Transactions of the VSB - Technical University of Ostrava Vol. XVI, No. 1, 2021
Safety Engineering Series, ISSN 1805-3238 pp. 18-28, DOI 10.35182/tses-2021-0003

PROGNOSIS FOR THE DEVELOPMENT OF VULNERABILITY OF OBJECTS WITHIN THE FIRE PROTECTION

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Research article

Abstract: The article deals with the prognosis for the development of vulnerability of objects within fire protection. The article defines vulnerability, its significance, causes, analysis, criteria and determination. The following section deals with a brief historical development of the vulnerability of buildings in fire protection, followed by a section on the current state of vulnerability of buildings in fire protection. The following parts of the article deal with the prognosis of the development of objects' vulnerability for the years 2030, 2040 and 2050. The prognostic method, description, application, and final result of the prognosis are chosen within these parts.

Keywords: Prognosis, Vulnerability, Fire Safety, Prognostic Method, Safety.

Introduction

Safety and a sense of safety are among the basic needs of a person for the good life. Therefore, types of safety began to emerge in various forms, which were transformed continuously and updated with society's development, depending on the current situation. Fire safety is also one of the oldest types of safety. Due to the more significant impact of fire protection threats, the demand for fire safety has begun to develop in the past. Gradually, smaller units began to be created aimed at protecting the population and property from fires. With the company's development, these units began to expand and integrate until associations with a common interest in fire protection began to emerge. Gradually, voluntary fire brigades began to develop, whose task was to protect the population and property within fire protection. Due to the ever-increasing demand for fire safety, professional fire protection units have been created. These professional units with voluntary fire protection units currently form one large integrated unit, whose task is rescue and liquidation work during emergencies and also, in addition to repressive activities, also the implementation of preventive activities. Within the framework of fire risk in a more global predictive sense, it is important to focus primarily on threats related to the origin and effect of fire, the explosion of hazardous substances, flood management, constantly improving the responsiveness of fire protection units for technical interventions such as traffic accidents, removing trees from roads, ecological calamities, conducting regular inspection and tactical exercises, cooperation with cities and institutions and the like. This article focuses on the prognosis of developing the object's vulnerability for the years 2030, 2040 and 2050 using suitable prognostic methods. The article describes the vulnerability and current vulnerability of the building within the fire protection within the individual parts. Based on the current state's analysis, a part is conceived, focused on the development prognoses themselves. First, the prognostic method for individual years is chosen. The resulting state is a prognosis of developing the building or company's vulnerability within the fire protection.

Vulnerability

Vulnerability generally expresses the weakness of an object and its assets, through which security can be compromised. Vulnerability can also be defined as an amount expressing the ease with which an object can be damaged. It also expresses the susceptibility of the protected interest to damage. Its most common causes include the omission of a threat, ignorance of the threat or a new harmful effect. Therefore, it is essential to create a vulnerability analysis, in which an estimate is made of the probability that the threat will occur and cause damage to the building and its assets. The vulnerability analysis aims to assess the measures taken against individual threats, ideally by expressing all possible scenarios

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that may occur. The most common vulnerability criteria closely related to the vulnerability analysis include the number of layers of protection, level of breakthrough resistance of mechanical restraint systems in layers of the protection system, mode of physical protection, level of compliance with regime measures through internal operating rules, possibilities of operation of exit groups of private security services, tactics of using elements of alarm systems and the level of other measures to protect the object (Lukas, 2017).

Object attack scenarios can generally be divided into predictive, normative and non-normative. The vulnerability can also be determined according to specific criteria and methods. Among the most common vulnerability determinations, semi-quantitative methods are used, which ultimately determine the probability of overcoming the protection system, causing damage (negative impact) to the reference object and its assets. The resulting probability is usually expressed in the value 0-1 or as a percentage of 0-100 %. The higher the value, the higher the value of the object's vulnerability and the greater the chance that the threat will cause harm (negative impact). Since it is a semi-quantitative method, expressing the final state through a description is also a matter of expressing the final state. The most commonly used terms are on a scale from very low vulnerability to very high vulnerability. It is also possible to determine the final value of the vulnerability by scoring. Based on specific criteria, a specific value is added to the given points. After adding up all the values, the total value of the vulnerability is expressed and expressed as a percentage (Hoffreiter, 2015).

Historical development of the vulnerability of the building in fire protection

Fire protection began to evolve gradually with the development of human society. This type of protection is one of the first types of protection dealt with by the company. The first mention of fire-fighting organizational units dates back to ancient Rome. The main reason for these more massive fires was the construction of wooden dwellings. The individual houses usually had wooden ceilings, wooden furniture, and floors, which significantly increased fire risk. Therefore, people at higher education levels addressed this issue and decided on the correct location of houses and their homes. The significant disadvantage of that time was the possibility to remove the fire only with water. Water was most often pumped from fountains, wells, rivers, streams and lakes. Based on a more massive increase in fire cases, the so-called preventive component dealt with monitoring places and areas where fires occur most often. The fire's leading causes were sought, and thus the vulnerability of the given localities began to be assessed. The recurring fire forced him to build houses and dwellings from more suitable materials and not use a straw on the roofs of houses. Later, the so-called prefecture was established, which was in charge of enlightenment and preventive educational activities. In the early Middle Ages, fire protection activities were divided among individual citizens of municipalities and cities. City representatives assessed the vulnerability of buildings and determined their conditions within the framework of fire protection. The main reason was also the construction of houses and dwellings from non-combustible materials. In modern times, the vulnerability within buildings began to be addressed by the first general units, which were voluntary. As part of the vulnerability, the first fire regulations were issued by Emperor Joseph II. in 1788. At the beginning of the 20th century, fire protection vulnerabilities began to be addressed about transport such as trains, ships, airships and later, mainly aircraft and automobiles. Vulnerability in the context of fire protection was also affected by world wars, which caused massive fires of houses, streets, vehicles, industrial parks, forests, meadows, fields, and the vulnerability of buildings to fire protection of hazardous substances began. After the end of the Second World War, the interest in fire protection began to increase again. The vulnerability of manufacturing companies, apartment houses, family houses and the natural environment was mainly addressed. Within the framework of vulnerability, work safety has begun to be institutionalized. Demand for fire extinguishers began to increase. Various training and courses began to be created and implemented, focused on the correct use and application of manufacturing companies' devices and equipment (Weiss, 2015).

Since ancient times, they have tried to predict threats to fire protection and prepare for possible fires as a precaution. Over time and increasing the number of fire brigade members, a group of people began to form designed to predict possible future fires. These predictions were primarily focused on riskier buildings built of flammable materials or a higher fire incidence. The most significant predicting fire protection threats began in the 20th century, where fire prevention associations were gradually formed.

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The current state for assessment of the vulnerability of the objects within fire protection

When determining the vulnerability of buildings within fire protection, it is essential to determine what type of building it is, in which the environment is located and whether the threat within fire protection will be a fire or explosion, which can be caused by various factors-individual activities to reduce the vulnerability of the building concern legal and natural persons - entrepreneurs and municipalities. The most common activities are: carrying out preventive fire inspections and eliminating identified deficiencies, identifying places with an increased risk of fire and marking them with appropriate orders, prohibitions and instructions, providing training and verification of knowledge about fire protection of employees and designated persons, keeping documentation on fire protection, operation of technical equipment and technological equipment, determination of fire characteristics of products and substances and principles of their safe use, elaboration of project documentation of buildings, ensuring regular cleaning and inspection of chimneys, fire safety during installation and operation of appliances, handling of flammable substances, installation of suitable types fire equipment - fire extinguishers, correct marking of accessible escape routes, location of the electric fire system and proper handling of it, maintenance of water sources for fire extinguishing, for in case of further pumping, carrying out a fire alarm at least once a year, setting up the necessary number of fire alarms, preparing an analysis of fire hazards in their buildings and premises, setting up fire patrols, in case of fire contact the relevant Fire and Rescue Service and provide the necessary documents to the Fire and Rescue Service Corps when carrying out firefighting for better orientation (Act, 2001).

The environment within fire protection is divided into natural (for example, forests, mountains, rivers, parks, caves, and others), technical-working (for example, industrial parks, enterprises, technical warehouses and others), operational (for example, offices, schools, hospitals, shops, banks, restaurants, churches and others), residential (for example, family houses, apartment houses, cottages, dwellings and others) and their combination. Fire and the explosion of hazardous substances are currently the main threats to fire protection. Therefore, vulnerability assessments must focus most on the occurrence and subsequent effects of fire in the context of fire protection. Fire occurs in the presence of the following three quantities: oxidizing agent (oxygen, peroxide), combustible (fuel) and combustion initiator (temperature, spark). Therefore, it is essential to ensure no common combination of all these three variables within the vulnerability framework. Factors causing a fire in the building include: natural (for example, global warming, earthquakes, floods, storms, and others) and anthropogenic, which are divided into technogenic (for example, technical accidents, traffic accidents and others) and sociogenic (for example intentional ignition, intentional explosion, negligence and others). Within hazardous substances, it is an assessment of a particular class of hazardous substance in the building. Classes of dangerous substances are marked numerically 1-9 according to the type of dangerous substance (Janasek, 2004).

The most common way of extinguishing a fire is extinguishing with fire nozzles, extinguishing with a spray gun, snow foam, and the use of underground and above-ground hydrants. Until the fire protection unit's arrival, it is also essential to put out the fire before it has a more massive dimension. The most common means of extinguishing a fire before the arrival of a fire protection unit are fire extinguishers, wall hydrants or sprinklers. To reduce the building's vulnerability, it is essential to use the correct fire extinguishers. At present, fire extinguishers can be divided into five basic categories: water, powder, foam, snow and halon.

The fire unit currently determines the vulnerability of the building within the fire protection based on the following data: there are dangerous substances in the building, recurring fires occur in the building, the building is in a hard-to-reach place, the building is at a longer distance from the fire station, there are persons in the building, the building has an electric fire system or fire protection service panel, the building has an appropriate company fire unit or department, location of the building in the given environment, the building has a voluntary fire brigade, number of people in the building and the types of facilities and equipment available to the facility.

Prognostic method and vulnerability

The prognostic method is a set of procedures and activities in which prognostic methods are used. These methods express a particular way of expressing the prognosis of a given problem. Applying a suitable method and its creation depends on several factors, such as area, type, scope and goal of the prognosis, time horizon, available data, and

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others. A combination of several prognostic methods can be used in the processing of one prognosis. The primary division of prognostic methods is into two categories - qualitative (subjective), based on knowledge, experience and experts, and quantitative (objective), based on the application of individual data from the past, also called statistically (Valouch, 2016).

The article deals with the classification of prognostic methods into three groups: universal, structural and processual. Universal methods are suitable for processing several types within different periods and different areas. This category includes methods: brainstorming, the panel of experts, participatory methods and future status index. Structural methods are applied mainly in the identification and knowledge of the object of interest and its structure. This category includes methods: the wheel of the future, the tree of significance and morphological analysis, cross-interactions, text analysis, critical technologies and a systems approach. Processual methods are used mainly to process chronological sequences of monitored indicators in different time ranges and create development trends in the future. This category includes methods: the Delphi method, road maps for science and technology, decision modelling, simulations and games, scenario building, predictions of geniuses of their intuition and vision, extrapolation of trends and time series, trend impact analysis and megatrend analysis. This article will deal with predicting the vulnerability of an object in fire protection for specified periods. These are the years 2030, 2040 and 2050.

Development prognosis for 2030

The description of the prognostic method of extrapolation of the trend over time and its specific application to a possible threat within the prognosis of the development of the object's vulnerability for the year 2030 is based on the author's subjective estimate. As part of the prognosis of the building's vulnerability in fire protection for 2030, it is essential to identify the main threat in fire protection. The main threat in 2030 is the ever-increasing global warming, causing droughts and more numerous fires. Also, due to the drying of the soil in water bodies, the level of rivers, streams, dams and other water bodies is reduced, the low amount of water can cause a lack of water in fire extinguishing. Due to global warming during the summer, heavy rains often occur, which can cause more extensive floods. However, these floods are usually removed in time. Within selecting a suitable prognostic method for determining the vulnerability of the building in fire protection in 2030 - extrapolation of trends. This method is used mainly to process analyses of monitored objects' chronological sequences in different time ranges and mainly for creating development tendencies of monitored objects and interests in the future. Extrapolation of trends is a quantitative (subjective) prognostic method, which deals with monitoring the selected indicator within the development councils and their extension to the future. The starting point assumes that the given values of variables or processes will develop in the same direction or a different direction in the future. Among the primary forms of presentation of the results of this method are development curves. These development curves may be in the form of an ascending or descending line, a cyclic or periodic line, a parabola, an exponential, or a combination. This method is also suitable and used in several areas, e.g. economy, demography, crime, natural resources, development of various processes, meteorology and others. To determine and present the results within this method, it is essential to display the issue graphically (Valouch, 2016).

Based on the need for research, analysis and training, the following five areas have been created. Fire safety should be further addressed: cost-effective fire suppression systems, rational fire design approaches, characterization of new materials for fire performance, development of performance-based codes, fire hazard from wildfires. Based on the areas, the following conclusion of this prognosis can be drawn:

- fire represents a critical danger in both developing and advanced countries and models an essential threat to life, structure, feature, and environmental safety,
- modern fire protection measures lead to an unquantified level of fire safety in buildings, provide minimum procedures to decrease fire danger, and do not value for contemporary fire risk issues,
- implementing key measures that include improving fire protection features in buildings, proper regulation and execution of building code provisions, enhancing public knowledge, and proper use of technology and resources is vital to mitigating fire risk in buildings,
- elemental analysis and training need to enhance fire safety in buildings include improving cost-effective fire suppression systems, intelligent fire design requests, identifying new substances, increasing performance-based systems, and understanding fire risk from wildfires (Kodur, 2019).

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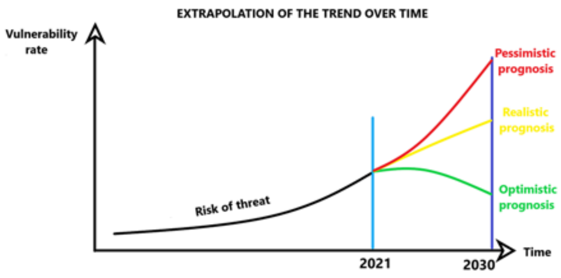

Fig. 1 Extrapolation of the trend over time for 2030

Fig. 1 shows a classical graph of the x and y-axis types. The x-axis shows a half-line with time values. Specifically, it is the year 2021, and it predicted the year 2030. On the y-axis is the degree of vulnerability. The resulting line shows the value of the threat risk. The given line is expressed exponentially and expresses the risk of exposure to the threat, specifically the threat of fire or explosion. This threat mainly concerns global warming. It can be seen from the picture that with the increasing number of years, the level of vulnerability increases and thus the risk of the threat, in which case it is a fire or explosion. Gradual global warming causes gradual warming of the earth. Warming the earth causes the gradual drying of streams, rivers, lakes, dams, reservoirs, and other water bodies. Gradual heating of the earth also increases the natural environment's drying, such as forests, meadows, fields and others. These natural environments or areas are more prone to fire in this case. A significant disadvantage is that more water is also essential to extinguish the fire when a fire occurs in these more extensive areas. However, due to the fire extinguishing unit's global warming, water resources are limited because the level of streams, rivers, and other water bodies is reduced.

Based on the statistics and the development of fire protection violations in case of fires, the following figure shows the development of the number of fires in the areas of burning from 1999 to 2018 in the USA.

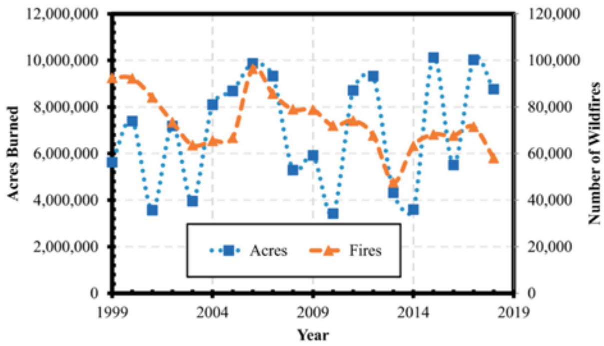

Fig. 2 Area of burning place and number of wildfires (Kodur, 2019)

From Fig. 2, a higher number of wildfires in a particular year do not certainly mean a higher area burned as the result of wildfire depends on possible fuel and weather conditions. Consequently, even a tiny number of wildfires can be dangerous to build infrastructure if they change into conflagrations. Also, there are currently minimum data in the research on critical differences in fire response of a structure subjected to wildfires and building fires from within. As buildings are usually designed for fire protection of 2-4 hours only, it is impossible or economical to design buildings to withstand wildfires, lasting as long as few days to a few weeks. Consequently, more focus should be on rapid evacuation instead of providing passive fire resistance. Further, there is a solid want to study the behaviour of buildings reduced to wildfires as studies are deficient on the same in literature (Kodur, 2019).

The global warming situation is closely linked to the fire protection of buildings. As the temperature of the environment constantly increases, the soil heats up, thus lowering the water level of the rivers. Increasing the temperature of the environment also causes the buildings in the environment to heat up. The way a building is heated depends on the material from which the building is built. The most typical materials include concrete, brick, iron, wood, stone and their combinations.

To reduce the temperature of building surfaces more effectively, it is appropriate to use so-called "green" materials, which effectively reduce the surface temperature of buildings by solar energy. The proposed structural materials and systems within the "green" include mass timber, additive manufacturing, inflated steel structure, hempcrete, ultra-high-performance concrete, carbon fire composites and modular construction. The proposed exterior materials and systems within the "green" include allusion panels, PET for facade system, interactive printed graphene, novel biological materials, building integrated carbon capture, organic insulation, composite window framing material, mass timber and timber facade systems, ultra-high-performance concrete, additive manufacturing or 3D printing and hempcrete. It is also suitable to use heat pumps and interior electronic vehicle chargers within building systems, and within the alternative energy system, it is suitable to use energy storage systems, building-integrated photovoltaics, and solar radiance concentration. It is also advisable to use out of plane geometries within the facade features. Within site, it is appropriate in the future to focus on EES (energy storage systems) fuel loads or hazards, electric vehicle fuel load or charges, propane vehicle hazards, fuel cell vehicle

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hazards, bicycle storage impact exits, reduced fire department apparatus access, densification or fire spread and electric vehicle chargers on building exterior (Meachan and McNamee, 2020).

Development prognosis for 2040

The description of the prognostic method around the future and its specific application to a possible threat within the prognostic of the development of the object's vulnerability for 2040 is based on the author's subjective estimate. As part of the prognosis of developing the building's vulnerability in fire protection for 2040, it is essential to determine the main threat within fire protection. This primary threat is proposed due to fig. 3, which shows the types of fire, where the most significant percentage is the fire of electrical equipment. These data were collected from 2002 to 2018.

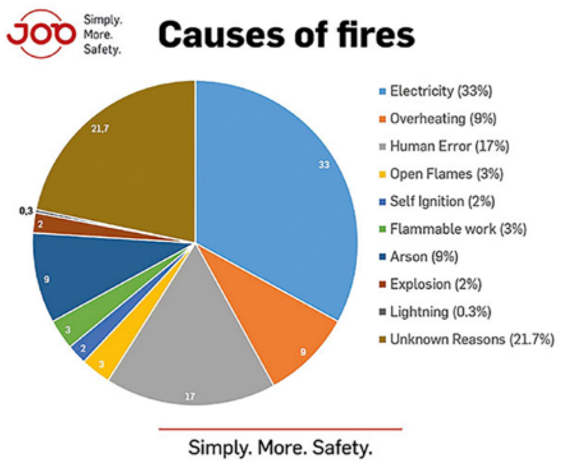

Fig. 3 Causes of fires (Eichhorn, 2020)

The threat of electricity is intended for this reason, as more and more people are switching to automated production, and most resources are starting to have an automated variant. Special care must be taken about their short-circuiting when using many electrical devices, leading to a fire. Within selecting a suitable prognostic method for determining the vulnerability of an object in fire protection in 2040, the structural method is chosen - the wheel of the future. This type of methods within the prognostic activity is applied mainly to identify and know the object's interest and structure. The wheel of the future is a method by which it is possible to identify and present the consequences of events and development trends. It is used mainly in identifying potential threats in the future. The basis lies in the initial representation of the solved event and the gradual addition of context (consequences). This gradually creates rounds of individual levels of consequences. This method can create the so-called mental map of the future that can serve as a feedback tool. When determining and presenting the results within this method, it is also essential to first display the issue graphically (Valouch, 2016).

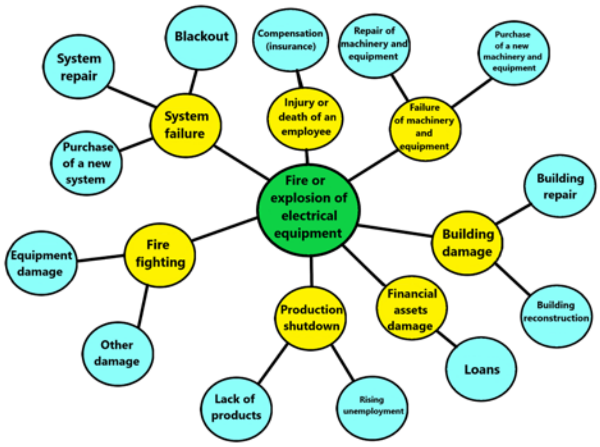

Fig. 4 The wheel of the future within fire safety

From Fig. 4, the main threat related to fire protection in 2040 is first selected. It is a threat to the type of fire or explosion of electrical equipment. Personal consequences can be deduced from this threat, and these are the primary consequences shown in yellow. The primary consequences of a significant threat such as a fire or explosionof electrical equipment include injury or death of an employee, failure of machinery and equipment, building damage, financial assets damage, production shutdown, fire extinguishing by a fire protection unit and system failure. There may or may not already be a direct relationship between the individual primary consequences. For example, the primary consequence of "fire extinguishing" is related to another primary consequence of "damage to a building", but for example, the primary consequence of "injury or death of an employee" is not directly related to the primary consequence of "damage to financial assets". Each primary consequence of a significant threat, such as a fire or an explosion of electrical equipment, has other consequences, called secondary consequences. Notably, the secondary consequences are no longer directly related to the main threat. Secondary consequences of the main threat of fire or explosion of electrical equipment include compensation - insurance, repair of machinery and equipment, purchase of new machinery and equipment, building repair, building reconstruction, loans, rising unemployment, lack of products, equipment damage by liquidation, other damage, purchase of a new system, system repair and blackout. There may also not be a direct relationship between the secondary consequences of the main threat. The direct relationship between secondary consequences can be directly related as long as they have a common primary consequence. Within each secondary consequence, there may be another consequence, called a tertiary consequence. Within the tertiary consequence, another level of consequences may arise. The primary and secondary consequences are shown and presented in the article because they are more or less related to the object's main threat. As the consequences develop, the direct link to the main threat decreases.

As part of the statistics for this prognosis, an analysis of the goals, strengths and weaknesses of the results was created. The essential points of the prognosis goal include: highly desirable, low-likelihood consequences (and policies or management actions designed to increase their likelihood), highly undesirable, high-likelihood consequences (and policies or management actions designed to decrease their likelihood), surprising consequences and including those that could have catastrophic or extraordinarily positive impacts, differences in scoring from alternative points of view, information and monitoring needs for highly uncertain developments (Bengston, 2015).

Strengths of this prognosis are: easily grasped by participants, stimulates complex and systematic thinking, provides a clear visual map of complex interactions, flexibility for respondents, fast data collection, no transcription of data required. Weaknesses of this prognosis are: results vary in consistency, limited by knowledge and perceptions of participants, information overload, complex and time-consuming data analysis, higher cost per respondent, speculative nature of data (Benckendorff, 2007).

Development prognosis for 2050

The description of the prognostic method around the future and its specific application to a possible threat within the prognosis of the development of the object's vulnerability for 2050 is based on the author's subjective estimate. As part of the prognosis of developing the building's vulnerability in fire protection for 2050, it is also essential to determine the primary threat within fire protection. The primary threat for 2050 could be creating illegal landfills for hazardous waste, which would endanger health, the environment and the ecosystem. As the number of hazardous waste landfills increase, so does the long-term toxicity to air, soil and water. Other harmful properties of illegal landfill formation include increasing infectivity, irritability, explosiveness, flammability and carcinogenic properties. At present, the problem of creating hazardous waste landfills remains the norm. With a growing population, there is a growing demand for products and thus an increase in the amount of waste that can be more or less dangerous to human lives. As a perfect example of ever-increasing waste, see Fig. 5, which covers the United States. Fig. 5 shows the increasing amount of waste in tonnes in the period from 1960 to 2014. The waste is divided into durable goods, nondurable goods, containers and packaging, food, yard trimmings and other wastes - the rate and amount of waste increases in proportion to the growing population.

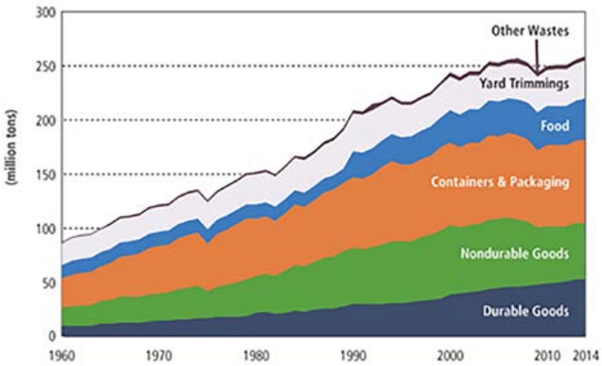

Fig. 5 Generation of products (EPA, 2016)

A less critical (secondary) threat to fire protection should be a fire or explosion in single-family homes due to neglect of chimney cleaning care. This threat is identified for this reason, as there are fewer and fewer chimney sweeps at present, and it is expected that in the future, homeowners will arrange their chimney cleaning either through external companies or in other ways. It is also important to realise that in 2050 the company will make great efforts to promote decarbonisation, which will also be reflected in solid fuels in households, where most homes should be heated by solar panels or geothermal energy. The threat of fire due to neglect of chimney cleaning care should mainly affect residents of family houses or dwellings outside towns and larger villages, where decarbonisation and the use of solar panels or geothermal energy will be minimal non-existent. Furthermore, since there will not be much demand for chimney sweeping activities in the future, the number of chimney sweeps will rapidly be reduced to a minimum. As the inspection of chimneys is mandatory only before the approval itself, it is likely that many people will not clean the chimneys after the approval and will gradually form significant soot in the chimneys, which will cause the chimneys to clog and later cause a fire or explosion gradually.

In selecting a suitable prognostic method for determining the vulnerability of an object in fire protection in 2050, a processual method is chosen - scenario creation. It is a form of prognosis processing that describes possible future developments at a specific time. The prognosis for the development of individual scenarios is based on the developmental connections between individual events. It follows that a scenario is an arrangement of various forward-looking statements under certain conditions that may occur. They are used to create concepts and strategies in various areas. It is one of the most used methods. The creation is based on the assumption that the future cannot be predicted precisely, and it follows that various alternatives can be considered. The scenarios' aim is a systematic examination and creation of possible, probable states of the future. As part of creating a scenario within the framework of fire protection for the year 2050, an exploratory scenario is selected, which describes what may happen in the future if specific procedures are performed. In particular, it is a prognosis of the development of the vulnerability of family houses, in which a fire or explosion may occur due to incorrect or no activity associated with the cleaning of chimneys. First, it is essential to determine the type of scenario according to the classification. Within the classification point of view, the selected type of scenario is:

- degree of normativity - descriptive scenario - a description of the prognosis of a possible future situation,
- processing rate - an indicated scenario - is not substantiated by scientific claims,
- content - specific - focused mainly on one section,
- quantification - partially quantified - comparing values of trend characteristics,
- time horizon - long-term - development prognosis for 2050,
- the flow of time - prospective - development from the present to the future,
- function - exploratory scenario - possible situation in the future under current conditions,
- processing methodology - logic based on extrapolation of trends - development of the present and prolonging possible future states.

Another critical point in creating a scenario is the process. The general process of exploratory scenarios is the identification of critical topics and problems, identification of critical factors in the internal environment, identification of driving forces on the broader environment, ranking driving forces according to importance and degree of uncertainty, determination of scenario logic, completion of scenarios, management of all implications and selection of key indicators and variables measured by the change. Based on this procedure, three scenarios are determined, which will be their combination through a critical path (Valouch, 2016).

Based on the development of fire safety and trend scenarios, the following four primary goals were created within the analysis and the creation of the fire safety scenario:

- there must be a clear-cut method for engineers to define the range of possible levels of safety in a method that can be modified into useable social policy. Inputs to models must be defined in a form that presents itself to the regulatory process; rather than being defined by the requirements of the models,
- engineers cannot expect to define the form in which public policy must be made. Society must be available to protect property, vulnerable populations or insist on redundancy or margins of safety,
- social safety levels and technical specifications have to be produced in tandem. At all steps, engineers should avoid concealing social decisions in technical standards,
- there must be clear technical measures adequate for managing a building's compliance with the premises in a fire safety analysis (Brannigan, 1999).

Results of the development prognosis

Based on the development prognosis for 2030, 2040 and 2050, their results for each year are evaluated.

Results of the development prognosis for 2030

Within the result of the development prognosis for 2030, 3 results of the possible prognoses are selected. It is an optimistic, realistic and pessimistic prognosis.

Realistic prognosis - the most probable future situation within the set 3 prognoses is a realistic prognosis. As part of the realistic prognosis, the situation regarding global warming is operating and deteriorating. There is the gradual heating of the ground, which causes dryness and, as a result, more frequent fires. The level of rivers, streams, dams and other water bodies is drying up, but there is still enough water for the eventual extinguishing of fires. During the summer, heavy rains often occur, which can cause more extensive floods. However, these floods are usually removed in time.

Optimistic prognosis - the probability that the optimistic prognosis will be fulfilled is less than the realistic prognosis. As part of the optimistic prognosis, global warming is beginning to improve, and the number of fires caused by this warming is also decreasing. The level of rivers, streams, dams and other water bodies is stable, and the situation is ideal. Occasional rains do not cause any elevated river levels and thus no floods.

Pessimistic prognosis - the probability that the pessimistic prognosis will be fulfilled is also less than the realistic prognosis. As part of the pessimistic prognosis, the situation regarding global warming is deteriorating significantly. Lakes, rivers, streams and other bodies of water are completely dry. The number of fires is rising rapidly, and there is a significant water shortage to put out the fire. The tremendous heat creates massive and heavy rains, which cause extensive floods and can flood many buildings containing hazardous substances. This can cause explosions and other massive and extensive fires. Due to the increasing number of fires and floods, there are few fire protection units for possible other emergency events related to fire protection.

The result of the fire safety prognosis of buildings is to change the building material and surface of buildings and replace it with "green" material, which reduces and effectively reduces the risk of fire due to global warming, which causes a gradual increase in temperature due to years and thus heating buildings and equipment are located in buildings. Within the proposal "green" materials, using these proposed structures and systems in buildings would not lead to a higher risk of fire or explosion of hazardous substances due to global warming, subject to strict regulatory conditions. More significant amounts of electricity can also cause a fire hazard, but the risk is low if the necessary conditions are met.

Results of the development prognosis for 2040

The current trend of automation of devices and equipment is still rising. In 2040, it is assumed that the main and, simultaneously, the most significant vulnerability in fire protection could be a fire or an explosion of electrical equipment. It is assumed that there will be a significant power gain, and individual systems may not work correctly. The worst part of fire protection is if there are frequent failures in electrical fire systems. A significant vulnerability, such as a fire or an explosion of electrical equipment, has many other consequences. This high level of vulnerability can negatively affect the entire system of object protection. Based on Fig. 3, it is essential that the company primarily addresses and addresses threats in particular and secondarily addresses less dangerous threats threatening object protection systems.

Results of the development prognosis for 2050

The result of the development prognosis for 2050 is for primary threat - the creation of illegal landfills for hazardous waste is a proposal for preventive and repressive measures. The main preventive measures include: increasing controls to prevent further illegal landfills, creation of goods for consumers from less dangerous (alternative) products, strengthen legislation to address illegal landfills and strengthening the ecosystem with the expansion of forests, reservoirs and dams, streams and rivers. The main repressive measures include disposal of illegal landfills for hazardous waste and stopping the spread of hazardous substances from illegal landfills for hazardous waste to the soil, water or air. The result of the development prognosis for 2050 is for secondary threat - chimney cleaning care is creating a critical path from a combination of possible outcome scenarios. The critical path is shown in fig. 6. The prognosis for 2050 is mainly intended for residents of houses and dwellings located outside towns and larger villages, where chimney heating of households will still be used.

Fig. 6 is a graphical representation of the critical path of the issue. The rectangles contain the beginning and end of the process. The individual processes of the critical path are located in the circles. There are numbers between the individual processes. These numbers express the value of the importance of the given process. The individual values of the numbers are calculated based on the progress of activities. The resulting state expresses the given value- the higher the numerical value, the more efficient the process. The most effective process is the following points: Start of the process → Stricter legislation → Fire protection preventor → Professional firefighters → Controls or sanctions → Setting a deadline → Cleaning process → Automatic re-order → Electronic database → Process evaluation (total number of points - 19). The least

Safety Engineering Series, ISSN 1805-3238 pp. 18-28, DOI 10.35182/tses-2021-0003

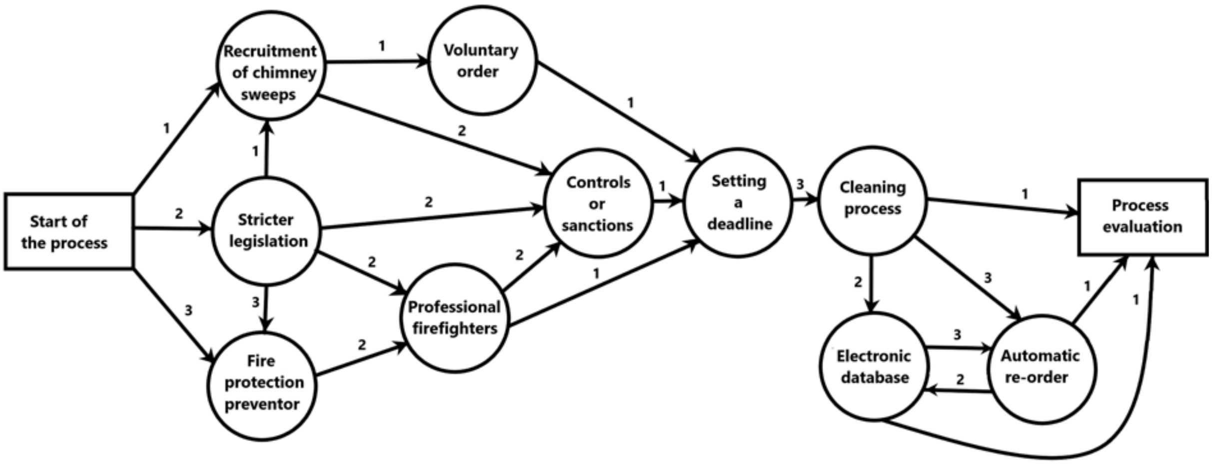

Fig. 6 The critical path of the issue

effective process is the order of the following points: Start of the process → Recruitment of chimney sweeps → Voluntary order → Setting a deadline → Cleaning process → Process evaluation (total number of points - 7).

The following table expresses the effectiveness of the process for the appropriate number of points.

Tab. 1 Effectiveness of the process

Effectiveness of the process	Total number of points
Very good process	17-19
Good process	13-16
Weak process	10-12
Very weak process	7-9

The ideal situation is if the effectiveness of the process belongs at least to the category of the good process with a minimum number of 13 points.

Conclusion

It is essential to deal with the safety prognosis. The article dealt with the prognosis of the development of vulnerability and the building's main threat within the fire protection for the specified years. The first part of the article described the vulnerability, definition, causes, analysis, criteria, attack scenarios, and identification. The next part of the article focused on a brief historical description of the vulnerability in fire protection, which was followed by assessing the current state of vulnerability of the building in fire protection. This chapter defined actions to improve vulnerability, environment, fire, hazardous substances, agents, firefighting, fire extinguishers, vulnerability assessment and identification. Other parts of the work focused on diagnosing the vulnerability of the building in fire protection for three years: 2030, 2040 and 2050. For each prognosis in the following years, the main threat to the building is selected within the development prognosis subsequent result. For 2030, a processual method was chosen - extrapolation of trends, for 2040, a structural method was chosen - the round of the future, and for 2050, a processual method was chosen - scenario creation. The prognosis years' main threats were more frequent fires, or explosions of buildings or floods caused by global warming, fire or explosion of electrical equipment and creating illegal landfills for hazardous waste. A less likely threat would be fire or explosion in detached houses due to neglect of chimney cleaning. The general goals, results and analyses of individual prognoses are given in the last chapters, which describes the development of prognoses for specified years.

Acknowledgment

This research was based on the support of the Internal Grant Agency of Tomas Bata University in Zlín, IGA/CebiaTech/2021/004 and The Department of Security Engineering, Faculty of Applied Informatics.

Safety Engineering Series, ISSN 1805-3238 pp. 18-28, DOI 10.35182/tses-2021-0003

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