount of information which represents the importance of the segments of the project of the chosen aspect including the rules of the structure, the significance of the sources of danger including the rules of the structure of danger, especially the practice of filling in a form. We can simply compare it to a technical questionnaire. The evaluation is mainly the matter of the risk analyst; the expert’s task is to fill in the form.

2.4. Procedure of students’ work

The important part of the work is evaluating the acquired data. Assessment is performed using an analytical approach or by using probability analysis according to the students’ choice and both methods of evaluation are often used because of the comparison of the results [3], [4]. The results are presented in front of an expert audience (Fig. 1b), they are argued about and put through uncompromising criticism.

Acknowledgements

The conceptual development of science, research and innovation 2013, were awarded by the Ministry of Education, Youth and Sports of the Czech Republic.

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