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Securing Schools against Terrorist Attacks

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Abstract: The population is nowadays increasingly threatened by events that have an immediate impact on their health and lives. One of the most endangered targets are the so-called soft targets. These are such targets that are characterized by a high population concentration, and low or even no level of security against violent or even terrorist attacks. The research carried out by the authors clearly showed that one of the important and easily vulnerable soft targets are schools. This article focuses on the safety of schools and their facilities. The authors focused on finding out the safety of schools as soft targets in the Czech Republic. The security level of schools was measured at selected nursery, elementary, and secondary schools in the city of Brno. As well as technical elements, other factors contributing to the overall safety of schools were also verified. It was found that although a large number of schools have at least basic elements of security available, systemic and organizational measures are not sufficient for technical measures to be important.

Keywords: security; safety; soft targets; expert assessment; Fishbone diagram; Pareto law

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1. Introduction

The population is increasingly threatened by events that have an immediate impact on their health and lives. The increasing complexity of the threats and the resulting risks affects, directly or indirectly, the protection of the population. Emergency situations can cause major material damage, such as in the event of widespread flooding, or damage the health of individuals to a large extent [1,2]. Given the ever-increasing number of naturogenic and anthropogenic emergency situations and the severity of their consequences, it is essential to adopt the right integrated approach to reduce the impact of these phenomena, and measures to protect the population when an emergency situation occurs, and also during and after such a situation [3,4]. Special attention should be paid to places (so-called soft targets) where the occurrence of an emergency situation would have a major impact on the health and lives of people there. For this reason, it is necessary that not only the company management, the Integrated Rescue System, but also the population itself be prepared and able to react to the emergency situation [5–8], especially in a case when any kind of contamination can occur [9–11].

Soft targets are places characterized by a high population concentration and low or no level of security against terrorist attacks. This includes hotels, restaurants, bars, entertainment centers, shopping centers, schools and school facilities, hospitals, airport terminals, train and bus stations, and many more [12].

Schools and school facilities can certainly be classified as places with a high concentration of people, mainly children, pupils and students, and a relatively low level of security [13]. Although there has been an increase in school security since the attack in Žďár nad Sázavou in the Czech Republic in 2014, there are still many opportunities to threaten the lives not only of pupils or students, but also of their parents. Attacks directed

at schools and school facilities can generally be seen as one of the worst. The vulnerability of children and the value that they represent, not only to their families but also to society, is very high. Due to regular school hours and the presence of a large number of pupils and students in the classroom, and the start of school, when a considerable number of pupils and students are entering the school, it is relatively easy to commit a terrorist or other violent attack not only in a school building, but also before entering a school building [14,15]. The attack can also be carried out after school hours, when a large number of pupils and students leave the school premises. A very specific example is an assault and a planned attack by a student, which can hardly be prevented. In this regard, teachers in particular have an important role to play, because they can notice different behavior of the individual or possible preparation for a potential attack. However, it is necessary to inform and educate teachers and staff of a school about possible suspicious behavior of the individual, and signs that they may indicate in preparation for a possible attack, etc. In these cases the real possibility of realization of physical protection against the effect of toxic compounds should also be taken into account [16,17].

The main goal of this paper is to increase the security of the investigated schools and to develop a risk management strategy suitable for effective prevention of attacks at schools.

The paper is structured as follows. First, a discussion on terrorist attacks on soft targets and some information about the vulnerability of schools to violent or even terrorist attacks is undertaken and hypotheses are developed. Then the research sample, methodology and data composition is described. The quantitative and qualitative modelling approach leads to the exploration of the causal interrelationships between selected main problem elements and root cause analysis. The next section presents research findings and discussions. Finally, conclusions and limitations, and recommendations for future investigations are suggested.

2. Holistic Process of Decision Making

Our aim is to design a model with a holistic approach to ensure that the designers of policies have the extended information and intelligence when they have to find solutions on counter-terrorism. To achieve better protection results, all processes were separated into three stages. Each stage includes many processes which are important.

According to the process complications, the person responsible for decision making must have collected the latest conceivable information before regulating schools' hazards. Knowledge of violence is fragmented and processed by diverse actors (ministry of education, intelligence community, school community, and needs, etc.), and it is advisable to cooperate with them. The results of the prevention process must be evaluated so it is clear whether it has the proper effect and offers an integrated knowledge and intelligence system to persons who are responsible for future strategy development.

Due to the fact that policy-makers are not completely rational, but influenced also by public opinion and other outside pressure, we must take into account the use of incremental models.

Different guidelines generate different effects that must be measured. Rational indicators are typically used for measurements (detention of suspects, quantity and total cost of attacks, period between attacks), but for triggering terror, which is the main purpose of terrorism, and so fear and terror must be measured, and additional social effects of counter-terrorism strategies (i.e., loss of civil freedoms). To improve future policy making, this process aims to determine the success of the policies.

According to this the holistic process of decision making against terrorist attacks at schools and school facilities, a model was designed (Figure 1). This model integrates the concept of evidence-based monitoring, evaluating dissimilar processes: the necessities or requirements of intelligence, the intelligence development devised by professionals and their supervisors, the decision-making process, and the impacts of the terrorism tactics (effectiveness, budgets, effects in inhabitants and other non-desired impacts) (Figure 1).

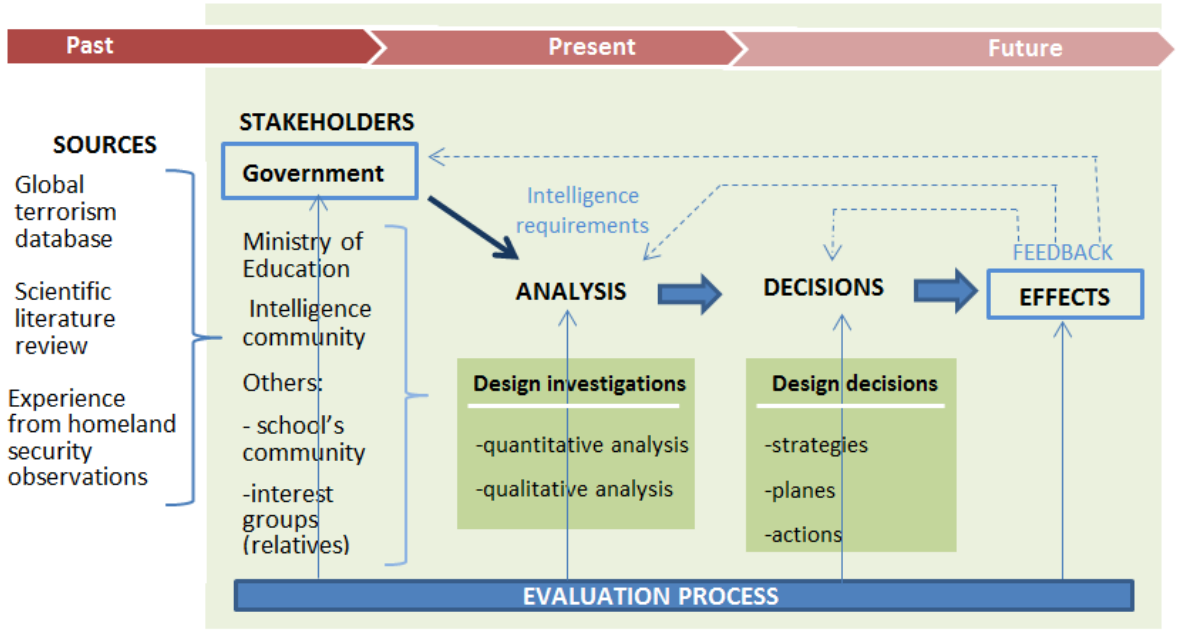

Figure 1. The all-inclusive process of decision-making against terrorist attacks at schools and school facilities. Source: authors.

Depending on the organization/school and its environment, either general or in-depth terroristic attack risk analysis methods may be used. [18,19]. Notably, the general methods are based on a quantitative method, whereas in-depth analysis can be based on qualitative methods. This study was based on qualitative and quantitative methods. Such a detailed risk assessment analysis enables us to evaluate and find the possibilities to increase the security in the tested schools and to develop a risk management strategy appropriate to the effective prevention of the risk of violent or terrorist attacks at schools. The main goal was to increase the security of the investigated schools and develop a risk management strategy suitable for effective prevention of attacks at schools. Assuming that schools are categorized as soft targets, a preventive strategy is needed for unifying all safety efforts and enabling efficient use of all internal resources and time. Based on the argument, two hypotheses were developed.

Hypothesis 1. *The participation of responsible decision-makers (government, ministry of education, school community, etc.) of a nation state gives higher priority to taking actions for designed strategies against violent attacks by which the country's schools will achieve a higher safety level.*

Hypothesis 2. *A country's schools safe level is more dependent on funding than investments on training formally used at schools.*

3. Survey Methodology

In order to gain more knowledge and new information regarding the safety measures applied to soft targets, the method of controlled interviews with specialists from the police and the fire rescue service of the Czech Republic have been used. The problem analysis tool is well known as the Fishbone diagram, which typically is used to determine the root cause-module, design element, or application of a problem; the Pareto principle is used as a management principle to identify factors that are reducing effectiveness of schools' security. All mentioned analyses were valuable in identifying the main components that cause safety problems in the majority of the schools.

3.1. Data Collection from Public Resources

The data collected by the Global Database on Terrorism were used to determine the threat to schools and school facilities from the perspective of a terrorist attack. The security

of schools in the Czech Republic, specifically in the city of Brno, was investigated by structured controlled interviews with headmasters of nursery, elementary and secondary schools.

As a resource for this article, we used the public site Global Terrorism Database (GTD). This is the only source of evidence which is certified and updated on a regular basis. This database is a comprehensive overview of the terrorist attacks committed between 1970 and 2017 [20].

3.2. Data Collection from Questionaire

A structured, controlled interview with school principals in Brno was used to find out the security of schools. A structured interview is one of the techniques of data collection in social research, where the interviewer proceeds with question after question according to a set questionnaire, and the interviewee answers these questions. The questionnaire (prepared by authors) consisted of 15 questions and dealt with the issue of security in selected nursery, elementary and secondary schools. The composition of the questionnaire consisted of information about the school and specific questions. The headmasters were informed about the research problem, assured of the anonymity of the data they would provide for the research, they were politely asked for a meeting to fill in the questionnaire, and they were informed of the time required to complete it. The questionnaire was designed as semi-structured—it included closed dichotomous (yes, no) and open questions. The headmasters of nursery, elementary and secondary schools in Brno participated in the questionnaire survey. A total of 180 schools were contacted, of which 46 participated in the research itself. Specifically, there were 8 preschools, 24 elementary schools, and 14 secondary schools. The authors undertook the research personally. They did not collect any personal data. Only technical data of a specific type of schools were collected.

4. Methodology and Results

4.1. Research Questions Formulation

The aforementioned database was used to determine the vulnerability of schools to terrorist attacks. The authors carried out research on available data and used this to work out basic descriptive statistics. They focused especially on answering these questions:

- How did terrorist attacks on schools and school facilities develop over the period 2000–2017?
- What was the number of victims injured in attacks on soft targets?
- What type of attack was most common?
- How are schools secured in the Czech Republic, specifically in Brno?

The following methods of scientific work have been used in order to gain more knowledge and new facts regarding the safety measures applied to soft targets:

- Method of controlled interviews with specialists from the police and fire rescue service of the Czech Republic.
- Research of current state of the subject matter—survey of measures and processes actually used in practice.
- Basic statistical methods.
- The problem analysis tool known as the Fishbone diagram, which typically is used to determine the root cause-module, design element, or application of a problem.
- The Pareto principle, a management principle to identify causes which are reducing the effectiveness of schools security.

All analysis methods were valuable in identifying main components that cause the majority of the schools safety problems.

4.2. Terrorist Attacks at Schools and School Facilities

As can be seen in Figure 2, which shows the evolution of terrorist attacks on schools and school facilities around the world during the years 2000–2017, since 2004 there has been a gradual increase in terrorist attacks on schools and school facilities.

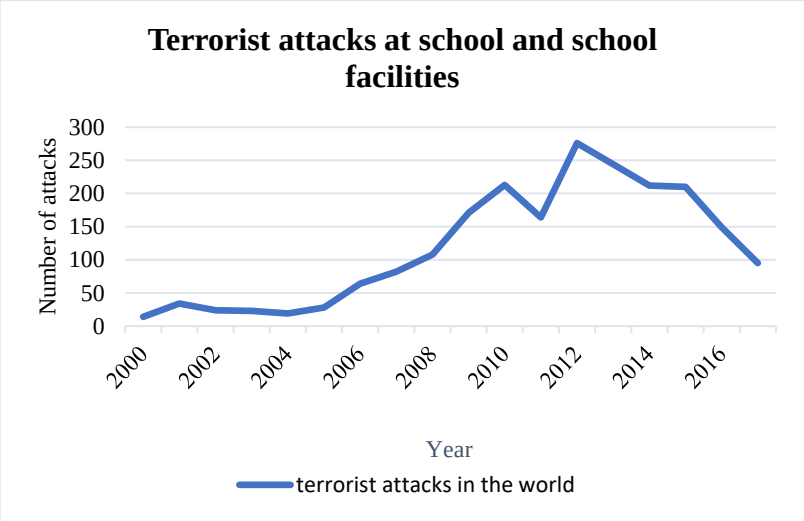

Figure 2. The evolution of terrorist attacks at schools and school facilities in 2000–2017 [20].

Since 2012, there has been a relatively sharp decline in attacks. This may be due to increased security measures in schools and school facilities, the focus of terrorist organizations on other soft targets, or more effective operation and cooperation of secret services.

Given the high concentration of children in schools, the probability of them being hit and loss of life is very high. The number of victims and people injured in attacks at schools and school facilities between 2000 and 2017 is shown in Figure 3.

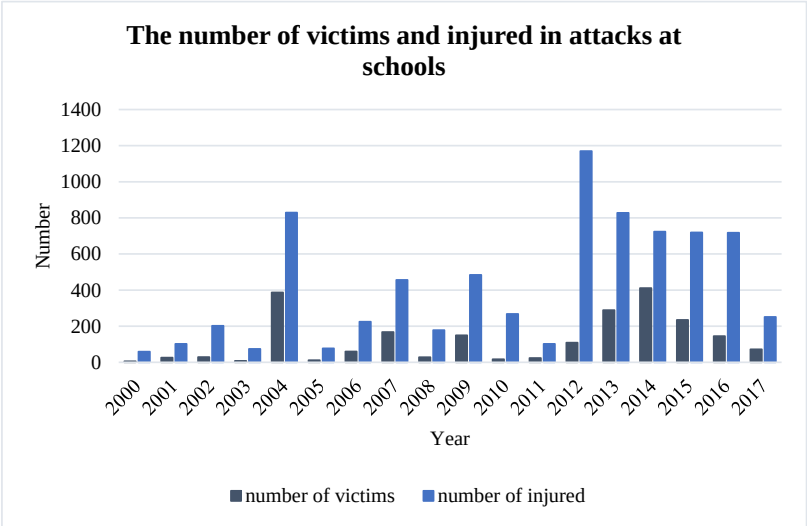

Figure 3. The number of victims and people injured in attacks at schools and school facilities between 2000 and 2017 in the world [20].

In total, 2110 attacks were committed in the period under review, with 2176 people killed and 6431 injured. The most common type of terrorist attack is a bomb attack with a total of 1509 attacks, the second most common type is an attack at a building with a total of 389 attacks; a total of 109 attacks were committed using a weapon. However, the type

of terrorist attack very often changes over time. The type and number of attacks, and the number of killed and wounded are shown in Table 1.

Table 1. The type and number of terrorist attacks, the number of killed and injured in the world (National Consortium for the Study of Terrorism and Responses to Terrorism, 2017).

Type of Attack	Number of Attack	Number of Killed	Number of Injured
Bomb attack	1509	1121	3518
Armed attack	109	215	206
Assassination	2	2	5
Attack on a building	389	32	249
Unarmed attack	42	0	2399
Kidnaping	45	26	43
Unknown	14	82	11
Total	**2110**	**2176**	**6431**

When interpreting this data, it should be taken into account that the average value of the number of dead or injured is strongly influenced by outliers. Considering only the average values of the number of victims or injured "outliers", i.e., cases with extreme values of victims can significantly affect the results of data summarization. This may lead to misinterpretations and conclusions. The same is true of more advanced statistical methods and models, but our ability to detect outliers based on results is worse than simple summaries. It is thus clear that the problem of outlying observations must be addressed before any calculations are started. The definition of extreme (outlying) values is not easy, because the range of possible values of random variables always depends on the specific problem we are solving. Some authors define outliers as a value that lies several times (three, five, seven times) over the sample standard deviation or interquartile range (often one and a half or three times the IQR), respectively, from the mean and median, respectively. However, this rule cannot be taken strictly, as the fact that the values are or are not possible should be defined mainly by the sponsor of the analysis (expert on the issue). It is better to use the free definition of outliers, which defines them as atypical observations that do not fit into the probabilistic behavior of the dataset.

In this particular case, one of those events whose values may be skewing the data related to the severity of the problem (in terms of those killed is the attack in Beslan. The Beslan school siege in 2004 accounts for the vast majority of those killed in that year.

A graphical comparison of the type and number of terrorist attacks, the number of killed and injured over the period 2000–2017 is shown in Figure 4. A logarithmic scale is used on the *y*-axis for a graphic reason.

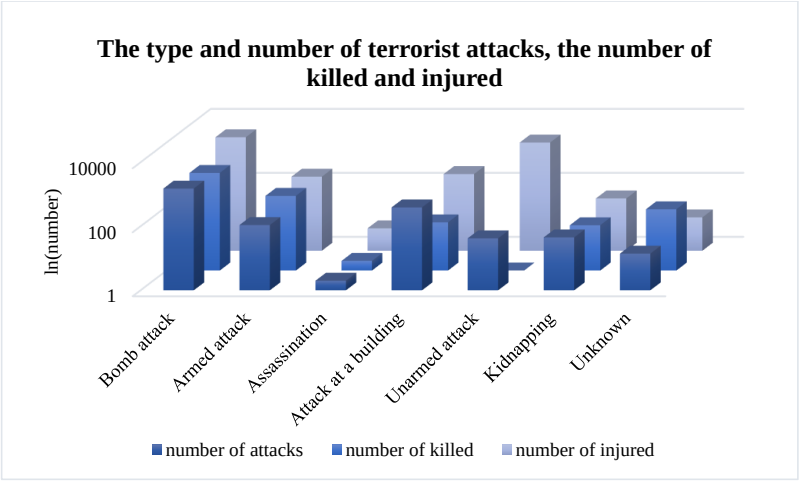

Figure 4. The type and amount of terrorist attacks, the amount of killed and injured in the world over the period 2000–2017 [20].

4.3. Attacks at Schools in the Czech Republic

Examples of carried-out and planned attacks at schools in the Czech Republic:

- 24 October 2002—a 16-year-old pupil beat a teacher at a special school for the hearing and mentally handicapped in Vodnany, South Bohemia;
- 8 December 2003—a mentally ill student from the University of Hradec Králové attacked a teacher with a baseball bat;
- 1 March 2004—a student at a trade school in Svitavy stabbed his teacher who died after being transferred to the hospital;
- March 2009—a 17-year-old trouble-free student of grammar school in Nový Bydžov was planning a bomb attack on his classmates;
- 26 September 2011—a 15-year-old student assaulted a secretary of a grammar school in Chomutov with a knife and a meat mallet, screaming that he was a terrorist;
- October 2011—a Polish student planned to set fire to Masaryk University in Brno and murder teachers and students;
- 22 May 2012—in the dining hall of a school in Havířov-Šumbark, a woman stabbed an after school club assistant and took a seven-year-old schoolgirl hostage;
- 29 October 2012—a 14-year-old student attacked and stabbed a teacher at a grammar school in Rakovník;
- 25 March 2014—two young men attacked two officers of the Juvenile Detention Center in Králíky, in Ústí nad Orlicí district. The men stabbed one officer in the neck with a screwdriver, and knocked the other officer down, kicking her in the head and body;
- 14 October 2014—a woman broke into one of the high schools in Zdar nad Sazavou and stabbed several students, one of whom was killed;
- September 2016—a 19-year-old student in Teplice threatened by a text message to shoot up a school;
- November 2016—a 15-year-old student in Kralovice attacked a teacher with an airsoft weapon, carrying two knives and calling out "Allah Akbar" [21].

The above examples of violence have led to casualties, injuries and lifelong consequences. This fact clearly showed the importance of devoting effort to prevention tasks. This research was stressed on the detailed violets attacks' risk analysis, which helped to assess the relationship between risk, vulnerability values, security controls and the interconnectedness of the predictable hazard of terroristic attacks. All distinguished interactions are graphically illustrated in Figure 5.

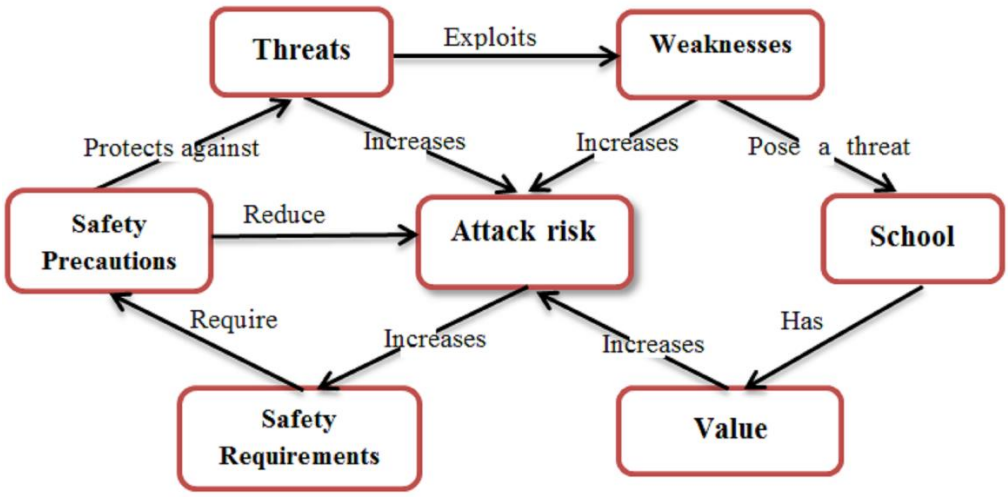

Figure 5. Interconnections between terroristic attacks risk management elements.

Depending on the organization/school and its environment, either general or in-depth terroristic attacks' risk analysis methods may be used. Notably, the general methods are based on quantitative methods, whereas in-depth analysis can be based on qualitative

methods. This study was based on qualitative and quantitative methods. Such a detailed risk assessment analysis let to evaluation and to finding possibilities to increase the security in the tested schools and the development of a risk management strategy appropriate to the effective prevention of the risk of terrorist attacks at schools. The main goal was to increase the security of the investigated schools and to develop a risk management strategy suitable for effective prevention of terrorist attacks at schools [11,22]. Assuming that schools are categorized as soft targets, a preventive strategy is needed to unify all safety efforts and enables efficient use of all internal resources and time.

4.4. Safety Assessment of Selected Schools in the City of Brno

Structured, controlled interviews were used to investigate mainly the level of safety in relation to a violent entry of an individual to nursery, elementary, and secondary schools. Of the total number of schools contacted, a total of 46 schools were involved in the survey, which approximately 16% of the total number of schools are in Brno. Depending on the type of school, 49 preschools (27%), 73 elementary schools (41%), and 58 secondary schools (32%) were contacted. Out of the total number of schools contacted, 8 preschools (4%), 24 elementary schools (13%) and 14 secondary schools (8%) participated in the survey.

An analysis of the legislation in effect in the Czech Republic revealed that neither safety measures against violent attacks nor requirements for securing schools and school facilities in the event of an attack by an attacker are laid down by law. The general obligation of schools and school infrastructure to guarantee the security and health defense of children, pupils, and students in education and related activities, and in providing school services is enshrined in Section 29 (2) of Act No. 561/2004 Coll., on Pre-School, Basic, Secondary, Tertiary Professional and Other Education (the Education Act), as amended. Furthermore, to this provision, the Ministry of Education, Youth and Sports (MEYS) issued a methodological guideline to ensure the safety and health of pupils in schools and school facilities [23], as well as methodological recommendations on the protection of children, pupils and students in schools and school infrastructure—a minimum standard of safety.

Of the total number of schools that participated in the survey, in 93.5% of schools safety was managed by a qualified person or an external company.

All schools have a fire protection directive, evacuation plan, Occupational Safety and Health (OSH) directive, and school policy. Some schools also have materials such as an emergency preparedness plan, a trauma plan, an emergency action plan—the measure for dealing with emergency situations is mandatory under the Labor Code and should therefore be prepared by all schools. However, this measure does not address the issue of terrorism and violent behavior of an individual (an attacker at a school).

When ensuring the safety of a school, it is important to map out all possible threats that may occur in the school environment. It is essential that threats that may occur in front of the school building, and threats that may be caused by pupils and students are mapped as well. Most schools (82.6%) have a map or risk overview, however, they usually do not address the issue of violent behavior of an individual (Table 2).

Table 2. Schools safety readiness.

Type of Preparedness	Yes [1]	No [1]
Compiled a map or risk overview	82.6%	17.4%
Funds for ensuring school safety	28.3%	71.7%

[1] Identified weight in percentages for schools' safety preparedness. Source: own.

One of the biggest problems in ensuring school safety is the issue of finance. Although some schools applied for subsidies to increase safety, their requirements were not met. Of the total number of schools, 13 replied that they had sufficient funds to ensure safety (Table 2). These were usually elements (a new door lock, a camera at the entrance, etc.) that the schools needed to secure the entry into the school and which they were able to raise money for.

The issue of finance is also related to safety staffing and material resources. Most school headmasters see the presence of a trained person at the gatehouse or reception as one of the main deterrents of a potential attacker. This is the first person who can alert other employees of the school and the Integrated Rescue System about the entry of an unauthorized person in the school building and the threat of an attack or an ongoing attack. A person at the school gatehouse can also prevent an unauthorized person from entering if the school has turnstiles or lockable doors that can be closed remotely or in some other way. However, it is important that these people are adequately trained for the possibility of a forcible entry of an individual to the school building and a following attack. Of the total sample of the surveyed schools, 32.6% of schools have a doorkeeper, receptionist or other staff who controls the entry of persons into the school building (Table 3).

Table 3. Responsiveness to ensure school safety.

Type of Preparedness	Yes [1]	No [1]
Staffing to ensure school safety	32.6%	67.4%
Material security to ensure school safety	19.6%	80.4%

[1] Identified weight in percentages for schools' safety preparedness. Source: own.

In total, 19.6% of school headmasters perceive their school as sufficiently materially secured (Table 3). From a technical point of view, the passive security features at schools' disposal were investigated. The method of security and the percentage of schools are given in Table 4.

Table 4. Technical security of schools—percentage of schools.

Security Method	Preschool [1]	Elementaryv [1] School	Secondary [1] School
Turnstiles	0%	0%	35.7%
Closed Circuit Television systems	37.5%	41.7%	50%
Locked door (doorbell)	87.5%	75%	28.6%
Video phone	62.5%	20.8%	0%
Electronic chips/cards	37.5%	0%	35.7%
Entrance to school after code entry	0%	0%	0%
Safety glass on doors	12.5%	0%	0%
Bars on windows and doors	25%	8.3%	0%
Other technical measures	0%	0%	14.3%
No security	0%	0%	14.3%

Source: own. [1] Note: the total of all answers exceeds 100% because of the possibility to select multiple answers.

The entry to a preschool is most often ensured by locked door (87.5%), which is usually provided with a doorbell with an intercom, whether for the school headmaster, a school manager or other school staff. Upon entry into preschool, a videophone is installed and fully used in 62.5% of preschools. Camera systems and entry with electronic chips or cards are installed in 37.5% of preschools, 25% of schools have bars on windows (usually on the ground floor), 12.5% of preschools have safety glass on the entrance doors. Entry is secured by locked door.

As in preschools, entry to elementary schools is secured by locked door (75%). Compared to preschools, a Closed Circuit Television (CCTV) system is more used in elementary schools (41.7%). On the other hand, a videophone (20.8%) is a less used technical measure when entering school. Window bars were installed only in 8.3% of elementary schools. None of the surveyed elementary schools had access to the school by means of electronic chips or cards, or after entering the code on the entrance door.

At secondary schools, the most common security system, in comparison with nursery and elementary schools, is the CCTV system (50%). School access is secured through turnstiles and electronic chips/cards at 35.7% of secondary schools; 28.6% of secondary

schools have locked doors. Secondary schools also use other technical security measures (14.3%)—gateway at the entrance to the school premises, barriers preventing vehicle entry into the school premises, etc. Technical security was not found in 14.3% of secondary schools.

A comparison of the different types of technical security measures in nursery, elementary and secondary schools shows that the most frequently used type is a locked door usually equipped with a bell (mostly in nursery and elementary schools). The second most common technical element for ensuring security is a CCTV system, most often represented at secondary schools, which, in contrast to nursery and elementary schools, use the security method of access through locked doors quite rarely. Furthermore, it can be seen that turnstiles are used only in secondary schools, which in turn do not have a videophone installed at the entrance. Electronic chips/cards are used only by nursery and secondary schools. None of the elementary schools has access to the school through these security elements. Also, none of the schools has the possibility of entry into the school by entering a code. The method of security staffing and the percentage of schools are given in Table 5.

Table 5. School security staffing—percentage of schools.

Type of Security Measures	Preschool [1]	Elementary [1] School	Secondary [1] School
Pedagogical supervision (when entering school)	0%	66.7%	14.3%
Non-pedagogical supervision (when entering school)	0%	50%	0%
Receptionist/doorkeeper	25%	29.2%	42.9%
Supervision by students (when entering school)	0%	0%	0%
Security service worker	0%	0%	0%
Municipal/state police	0%	0%	0%
None	75%	29.2%	42.9%

[1] Note: the total of all answers exceeds 100% because of the possibility to select multiple answers. Source: own.

The staffing of preschools is provided by a receptionist/doorkeeper in only 25% of preschools and in 75% of them there is no personnel at all. Entry to the school is not controlled either by pedagogical staff or by non-pedagogical staff, such as a janitor.

In 66.7% of elementary schools, access to schools is controlled by pedagogical staff, in 50% by non-pedagogical staff. At elementary schools, the presence of a pedagogical worker can be found together with the janitor who controls entry into the school. The presence of a receptionist/doorkeeper was found in 29.2% of elementary schools, and in the same number (29.2%) of elementary schools there is no personnel present to ensure security against the entry of an unauthorized person.

Almost 50% of secondary schools have a receptionist/doorkeeper at the entrance to the school, who controls the entry to the school. Only 14.3% of secondary schools have pedagogical supervision at school entry. A total of 42.9% of secondary schools do not have any staff to ensure the safety of the school.

As can be seen in Table 5, preschool staffing is minimal, elementary schools are mostly guarded by pedagogical and non-teaching staff at the entrance, and secondary schools mostly have a receptionist/doorkeeper or no staffing. None of the schools has pupils and students who would assist in controlling entry into the school; there is no employee of the security service, the municipal police, or the police of the Czech Republic.

The low number of schools with security staffing is the reason for lack of financial resources that schools could spend on hiring a qualified person in place of the doorkeeper, who would monitor entry to the school. Although some schools have a receptionist/doorkeeper present 24 h a day, it should be stressed that these are generally retired persons who are not trained to deal with the potential situation of an unauthorized person entry to the school premises.

When ensuring the safety of the school, it is important to note that if an attacker wants to get to the school at all costs, no technical or personnel security will usually stop him, but at least the consequences of the attack can be mitigated. One of the most important measures that can help to prevent or at least mitigate the consequences of an attack is regular training of pedagogical and non-pedagogical staff and pupils or students. 95% of schools (with the exception of schools with a specific approach to children) receive theoretical training for students in possible emergency situations, but these training usually do not address the issue of violent entry or behavior of an individual (Table 6) [24].

Table 6. Training formally used at schools.

Type of Training	Yes [1]	No [1]
Theoretical training	95%	5%
Practical training	91.3%	8.7%
Occurrence of emergency situations at schools	19.6%	80.4%

[1] Identified weight in percentages for schools' safety preparedness. Source: own.

Practical exercises are also dedicated only to the evacuation of pupils and students from the school in the case of a fire alarm, which is usually repeated once a year. 8.7% of schools do not have any practical training (Table 6). An emergency situation occurred in 19.6% of schools (Table 6). They were these following emergency situations:

- small fire;
- false fire alarm;
- an individual's violent behavior connected with threats;
- violent behavior of a pupil's parent towards the school headmaster—the municipal police were called
- a parent's entry to an elementary school with a knife in their handbag;
- setting a substance in a plastic bottle on fire in the school restrooms;
- bragging of a pupil about the presence of a weapon in their backpack;
- filming of children by a stranger from short and long distance;
- evacuation of a school based on a reported bomb;
- a thief at a school;
- admission of unauthorized persons by students of the school to the school premises and the subsequent destruction of fire-fighting equipment.

None of the schools regularly practices the occurrence of an emergency situation other than fire and subsequent evacuation from the school. Only one of the schools surveyed carried out an exercise to prepare students for an entry of the school premises by an armed terrorist. Many schools, however, take part in events organized by the Integrated Rescue System units or other institutions—military days, Earth Days, demonstrations of firefighters and policemen training, their equipment, etc. However, only 15.2% (Table 7) of schools organize training with Integrated Rescue System units for emergency situations.

Table 7. Additional focus to increase security at schools.

Type of Preparedness	Yes [1]	No [1]
Training organization	15.2%	84.8%
Established cooperation with the Integrated Rescue System	69.9%	30.4%
Identity verification	6.5%	93.5%

[1] Identified weight in percentages for schools' safety preparedness. Source: own.

In relation to the occurrence of an emergency situation, schools have established cooperation in 69.9% through the "Integrated Rescue System" units, mostly according to the municipal police rules. Moreover, during the visit to the schools, it was also tested in how many cases a proper identification would be necessary and in how many an admission

would be allowed without any problems. Only 6.5% of the schools required identification (Table 7).

5. Qualitative Research Findings and Discussion

Analysis of selected schools' safety in the city of Brno had the following findings:

1. Most schools (82.6%) have an overview of security risks. However, it does not usually address the issue of violent behavior of an individual or an attacker at school.
2. In most cases, schools have various technical features (mostly locked doors to the school building) to prevent unauthorized persons from entering the school building.
3. The vast majority of systemic and organizational measures are not set so that technical security measures meet their importance.
4. Testing at schools found out that in almost 84.8% of cases the person entering was not properly verified and was granted access.
5. Theoretical training of students and school staff usually takes place once a year and focuses mainly on the issue of Occupational Safety and Health. The correct reaction to the presence of an "attacker" at school is not addressed.
6. Practical exercises are held once or twice a year and focus only on fire alarm and school evacuation. The correct reaction to the presence of an "attacker" at school is not practiced.
7. A very effective security measure is trained security personnel who would be permanently present at the entrance to the school.
8. For financial reasons, hiring physical security personnel at schools is not implemented. While some schools have a doorkeeper at the entrance, they are usually an older person who has not been trained for the potential occurrence of an attacker at school. Thus, an adequate response would not be possible.
9. Parents or grandparents who do not know or respect systemic security measures also pose a major risk.

The fishbone method was chosen to identify the causes of a school's safety problems in the city of Brno. A cause-and-effect diagram helped uncover all possible or actual causes that trigger real consequences. The result of critical analysis of the school's safety-reducing causes is presented in the Figure 6.

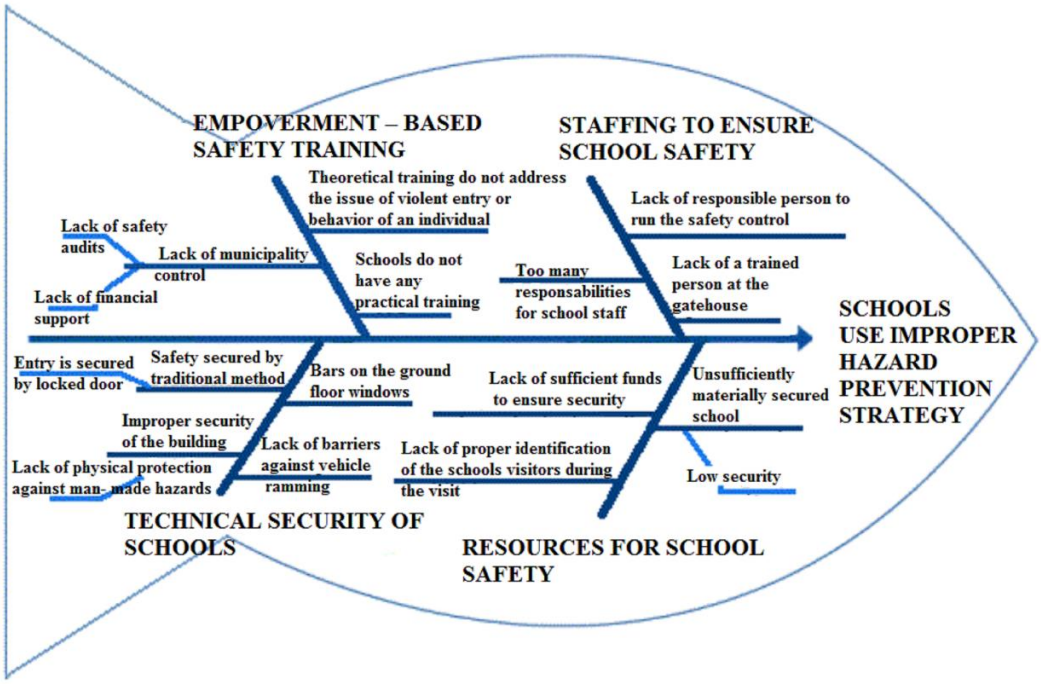

Figure 6. Cause-and-effect diagram for school hazard prevention strategy. Source: own.

In general, the causes which influence schools' safety were divided into external and internal security. The terrorist attacks on schools and school facilities around the world during the years 2000–2017 showed, that the most common type of terrorist attack at schools was a bomb attack—1509 attacks, the second most common type was an attack at a building—389 attacks. According to this, the external causes mostly belong to school building not being secured. Meanwhile the internal schools' security problems belong to resources for school safety such as staffing to ensure school safety and lack of sufficient funds. After analyzing all possible terrorist attacks as risk increasing causes were pointed the factors related to: the technical security of school, empowerment-based safety training, lack of practical training, lack of organization training with the Integrated Rescue System, staffing to ensure school safety and resources for school safety, lack of the proper identification of the schools' visitors during the visit and others. The cause-and-effect process helped to review many vulnerability components and their causes and effects on possible terroristic attacks at schools.

The stimuli and actions' distressing effects or results of causes are graphically presented in Figure 6. The root cause of the problem was identified as the main problem—the schools use an improper hazard prevention strategy. As you can see, this problem grew from different factors: inadequate practical and theoretical training, lack of human resources, lack of appropriate technical security and lack of school building protection. Each factor is made up of at least a few reasons which helped to identify why the schools have had low security and developed poor hazard prevention processes. Additionally, it can be mentioned that the cause-and-effect diagram pointed out the ways how schools' security problem can be mitigated and reduced.

In this case the presented data is too voluminous to identify those components that cause the majority of the schools' safety problems. Therefore, for a better understanding of the schools' security a mathematical method as Pareto principle was chosen [3]. This analysis is used in different areas and represents the law of 80/20 rule. The law of the vital few, or the factors' sparsity principle which affirms that for many actions roughly 80% of the consequence come from 20% of the origins. According to Pareto's Law, in this research can be identified the 20% of the causes for 80% of the schools' safety results or problems. It has to be pointed, that the Pareto principle was not chosen to find solutions for safety problems, but to find the information about the causes that affect most of the problems, solving which can help to make the existing situation well-organized.

The data presented in the Tables 2, 3, 6 and 7, which were collected from 46 (the total number of schools participated in the survey) structured controlled interviews were used for Pareto analysis. The 46 experts evaluated the schools' safety readiness in the nominal scale "Yes = 1" and "No = 0". All 46 surveyed experts' answers were counted and then the study results were presented in a more proper view. Each of the assessed causes that were discussed with experts as possible reducing school safety were individually assessed on a 100% scale (see Table A1, Appendix A).

This research focus was to identify the weakness of schools' safety, so for future results analysis was used all experts' survey values of category "No". Moreover, the collected data before continuing the analysis were normalized. The typical rescaling was used when each of data set element was divided by the total sum of all data set. After normalization, all investigated safety criteria fall in the range between 0% and 100%. For weighted values we used the following equation:

$$w_i = \left(\frac{X_i}{\sum X_i} \right) \cdot 100\%,\ i \in [1, \ldots, n] \quad (1)$$

where

X_i—possible causes that may reduce the schools' safety;
i—number of causes;
$\sum X_i$—sum of values of nine evaluated causes.

Used normalization for experts' values helped to compare corresponding normalized values according nine different measurements and eliminated the impact of the data variation in the scale. The standardized weights for possible causes that may reduce the schools' safety are presented in Table A1, Appendix A.

Additionally, the appropriate rank (from 1—the least-affecting to 9—the most-affecting) was assigned to each of preparedness lacking a cause depending on determined standardized weight (see Table 8). For the first graphical data analysis, we used the radar principle diagram, which is suitable to present individual data points signifying changes in values relative to the center point. In this case, the radar diagram was used to draw the standardized weight in percent for each of all lacks of schools' safety (see Table 8), which were identified after 46 experts' survey (see Figure 7).

Table 8. Possible causes that may reduce the schools' safety.

No.	Causes	Description	Rank (from 1 to 9)	Weighted [1] Contribution
1.	Compiled a map or risk overview	It is important to map out all possible threats that may occur in front of the school building, and threats that may be initiated by pupils and students.	7	3.79%
2.	Sufficient Funds	Sufficient funds to ensure secure entry into the school (a new door lock, a camera at the entrance, etc.).	4	15.62%
3.	Safety Staffing	The schools have a doorkeeper, receptionist or other staff that controls the entry of persons into the school building.	5	14.68%
4.	Material security	The school headmasters perceive their school as sufficiently materially secured.	3	17.52%
5.	Theoretical training	The regular theoretical training of pedagogical and non-pedagogical staff and pupils or students used to prevent or at least mitigate the consequences of an attack.	9	1.09%
6.	Practical training	Practical exercises dedicated to the evacuation of pupils and students from the school, which is usually repeated once a year.	8	1.90%
7.	Training Organization	The exercise to prepare students for an entry of the school premises by an armed terrorist.	2	18.47%
8.	Established Cooperation	The Schools' possibility to establish cooperation for an emergency situation with the "Integrated Rescue System" units.	6	6.56%
9.	Identity verification	Proper identification of the schools' visitors during the visit.	1	20.37%
		Total:		100.00%

Note: [1] Standardized weighted contribution for negative experts' answers. Source: own.

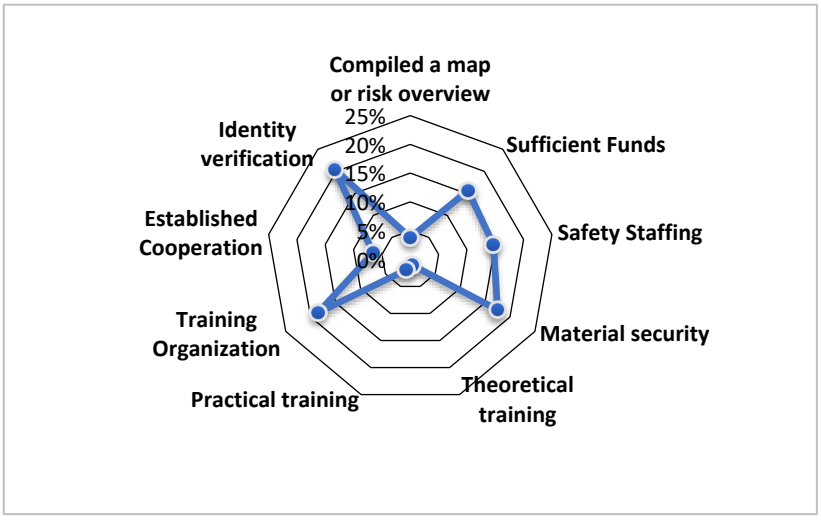

Figure 7. The causes of the inadequate level of school security. Source: own.

For the second graphical data analysis we used the Pareto chart, which according well-known as the 80/20 rule showed the indication about the causes that have the most impact of the analyzed problem (see Figure A1, Appendix A). According to Pareto's law in this research we identified the 20% of the causes which effect 80% of schools' safety: *Identity verification* (20.37%, see Figure A1, Appendix A), and an inadequate *Organization Training* (18.47%, see Figure A1, Appendix A) are most of the problems which have to be managed and this can help to make the existing lack of safety at the schools' situation more efficient. These findings prove the lack of the practical exercise to prepare students for an entry of the school premises by an armed terrorist (18.47%, Table 8).

Additionally, it can be pointed, that the *Theoretical Training* was indicated as the less influential indicator of safety (1.09%, Table 8) at the moment. This can be true, because the regular theoretical training of pedagogical and non-pedagogical staff and pupils or students, according this assessment, mostly was used in the nursery, elementary, and secondary schools to prevent or at least mitigate the consequences of an attack.

It can be true, that according to the Pareto principle, it can be comprehended that the most important causes which influence on the improvement of school security are: Identity Verification (20.37%, Table 8) and Organization Training (18.47%, Table 8), because according to the structured, controlled interviews used to investigate the existing security level at schools in this survey, a decent-looking individual in most cases can get into the school without major complications. In the field testing, it was sufficient to ring the bell, announce who is entering the school and who they are meeting, for being admitted (remotely) to the school building with no problems, without verifying the real reason for the visit, without being accompanied, their identity checked, announced where the office or person to visit is located, etc.

Even in the situation of a doorkeeper or receptionist, it was only necessary to report the name and person with whom the appointment was arranged and access to the school building was possible without major security measures (e.g., escorted to the headmaster's office, verification of the appointment, etc.).

In the case of a morning or afternoon visit to the school, when pupils and students were present at the school entrance, it was even easier to enter the school building. These pupils and students are very willing to let a stranger enter the school and even hold the door open for them. The same applies to the parents present.

According to Pareto's analysis we identified the set of non-dominant causes of the inadequate level of school security and dominant. A dominant alternative is one that is lesser to another reasonable alternative in the set with respect to all schools' security characteristics under deliberation. This means that by law, 20% causes can be solved by 80% problems. Addressing the main pressing issue, the *Identity Verification*, would allow the school to implement an effective security balance and reduce the risk of violent attacks.

This research is limited to the safety of schools and school infrastructure as soft targets in the city of Brno, (Czech Republic). Therefore, other soft targets might be investigated in the future research. This research is applied to schools' safety in general. Therefore, future research might be applied to specific sectors such as hospitals. This research only covers the observations of employees responsible for schools' safety in the city of Brno. Hence, other researchers may investigate schools' safety from different perspectives. This research uses a cause-effect model (Ishikawa diagram) and Pareto analysis. Future research could be used multicriteria decision analysis techniques to rank the obtained design alternatives or other models such as histograms or statistical process control.

6. Conclusions

The issue of soft targets and their security is very current worldwide. There are no standards in the Czech Republic or abroad for defining the term soft target. Domestic and foreign documents define soft targets generally as places with a high number of people and low or even no level of security. Examples of such places are closed buildings such as shopping centers, schools and school facilities, restaurants, entertainment centers, etc., but

also open places such as festivals, demonstrations, parades, Christmas markets, and many others.

The attacks on schools and school facilities were more or less increasing worldwide since 2000, and have started to decline only since 2012. Between 2000 and 2017, 2176 pupils, students and school staff were killed, and 7466 were injured. The most common type of terrorist attack is a bomb attack, but the type of attack and the weapon used change frequently over time.

Given the planned and executed attacks that have occurred in the Czech Republic, it is important to focus on ensuring the safety of schools in the Czech Republic. Nursery, elementary, and secondary schools in the city of Brno were selected for the research. Out of the total number of schools contacted, 46 participated in the research.

Based on a structured controlled interview with school principals in Brno and a personal tour of the school, mainly the security measures implemented by the schools were identified. It was found that from the technical elements, especially nursery and elementary schools mostly have locked entrance doors in order to prevent unauthorized persons from entering the school building. On the other hand, in the case of secondary schools, a CCTV system or turnstiles were mostly installed, which students and staff use to enter the school building. In the presence of a doorkeeper at the entrance to the school, who was most often present at secondary schools, the entry and exit of the person entering was recorded. In almost 80% of the cases, however, the identity was not properly verified and the person was allowed access to the school building. It has also been verified that the vast majority of systemic and organizational measures is not set up so that technical measures meet their importance. It is also important to focus on theoretical and practical training of students and staff on the potential occurrence of an attacker at school. Although 95% of schools have theoretical training, they usually deal with Occupational Safety and Health issues, not with the possible occurrence of an emergency situation—violent behavior of an individual. Similarly, practical exercises focus only on evacuating people from schools in the event of fire.

According to the Pareto principle, it was comprehended that the most important causes which influence on the improvement of school security are very close or over of 20%. These main problems are: Identity Verification (20.37%, Table 8) and Organization Training (18.47%, Table 8). Taking into the consideration the main pressing issue, Identity Verification, would allow the schools to implement an effective security balance and reduce the risk of terrorist's attacks.

In addition to the students themselves, parents and grandparents who do not know or respect the systemic security measures in schools are also a great risk to the school. A very effective tool for detecting and deterring an attacker, or at least mitigating the impact is trained security personnel who would constantly monitor the school entrance and check the persons entering.

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Ethical Statement: All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved on 16 September 2020 by the Ethics Committee of University of Defense in Brno (Agenda Number 6/2020).

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committeeof University of Defense in Brno (Agenda Number 6/2020) on 16 September 2020.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data is contained within the article.

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Appendix A

Table A1. Lack of preparedness that may initiate different possible threats for schools' safety.

Code	Type of Preparedness	Assessments' Weight (%)		St. Weight [1]
		Yes	No	No
CA1	Compiled a map or risk overview	82.6%	17.4%	3.79%
CA2	Sufficient Funds	28.3%	71.7%	15.61%
CA3	Safety Staffing	32.6%	67.4%	14.67%
CA4	Material security	19.6%	80.4%	17.50%
CA5	Theoretical training	95%	5%	1.09%
CA6	Practical training	91.3%	8.7%	1.89%
CA7	Training organization	15.2%	84.8%	18.46%
CA8	Integrated Rescue System	69.9%	30.4%	6.62%
CA9	Identity verification	6.5%	93.5%	20.36%
	Total:	441.00%	459.30%	**100%**

Notes: [1] Standardized weighted contribution of negative experts' answers.

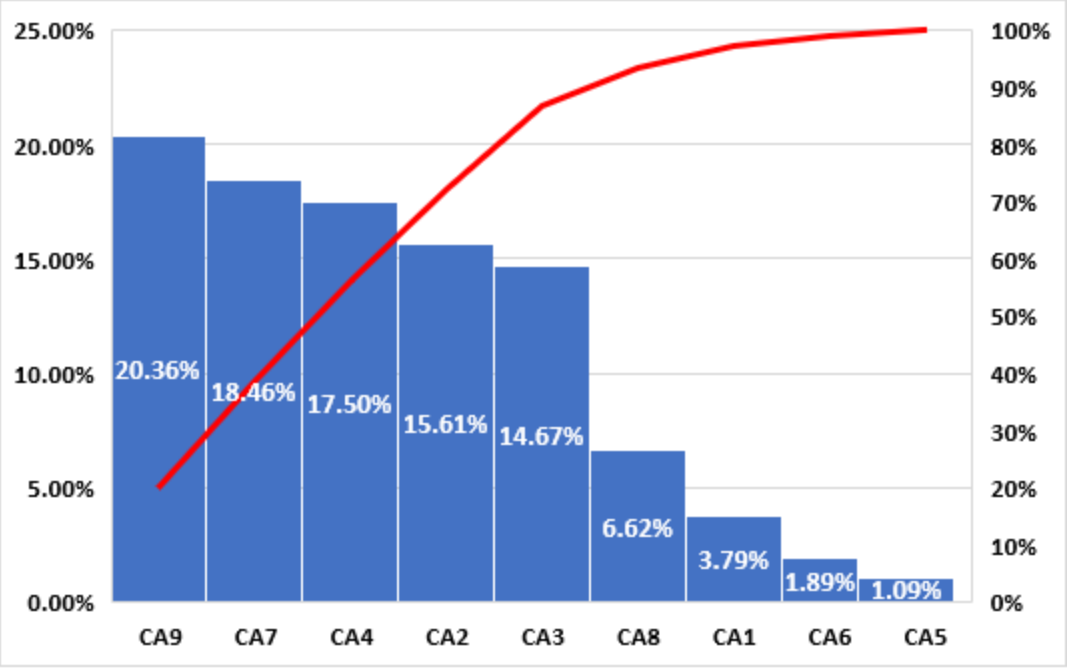

Figure A1. Schools' preparedness evaluation presented by Pareto chart. In descending order by bars are represented the assessed nine individual values of causes that reduces the schools' safety: CA1 = Compiled a map or risk overview; CA2 = Sufficient Funds; CA3 = Safety Staffing; CA4 = Material security; CA5 = Theoretical training; CA6 = Practical training; CA7 = Training organization; CA8 = Integrated Rescue System; CA9 = Identity verification; and the cumulative total is represented by the red line.

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