Scientific Journal of the Military University of Land Forces
ISSN: 2544-7122 (print), 2545-0719 (online)
2020, Volume 52, Number 3(197), Pages 632-642
DOI: 10.5604/01.3001.0014.3957

Original article

Study of the level of knowledge, response, and behavior in the event of possible threats at the Campus of the Silesian University of Technology among the students of Safety Engineering

Maja Taraszkiewicz-Łyda*, Natalia Koch

Department of Safety Engineering, Faculty of Mining and Geology,
Silesian University of Technology, Gliwice, Poland,
e-mail: maja.taraszkiewicz-lyda@polsl.pl; Natalia.Koch@polsl.pl

INFORMATION

Article history:
Submited: 13 September 2018
Accepted: 11 February 2020
Published: 15 September 2020

* Corresponding author

ABSTRACT

The article discusses the issue related to the study of the level of knowledge among students of Safety Engineering in the field of selected types of threats, the possibility of their occurrence, and knowledge of the rules of conduct in the event of their occurrence at the Campus of the Silesian University of Technology. Survey techniques were used for the analysis.

KEYWORDS

hazards, Safety Engineering, risk assessment

Introduction

Safety engineering, as a new discipline of science, is inextricably linked to the broadly defined issues of crisis management and safety of facilities, the environment, and residential and living areas of people. The objective of the study was to determine the level of knowledge among students of Safety Engineering in the field of selected types of threats, the possibility of their occurrence, and knowledge of the rules of conduct in the event of their occurrence at the Campus of the Silesian University of Technology.

In the first stage, the level of knowledge was studied among students of Safety Engineering in the field of selected types of threats and knowledge of the rules of conduct in the event of their occurrence at the Campus of the Silesian University of Technology.

In the next stage, on the basis of the opinions of the surveyed students, an assessment of the risk of occurrence of the selected threats and their possible consequences at the Campus was carried out.

1. Characteristics of selected types of safety threats

In order to minimize the consequences of a number of hazards, it is necessary to identify and analyze the potential hazards and take appropriate action. Threats regulated in legal acts include:

In the Act of 18 April 2002 on the state of natural disaster:

- natural disaster, means a natural disaster or technical failure whose consequences endanger the life or health of a large number of people, property on a large scale, or the environment in a large area, and where assistance and protection can only be effectively undertaken by extraordinary measures, in cooperation between different bodies and institutions, as well as specialized services and formations operating under unified leadership,
- natural catastrophe, an event related to operation of forces of nature, in particular lightning strikes, seismic activity, strong winds, intensive rainfall, long occurrence of extreme temperatures, landslides, fires, droughts, floods, ice phenomena in rivers and in seas, and in lakes and water reservoirs, mass presence of pests, diseases of plants or animals, or infectious diseases in people, or operation of other elements,
- technical failure is a sudden, unforeseen damage or destruction of a building structure, a technical device, or a system of technical devices resulting in an interruption in their use or loss of their properties.

A natural disaster or technical failure may also be an event caused by a terrorist action [1].

In the Act of 26 April 2007 on crisis management:

- an event of a terrorist nature, which should be understood as a situation resulting from an act specified in Art. 115(20) of the Act of 6 June 1997 – Penal Code or a threat of such an act, which may lead to a crisis situation (a terrorist offense is a prohibited act punishable by imprisonment, the upper limit of which is at least 5 years, committed with the aim of: seriously intimidating many people, forcing a public authority of the Republic of Poland or another state, or an authority of an international organization to undertake or abandon specific actions, causing serious disturbances in the political system or the economy of the Republic of Poland or another state, or an international organization, as well as a threat of committing such an act) [2, 3].

In the Act of 24 August 1991 on fire protection:

- other local threat is an event resulting from the development of civilization and natural laws of nature, not being a fire or a natural disaster, posing a threat to life, health, property, or the environment, the prevention or elimination of which does not require extraordinary measures [4].

In addition, we distinguish a group of civilizational threats that are often the side effects of technological progress in various areas of human life and activity:

- fires of forest areas and of industrial and storage facilities, and fires related to damage to industrial pipelines,
- chemical contamination caused by the emission of toxic industrial agents located in industrial plants or being transported,
- catastrophes and breakdowns of building structures, including bridges and overpasses,

– accidents in road and rail transport, including those related to damage to vehicles carrying dangerous chemicals [5],
– communications and messaging system failures, including dispatching systems;
– acts of terror and social incidents,
– major power failures.

A consequence of the development of the chemical industry is the emergence of a new category of hazards – toxic industrial agents (TIA), which are most often highly toxic chemical compounds, the escape of which from tanker trucks, containers, or equipment may cause an ecological disaster [6].

2. Characteristics of a safety engineering student

Students of Safety Engineering at the Faculty of Mining and Geology of the Silesian University of Technology acquire knowledge in two specialties: Technique and Organization of Occupational Health and Safety and Safety Engineering and Crisis Management.

The broad interdisciplinarity of Security Engineering makes students comprehensively combine technical knowledge with the skills of and techniques of effective team management and acquire theoretical knowledge and practical skills in areas such as:

– identifying, forecasting and diagnosing threats, and developing methods of preventing, counteracting, and preparing actions in case of adverse events and crisis situations,
– risk analysis of threats and forecasts of their potential consequences,
– design and implementation of modern and effective safety management systems in state administration units,
– creating conditions to ensure the continued operation of critical infrastructure;
– planning preventive actions,
– designing safety management systems, operating and improving procedures of such systems,
– cooperation with units of the national rescue and fire-fighting system and public order institutions,
– raising public awareness and general education on threat prevention,
– creating organizational, technical, and financial conditions for efficient crisis management,
– organizing communication and monitoring systems,
– organizing and maintaining warning and alert systems,
– creating conditions for the survival of the population in crisis situations,
– creating conditions to ensure continuity of functioning of public administration,
– estimating damages and losses resulting from disasters and crisis situations,
– analyzing the company's compliance with international safety standards and applicable laws,
– forecasting emergency situations and developing measures and ways to counteract them,

– cooperation with law enforcement institutions,
– using the knowledge of civil, administrative and criminal law.

3. Characteristics of the Campus of the Silesian University of Technology

The Campus of the Silesian University of Technology, also known as the Student Residential Estate, is one of the largest university campuses in Poland. It consists of 12 dormitories (10 in Gliwice and one each in Zabrze and Katowice) as well as the "SEZAM" Guest House and two canteens. The dormitories have 3,459 beds in single, double, and triple rooms of varying standards. Each of the dormitories has a TV room, a gym, and a table tennis room. There is a fiber-optic link to each building. In each of them there is a local computer network with Internet access, available to all residents. There are sports courts in the student residential estate, and the campus is adjacent to the Sports Center facilities: two sports halls, tennis courts, and an ice rink.

Within the Campus there is a promenade full of greenery with a representative square and fountain, and street furniture with decorative elements referring to the coat of arms of the Alma Mater in Gliwice. New lighting was installed and the light path, i.e. the route from the Piłsudski Square to the Silesian University of Technology and the Gliwice hall under construction, were marked with blue LED markers placed on the lanterns. There are also parking lots with a license plate recognition system at the entrance and a bicycle path, all covered by the city's video surveillance cameras.

4. Survey study

4.1. Stage I

The questions in the survey were drafted in such a way that the students could translate the knowledge gained during their studies into their individual experiences.

The hazards, e.g. chemical hazards occurring in the student's life and at the Campus, include damage of/leak from the gas system in the dormitories, chemical substances that are omnipresent in everyday life, e.g. in cleaning products, cosmetics, or food [7], chemicals used during classes in laboratories (gases, oils, lubricants, acids), road transport of dangerous substances (the Campus is located about 5 km from the Sośnica junction – the intersection of the A1 and A4 motorways), as well as various types of stimulants and prohibited intoxicants.

Biological hazards include contacts with other human being – factors from hazard groups 1-4 [8], contacts with animals (domestic, stray, wild), and expired/spoiled food products.

The survey study was carried out among full-time undergraduate and graduate students of Security Engineering at the Silesian University of Technology in a randomly selected group of 72 out of 149 students.

A survey consisting of 15 open questions was conducted among the students of this field of study:

1. Decode the abbreviation "CBRD threats".
2. List 3 sources of chemical hazards.
3. List 3 chemical hazards that may occur at the Campus of the Silesian University of Technology.

4. List 3 chemicals you have had, are having, or will have contact with during your studies.
5. List 3 possible ways of in which chemicals act on the human body.
6. List 3 sources of biological hazards.
7. List 3 diseases or symptoms that may result from contact with a biological agent?
8. List 3 basic hygiene rules that limit your exposure to biological hazards.
9. What would you do to help a person poisoned with natural gas?
10. Which three senses will you use to evaluate a victim's breath?
11. Write how you do CPR.
12. List any 3 rules that apply during an evacuation.
13. Would you be able to provide any rules/ways of acting after exposure to a substance of unknown origin, e.g. white powder in an envelope?
14. Would you be able to give any rules/ways of acting in the event of contact a corrosive substance?
15. Could you provide any rules on how to proceed following a radiological threat alarm?

The answers were scored: questions 1-12 on a scale of 0 to 3 with a threshold of 1, and questions 13-15 on a scale of 0-2 with a threshold of 1. The maximum number of points that could be scored was 42.

4.2. Stage II

In the next stage, on the basis of the opinions of the surveyed students, an assessment of the risk of occurrence of the selected threats and their possible consequences at the Campus was carried out.

Using the general principles of risk assessment according to the Polish Standard PN-N-18002 [9], the guidelines for estimating the probability of hazard occurrence were defined:

1) *unlikely* – the threat should not occur during the period of student activity,
2) *likely* – the threat can occur several times during the period of student activity,
3) *very likely* – the threat can occur several times during the period of student activity,

as well as their possible consequences:

1) *low-harm consequences* – injuries and illnesses that do not cause long-lasting symptoms, temporary deterioration of health: minor contusions and injuries, eye irritation, symptoms of minor poisoning, headaches, etc., lack of victims and no major material losses,
2) *medium-harm consequences* – injuries and illnesses that cause minor but prolonged or periodically recurring symptoms, e.g. wounds, second-degree burns on a small area of the body, skin allergies, uncomplicated fractures, several victims and/or significant material losses: short interruptions in the supply of utilities, minor damage to buildings, e.g. broken windows, cracked walls, rapidly repairable damage to technical infrastructure, temporary lack of necessities, reversible damage or destruction of the environment,

3) *high-harm consequences* – injuries and illnesses that cause severe and permanent discomfort and/or death: 3rd-degree burns, 2nd-degree large-area burns, amputations, complex fractures with subsequent dysfunction, cancer, toxic damage to internal organs and the nervous system as a result of exposure to chemicals, mutations, multiple victims and/or very large material losses: long term interruptions of utility supply, destruction of buildings, destruction of technical infrastructure, e.g., gas pipelines, water pipelines, lack of basic necessities, permanent, irreversible damage to or destruction of the environment.

The following hazards were considered in the assessment:

– floods,
– heavy snowfalls,
– fires,
– major construction failures,
– communications system failures,
– terrorist attacks,
– social incidents, public order disturbances,
– major power failures,
– chemical, release of substances, toxic agents,
– biological and epidemiological,
– major technical infrastructure failures (gas networks),
– radiological,
– transport.

The surveyed students were asked to determine the probability of a given threat occurring at the Campus and its possible consequences.

The opinions obtained were averaged and then the risk of the threats was estimated on a three-point scale according to the matrix shown in Table 1.

Table 1. Principles for risk assessment on a three-point scale

Gravity of consequences / Probability	Low-harm consequences	Medium-harm consequences	High-harm consequences
Unlikely	1 LOW	1 LOW	2 MEDIUM
Likely	1 LOW	2 MEDIUM	3 HIGH
Very likely	2 MEDIUM	3 HIGH	3 HIGH

Source: [9].

5. Results of the survey

An analysis of the answers given by the surveyed students and their assessment lead to the conclusion that only 5 respondents (7% of the respondents) scored less than 50%. Less than 20% (12 people) of the respondents gave correct answers in the range of 61-70%. The most numerous groups were those who gave 71-80% and 81-90% of correct answers; their number was 23 and 24, respectively. One respondent (1%) scored 100% of the possible points. These data are shown in Figure 1.

The average score was 74%.

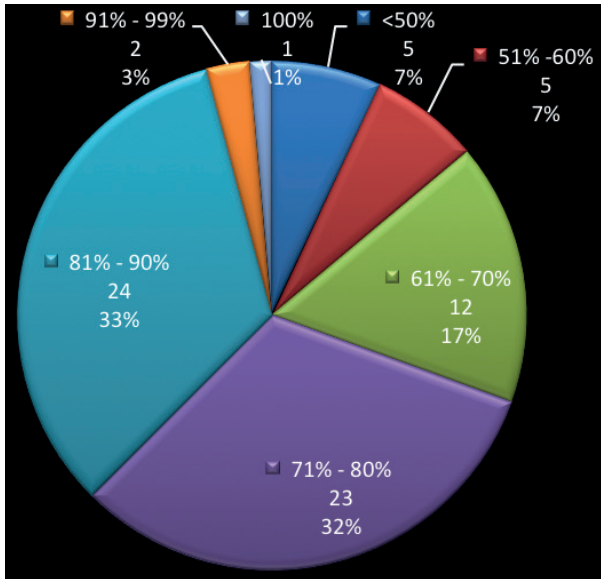

Fig. 1. Number and percentage of respondents according to the number of percentage points obtained
Source: Prepared by the author.

Figure 2 shows the number of percentage points obtained for a given question. Of the different questions, the most difficult for students was question 1, which concerned deciphering of the abbreviation "CBR threat" – 40% of correct answers, and questions 13, 14, and 15, which concerned the provision of any rules or procedures to be followed in selected cases: contact with a white powder in an envelope (60% of correct answers), contact with a corrosive substance (66% of correct answers), and announcement of a radiological threat alarm (26% of correct answers). It should be added that the response often given by students is "calling the appropriate services", which is also a correct way to act, but for some reasons (lack of knowledge, fear) respondents prefer not to take action themselves, but to leave it to specialized services. Another question for which the score was lower than the average of 73%, was the question concerning chemical threats occurring at the Campus – the percentage of correct answers was 71%. Question 9 on helping a person poisoned with natural gas also received 74% of correct answers – only a percentage point more than the average.

The study showed that as many as 96% of the respondents know how to assess the victim's breathing (question 10), whereas 80% of respondents know how to perform CPR.

It can also be noted that students have systematic knowledge of the sources of threats and the way they act on the human body, in case of both chemical and biological threats. This is confirmed by answers to questions 2, 4, 5, 6, and 7, where the number of correct answers is over 80%.

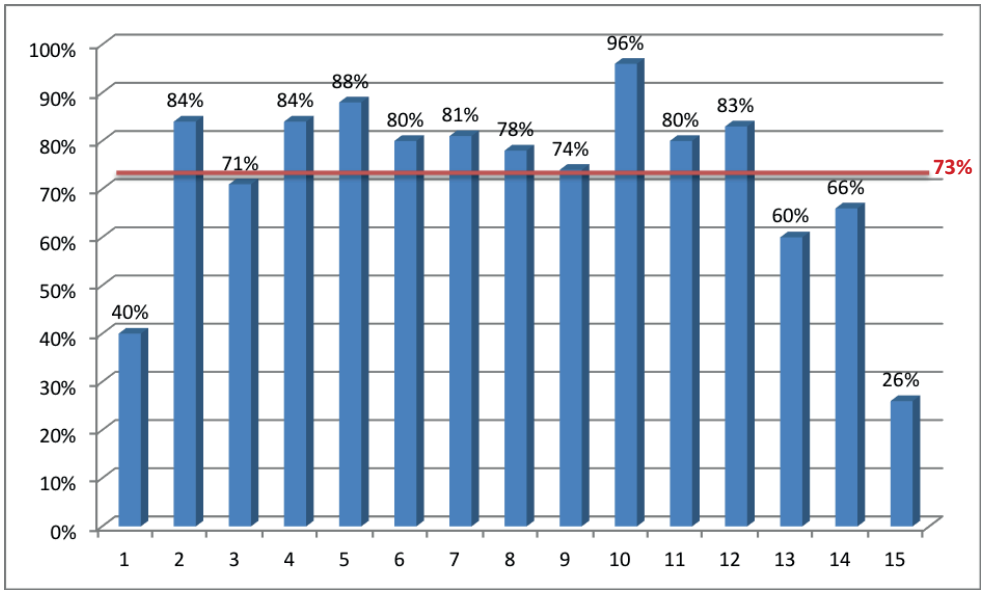

Fig. 2. Number of percentage points obtained per question
Source: Prepared by the author.

With regard to determination of the probability of occurrence of specific hazards and the possible consequences, the results shown in Table 2 were obtained.

Conclusions

From the surveys carried out among the students of the Department of Safety Engineering it can be concluded that they have systematized knowledge, at a high level of over 70%, in the field of chemical and biological threats. They are able to use the knowledge gained during their studies on hazards, crisis management, and occupational health and safety in their daily lives. 93% of the students surveyed obtained more than a half of the points available and 69% of them showed knowledge at the level of over 70%.

An analysis of the number of correct answers to individual questions leads to the conclusion that the results for two thirds of the questions were above the average value of 73%. The rules of conduct after exposure to a substance of unknown origin or with a corrosive substance are known to students at 60% and 66%. Unfortunately, the survey also showed that the students have little knowledge (26% of correct answers) about the rules of conduct

Table 2. Assessment of the risk of a hazard

Threat	Probability of occurrence of the hazard	Possible consequences	Estimated risk
floods	2 *likely*	2 *medium-harm consequences*	2 *medium*
heavy snowfalls	2 *likely*	2 *medium-harm consequences*	2 *medium*
fires	2 *likely*	3 *high-harm consequences*	3 *high*
major construction failures	2 *likely*	2 *medium-harm consequences*	2 *medium*
communications system failures	2 *likely*	1 *low-harm consequences*	1 *low*
terrorist attacks	1 *unlikely*	3 *high-harm consequences*	2 *medium*
social incidents, public order disturbances	2 *likely*	2 *medium-harm consequences*	2 *medium*
major power failures	1 *unlikely*	2 *medium-harm consequences*	1 *low*
chemical, release of substances, toxic agents	2 *likely*	2 *medium-harm consequences*	2 *medium*
biological and epidemiological	1 *unlikely*	2 *medium-harm consequences*	1 *low*
major technical infrastructure failures (gas networks)	1 *unlikely*	2 *medium-harm consequences*	1 *low*
radiological	1 *unlikely*	2 *medium-harm consequences*	1 *low*
transport	2 *likely*	2 *medium-harm consequences*	2 *medium*

Source: Prepared by the author.

in case of a radiological threat alarm and have problems with deciphering the abbreviation "CBR threat" (40% correct answers). Students – experts determined the probability of occurrence of the given threats and the possible consequences, if they occur. Having analyzed and counted all the answers, it turned out that, in the case of the fire hazard, the probability of occurrence was determined as likely and with high-harm consequences; thus the estimated risk in this case is high.

The risk of the seven threats was estimated as medium (flood risk, heavy snowfall, major construction failures, terrorist attacks, social incidents, public order disturbances, chemical, release of substances, toxic agents, and transport).

The risk of communication system failures, major power, biological, and epidemiological failures, major failures of technical infrastructure (gas networks), and radiological threats was assessed as low.

To sum up, students have a high level of knowledge and are aware of the dangers that occur or may occur in their environment and demonstrate knowledge of the rules of conduct.

Acknowledgement

No acknowledgement and potential founding was reported by the authors.

Conflict of interests

All authors declared no conflict of interests.

Author contributions

All authors contributed to the interpretation of results and writing of the paper. All authors read and approved the final manuscript.

Ethical statement

The research complies with all national and international ethical requirements.

ORCID

Maja Taraszkiewicz-Łyda https://orcid.org/0000-0002-3658-500X

Natalia Koch https://orcid.org/0000-0002-8339-1558

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Biographical note

Maja Taraszkiewicz-Łyda – PhD, assistant professor at the Department of Management and Safety Engineering at the Faculty of Mining and Geology of the Silesian University of Technology. Graduate of the Silesian Medical Academy, completed doctoral studies at the Silesian University of Technology. Specializes in emergency medical services and public health. Areas of interest: emergency medical services, industrial and mining rescue services, crisis management, organization of rescue systems, safety.

Natalia Koch – MSc, Silesian University of Technology in Gliwice, Faculty of Mining and Geology, Department of Safety Engineering, 2013; graduate studies completed with distinction (2013); currently participant of postgraduate studies at the Silesian University of Technology in Gliwice; areas of interest: occupational risk, occupational health and safety, fire hazard, fire protection, crisis management.

Badanie poziomu wiedzy oraz reakcji i sposobów postępowania w przypadku wystąpienia ewentualnych zagrożeń na terenie Miasteczka Akademickiego Politechniki Śląskiej wśród studentów kierunku Inżynierii Bezpieczeństwa

STRESZCZENIE W artykule poruszono zagadnienie związane z badaniem poziomu wiedzy wśród studentów kierunku Inżynierii Bezpieczeństwa w zakresie wybranych rodzajów zagrożeń, możliwości ich wystąpienia oraz znajomości zasad postępowania w przypadku zaistnienia ich na terenie Miasteczka Akademickiego Politechniki Śląskiej. Do analizy wykorzystano techniki badań ankietowych.

SŁOWA KLUCZOWE zagrożenia, Inżynieria Bezpieczeństwa, ocena ryzyka

How to cite this paper

Taraszkiewicz-Łyda M, Koch N. *Study of the level of knowledge, response, and behavior in the event of possible threats at the Campus of the Silesian University of Technology among the students of Safety Engineering*. Scientific Journal of the Military University of Land Forces. 2020;52;3(197):632-42.

DOI: http://dx.doi.org/10.5604/01.3001.0014.3957