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SCREENING FOR TERRITORY SAFETY MANAGEMENT NEEDS

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ABSTRACT

TERRITORY SAFETY MANAGEMENT INCLUDING THE PUBLIC PROTECTION REPRESENTS CO-ORDINATION OF SERIES OF HETEROGENEOUS PROCESSES THAT ARE UNDER WAY IN DIFFERENT REGIONS AND SOME OF THEIR OUTPUTS ARE MUTUALLY CONDITIONED. UNDER THE INVESTIGATIONS CONNECTED WITH SOLUTION OF TASKS OF FOCUS PROJECT IT WAS SHOWN THAT FOR SAFETY MANAGEMENT WITH INHERENT POTENTIAL FOR SUSTAINABLE DEVELOPMENT ENSURING THERE IS IMPORTANT TO CARRY OUT TERRITORY SCREENING HAVING THREE PARTS, NAMELY: TERRITORY CHARACTERISTICS IN RANGE OF LAND PLANNING DOCUMENTATION; CHARACTERISTICS OF DISASTERS THAT CAN AFFECT TERRITORY INCLUDING THE DETERMINATION OF THEIR SIZE AND SEVERITY OF THEIR IMPACTS ON PUBLIC ASSETS; DETAILED CHARACTERISTICS OF PUBLIC ASSETS AND THEIR VULNERABILITIES. WITH REGARD TO FINDINGS IT IS POSSIBLE TO DETERMINE CRITICAL ITEMS THAT ARE NOT TREATED BY MEASURES AND ACTIVITIES OF PREVENTION, PREPAREDNESS, RESPONSE AND RENOVATION AND THAT MAY BE AT LEAST FOLLOWED FROM VIEW OF ENSURING THE HUMAN SECURITY AND SUSTAINABLE DEVELOPMENT.

Key words:

safety management, territory screening, disaster screening, vulnerability

INTRODUCTION

Based on current knowledge, for human life is not enough to meet physiological needs. H. Maslow [1] showed that there are further needs as security and sureness, social use, self-realization and social recognition. The fundamental orientation of research and state administration on the issues of safety and on its management came after major terrorist attacks in the U.S. 11.09.2001, 11.3.2004 in Madrid, 3.9.2004 in Beslan, 7.7.2005 in London, etc., after which mankind fully understood what security means for him / her and its development and what represents highest value for him / her.
Current knowledge and experience [2] shows that we know that in order to achieve the desired state of each system, i.e. including the human system, and for its development it is important to set goals and procedures for achieving them, which are dependent on the resources, forces and means, which are never enough. Therefore, it is necessary to focus on priorities and to properly manage resources, forces and means in time and space. In addition to all above, it is necessary to know the territory and its protected assets, possible disasters that threaten it, a way of threatening, available resources, sources of power and resources [2]. Following paragraphs focus on the facts we need to know about the territory and the scope of details.

METHODICAL APPROACH TO PROBLEM

According to Act No. 114/1992 Coll., on nature and landscape protection the territory is defined as a part of the Earth surface and relevant (e.g. in terms of projection on map, but also in terms of display-ability on the map) objects on it: forests, waters, roads, buildings, equipment etc. For the reasons of territorial safety management we also include the human society that inhabits it and which is understood as a human system. In this approach we follow a system that has a disparate asset base: the lives and health of people, property, public welfare, environment, infrastructure and technology, the interdependences which are the sources of cross-linking risks, and which develop dynamically together in interaction with neighborhood. Therefore, its management by the man, or rather human activities management and human behavior must be done in such a way that a man does not contribute to the disintegration and disappearance of the human system, which is vital for him. In terms of current knowledge and experience such management must be proactive, strategic, complex (respecting all protected assets) and effective [2]. According to knowledge and experience it has 3 interrelated levels: management focused on creating the security and on sustainable development; emergency management; and crisis management [2], which is designed to be able to quickly avert any disruption of the territory undesirable in terms of security and sustainable human development.

From a methodological point of view integral safety management represents the coordination of many disparate processes taking place simultaneously in different areas with some of their results mutually interdependent, i.e. the processes are in some way dependent on each other, i.e. the mastering of respective tasks is determined by the guidance to a given objective. From the perspective of the objective it is necessary that each participant understands every problem in the existing context and seeks effective solution in given circumstances, and yet proceeds rationally with regard to costs

and available resources in their respective areas. This means that all the aspects above must be taken into account in safety management scenarios. The fulfillment is only possible when there is a quality tool to build scenarios for safety management, which is: is sufficiently flexible, transparent, accurate in the sense that it provides the same results when repeated, and right in the sense that the results are weighted with certain degree of both uncertainty and indeterminacy (vagueness).

Current knowledge and experience from disaster management and from theory of management of variable systems are used [2] for creation of a tool to build scenarios for the safety management.

In practice, however, there exist many problems that are unstructured, and in a number of elements, links and flows of the system under consideration there exists not only uncertainty, but also indeterminacy (vagueness). Under current knowledge, the ability to address these challenges is provided only by an application of a case study in decision-making in system conception and by expert methods. Expert methods mimic the thought processes of experts. They rely on a scenario process in which the leader of the task is led to the gradual solution of partial decision problems in a logical sequence of activities and considerations associated with creating and evaluating the various options for solving the problem. Method of application of case studies in decision-making is based on analysis of the current literature, cited in [3], and is now considered a reliable method, if done carefully. It is an ideal method for obtaining the results via compact and deep investigation. Specific rules for the given objective are created and they determine how the case study is performed and how it enhances the reliability and accuracy (validity) of results of performed investigations [3].

Both these procedures are based on variants of the safety management scenarios.

Development of variants for the safety management scenarios [2] must be based on:

- characteristics of the territory, i.e. the scenarios in which specific assets are placed in a given quality and quantity
- variant scenarios of specific disasters which affect or may affect the area in which specific assets are located

Current knowledge shows that disasters due to its nature do not affect assets evenly, and therefore specific individual vulnerabilities to potential disasters are different [4]. Therefore, the territory screening for the needs of safety management has two distinct parts, which we will discuss further.

STANDARD TERRITORY SCREENING

Screening is generally fact-finding procedure. Its goal in the case of territory is to build qualified characteristics of territory. Building codes applied for the territory of present Czech Republic in the last hundred years, were always based on contemporary knowledge, and therefore required preparation of planning documentation for the construction of safe buildings. This documentation contains both, the characteristics of territory and the judgment of changes that occur as a result of construction of objects.

Characteristics of the territory, according to the requirements related to the current Act No. 183/2006 Coll., consist of the following items:

- location, extent and description of the territory,
- description of the environment, i.e. conditions: geological, geophysical, geomorphological, pedagogical, climatic, meteorological, hydrological, and biotic conditions; landscape and nature protection; and protection of territory,
- demographic and social conditions, i.e. population, amenities, housing structure, transport and technical infrastructure,
- economic conditions, i.e. employment, tourism and recreation.

Report on changes consists of creation of possible expected scenarios after the construction of the building, and of assessment, in which limits for use and value of the territory are considered. The aim of evaluation according to [5] is to identify problems in the area and to apply the precautionary principle, which is an expression of attitudes toward uncertainty and irreversible changes, in the interest of security and sustainable development of territories.

At territory problem determination it goes on list of issues in relation to defects and conflicts in the territory, i.e.:

- urban defects,
- transport defects,
- sanitary defects,
- mutual clashes of plans for changes in the territory,
- conflicts of objectives with territory use limits.

Such conflicts and defects must be addressed, either by design changes, (e.g.: by moving to a more appropriate site, by application of different construction materials and methods,) or by dismissal if the risks are very high and cannot be offset by the advantages of constructed object, i.e. in the moment of decision they are unacceptable for human society.

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SCREENING THE DISASTERS THAT MAY AFFECT THE TERRITORY

Disasters are divided into several groups according to types of processes occurring inside and outside the Earth as a planet, and therefore have a different location and different characteristics. Current knowledge shows that possible scale of larger disasters depends on regional processes and sizes of their impacts depend on both, the regional processes and the local conditions. Their causes and characteristics are incommensurable. In terms of protected assets they have one thing in common, and it is their ability to destroy them, that is causing harms and damages. Based on current knowledge [2,4] following phenomena constitutes a disasters (note - this is a broader concept than threat, which is mainly used in military practice as a designation for any external cause damage to assets), which cause damages, losses and injuries to humans and other assets of the human system, which are the results of five of the following processes:

- disasters as a result of processes taking place inside and outside the Earth, at where human does not have the ability to manage them according to own wishes:
  * natural disasters, i.e. avalanches, hot humid summer days, drought, dam disruption, floods, tsunamis, earthquakes, volcanic eruptions, landslides, slope falls, rock falls, forest fires, hurricanes, tornadoes, heavy rain or snowfall, gas sprains from Earth's interior,
  * diseases of plants,
  * animal diseases
  * landscape erosion
  * desertification
  * soil liquefaction,
  * expansion of the oceans,
- disasters as a result of processes taking place in the human body, human behavior and human society and which are:
  * unintentional: diseases, human errors,
  * intentional phenomena caused by people, such as: wrongful appropriation of property, killing a human being, bullying, religious and other intolerance, criminal acts such as: vandalism and illegal business, robbery and attacking, illegal entries, unauthorized use of property or services, theft and fraud, intimidation and extortion, destruction and sabotage, terror against individuals, terrorist attacks, local and other armed conflicts,
  * intentional misuse of technology, such as: incorrect application of CBRN (Chemical, Biological, Radiological, Nuclear, Explosive), acquisition (mining) of information from social and other cyber networks for psychological pressure on the human individual,
- disasters as a result of processes and activities of people (incidents, accidents, infrastructure failures, technological failures, loss of serviceability, etc.), where humans have certain potential to adjust activities to affect the incidence, course and frequency of disasters,
- disasters as a result of processes associated with extreme and adverse interactions of planet Earth and the environment on human activities, such as:
  * induced earthquakes caused by certain human activities, e.g. by construction of large dams, mineral extraction, moving the materials along the Earth's surface and its vicinity, etc.
  * disruption of the ozone layer, to which man contributes with CFC emissions,
  * greenhouse effect, to which man contributes with high human exhalations of carbon dioxide (CO2),
  * perhaps rapid climate variations observed in recent times,
  * contamination of air, water, soil and geological environment,
  * desertification as a result of thoughtless regulation of water flows,
  * decrease in diversity of animal and plant species,
  * uncontrolled population explosion, migration of large groups of people,
  * gradual depletion of nonrenewable resources,
  * erosion of soil and rock massifs,
  * uniformity of landscape,
- disasters as a result of processes associated with the implementation of adverse internal dependencies in the human system:
  * natural, such as: stress and movements of tectonic plates, circulation of water in the environment, circulation of substances in the environment, circulation of substances in the human food chain, planetary processes, interaction of solar and galactic processes,
  * man-made, e.g.: results of managing human society as: corruption, abuse of power, the decay of human society into intolerant communities; flows of raw materials and products, energy flows, cash flows, information flows.

The list shows that disasters have very different physical, chemical, economic, biological, social, cyber etc. essence / nature related to process, as result of which they occur. This fact is crucial in terms of safety, because preventive measures must be focused on the nature of the disaster, in order to be effective.

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Disasters have certain characteristics that are the source of impacts causing the wrecks, losses, harms and damages to important elements, links or streams of the human system, from the perspective of a human. Therefore, according to the nature of disaster, the impacts of disasters include e.g.: vibration; streamlined rapid flow of air (from a light flurry to a phenomenon called pressure wave), water or soil; violation of stability and consistency of rock or soil; the movement of masses; outburst of liquids; temperature anomalies, etc. The given impacts affect human directly or indirectly through links and flows in the human system [2].

Impacts of disasters are multidisciplinary and cause system changes of different nature in the human system, i.e.:

- Physical changes, which include the occurrence of events: having the nature mechanical, electrical, optical, magnetic, electromagnetic, optical, acoustic, thermal, seismic; inducing the phase transitions or the radiation. Phenomena of heat nature are burning heat, radiation and convection. Phenomena of mechanical nature are blast, shock, fracture, shear, friction, shear, tear, twist, fall, fall, implosion, pressure wave. Phenomena of electrical nature are short-circuits, induction, resistance. Phenomena of magnetic nature are magnetization change, magnetizing object. Phenomena of optical nature are the optical refraction, false glare, mirage, glare, light pulse. Phenomena of acoustic nature are noise, rumble, infrared and ultra sound vibrations. As consequence of phenomena inducing the phase transitions or the radiation there are generated aerosol mixture, a mixture of dust, mists, fumes, active isotopes and mutation of living tissues.
- Chemical changes, which include the occurrence of phenomena having the nature of the action associated with properties such as pH, concentration of solutions, oxidizing or reducing properties, reaction mechanisms in the human organism and territories. These phenomena lead to: burning the various kinds, the pressure wave, creating chemical clouds, corrosion of metal structures, oxidation of organic matter, aging and changes in the structure of solids, acid rain.
- Biological changes that include the occurrence of events having the nature of effects associated with immediate or delayed changes in living organisms (e.g., mutation, immediate or sudden illness). These phenomena lead to transformations in living organisms of different species (appearance, size, structure change, mutation, loss of reproductive ability, stress, loss of resistance, reduced diversity, etc.).
- Structural changes, which include the occurrence of phenomena in the territory and in human society, which cause changes in the human system and are base for climate change, weather fluctuations, the occurrence of induced earthquakes, ozone holes, global warming, the polarization of society and the emergence of mutually intolerant groups.
- Psychological changes, which include the occurrence of such phenomena in humans as mental disturbance or imbalance, increased stress, frustration or mental illness. Based on these changes occur such phenomena as bullying, mental short circuits, feelings of alienation, violence, hostility, intolerance, xenophobia, crime, murder, violence, terrorism, migration, etc.
- Sociological changes, which include the occurrence of events in the territory, having the social, economic or political character. On the basis of these occur phenomena such as poverty, unemployment, debt, tax evasion and fraud, cartels, personal oppression, restrictions on freedom of expression, religious intolerance destabilize the system of government; violent occupation of territory, occupation, wars.

Further details are in the works [2, 4, 6].

The occurrence of disasters, their size, the size and specifics of their impacts depend on the characteristics of the territory, its population and its industry and infrastructure. Important there are the properties and parameters, methods of land use and its settlement, because these items significantly determine the vulnerability to a specific disaster, i.e. sources of domino effects.

Screening the disasters in the area means that from the disaster scenarios built for normal, design and beyond design (extreme) disaster sizes, there are found impacts for each specific disaster in the monitored area and according to them there are determined expected losses, damages and injuries to protected assets according to the method described in [4]. Disaster scenarios are determined by processing the empirical data, by modeling procedures with use of analytical or heuristic techniques [4].

DETAILED DESCRIPTIONS OF PUBLIC ASSETS AND THEIR VULNERABILITIES ASSOCIATED WITH POSSIBLE DISASTERS

Vulnerability is inherently complex entity of the system, the dynamic, i.e. not a static variable. In the scale of time and space (e.g. in the projection into area), certain aspects dominate at different point in time and at a different site. Verbally, it is the antonym for the two established concepts of robustness and resilience. Generally, it refers to the condition or predisposition [8.11].

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As based on collected facts, vulnerability is a property of place in the system. Due to the dynamic development of all systems, the vulnerability is also a function of time [8]. Because, each site has a certain structure, composition, its own network of links and flows, etc., which, moreover, change over time, and each disaster in the monitored system and its surroundings has its certain physical characteristics, so the vulnerability of the entity (site, system, building, infrastructure, human, etc.) also depends significantly on the physical characteristics of disasters, i.e., some entity is only vulnerable to beyond design (extreme) winds and intentional human activities, other to beyond design (extreme) earthquakes, floods and intentional human activities, and others fail to beyond design (extreme) failure of technological processes and deliberate human activities etc. The application of technical norms, standards and best practice procedures the vulnerability of buildings and infrastructure is reduced. The main problem of our times is the critical infrastructure, which represents a system of systems (i.e. the system of overlapping systems) for which we only look for measures to reduce its vulnerability with respect to all the above aspects, with necessity to find principles to reduce vulnerability across different systems and across systems of systems.

In literature it is possible to find variety of scales and curves for the classification of vulnerabilities [8]. Since each area is site specific, the following procedure must be applied for each area separately, with the vulnerability assessment made by a single, well-defined relative scale, such as grade 1 to 5 in order to achieve comparability. I.e., it must be told what damage corresponds to individual degrees, and what response / specific scenario is most suitable for it.

Procedure for determining vulnerable zones in the area is as follows:

- Setup of file of possible disasters P_1, P_2, ... P_n, which may occur in a given area (e.g. fire, flooding, wind, impact of a moving object, explosion, earthquake, landslide, vibration, hazardous substances, poorly secured supply of electricity, gas, water, information, lack of physical protection; lack the possibility of evacuation, inadequate air conditioning, etc.), in which the vulnerability will be monitored, as they can reach size, to which tracked public assets are not inherently resistant (i.e., can cause unacceptable damage).
- The area shall be assessed in terms of vulnerability to disasters P_1, P_2,….P_n for each protected asset O_1, O_2, ..., O_m or area of assets Z_1, Z_2, ..., Z_m, which are located in the territory, e.g. using the checklists adapted for the territory. It is advisable to use a scale from 1 to 5 for the evaluation, so that to ensure that degrees are at same level for all disasters (e.g. expected size of damage expressed in money for 1 year [9]).
- For each object O_1, O_2, ..., O_m or area Z_1, Z_2, ..., Z_m we set the order of vulnerability to disasters P_1, P_2, ... P_n, see the example in Table 1.
- Objects / zones are grouped together for practical reasons (acceptable number of specific response scenarios) to the sub-units in order of vulnerability.
- Determination of specific response scenarios / or specific inspection activities, which is allowed by existing legislation, for partial units.

Tab. 1 - Example of assessment of overall vulnerability of the object.

Disaster	**Assessment of vulnerability**
Fire	5
Violation of safety	4.8
Storage	4.5
Flood	4.2
Other threats	4.0
Explosion	3.9
Service disruption	3.8
Communication disruption	3.7
Data protection violation	3.6
Lack of contingency plans for situations	3.5
Overall rating	**4.1**

It must be noted that when evaluating the multiple entities to more disasters, the problem does not usually occur in a process model according to which the evaluation is conducted, but in the scale of values, by which different aspects are assessed and according to which an overall assessment is carried out [10]. Therefore, it is appropriate to create a value scale for vulnerability according to the procedure described in [9], based on procedure below:

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1. For disaster P_i (i = 1,2,..., n), with the size that occurs on average once a year (some simplification of precise calculations used in practice for monitoring needs) to evaluate the vulnerability of the monitored assets as follows:
   stage 1 - the expected damage to assets <5000 CZK
   stage 2 - the expected damage to assets between 5000 and 50 000 CZK
   stage 3 - the expected damage to assets between 50 000 and 500 000 CZK
   stage 4 - the expected damage to assets between 500 000 and 5 000 000 CZK
   stage 5 - the expected damage to assets above 5 000 000 CZK

2. At fifty-year disaster P_i (i = 1,2,..., n), i.e. at the size of the disaster that occurs on average once in fifty years (some simplification of precise calculations used in practice for the purpose of monitoring) to evaluate the vulnerability controlled assets as follows:
   stage 1 - the expected damage to assets <0,5 mio CZK
   stage 2 - the expected damage to assets between 0,5 and 5 mio CZK
   stage 3 - the expected damage to assets between 5 and 50 mio CZK
   stage 4 - the expected damage to assets between 50 and 500 mio CZK
   stage 5 - the expected damage to assets above 500 mio CZK

3. At one hundred-year disaster P_i (i = 1,2,..., n), i.e. at the size of the disaster that occurs on average once in one hundred years (some simplification of precise calculations used in practice for the purpose of monitoring) to evaluate the vulnerability controlled assets as follows:
   stage 1 - the expected damage to assets <5 mio CZK
   stage 2 - the expected damage to assets between 5 and 50 mio CZK
   stage 3 - the expected damage to assets between 50 and 500 mio CZK
   stage 4 - the expected damage to assets between 5 and 50 billion CZK
   stage 5 - the expected damage to assets above 50 billion CZK

When vulnerabilities are determined, and according to the disaster hazard size and the vulnerability measure size the risks are assessed, it is necessary to make an action plan focused on defeat of each risk. Usually 4 to 5 most risky entities are selected and for them the plan of activities is set. An example is in Table 2.

Tab. 2 - Example of action plan. It consists of response scenarios S1,..., S5.

Disaster	Response scenario
Disaster meaning the highest vulnerability for the object / infrastructure / organization.	S1
Disaster meaning the second highest vulnerability for the object / infrastructure / organization.	S2
Disaster meaning the third highest vulnerability for the object / infrastructure / organization.	S3
Disaster meaning the fourth highest vulnerability for the object / infrastructure / organization.	S4
Disaster meaning the fifth highest vulnerability for the object / infrastructure / organization.	S5

The problem of the vulnerability of the system in a certain area is so dependent on local conditions, that it is not possible to outline its general solution, because it is dealing with the solution of risk of system of systems [8]. For each area it should be solved by using a case study of a suitable type [3]. Based on the knowledge and practical experience in safety management it is primarily associated with search for:

- extreme cases (the reason is that usually in terms of security and development is necessary to avoid these cases, i.e., to take appropriate measures to not allow their occurrence),
- critical cases (the reason is that usually in terms of security and development these cases are strategically important because they create an interface at which the risk of default and losses associated with the materialization of risk are high, and when it is exceeded the catastrophe occurrence is highly likely and irreversible, i.e. these risks are unacceptable),
- paradigmatic (sample) cases (the reason is to design a suitable implementation of possible solutions for the usual case in practice).

Another example is an application of verbal scale for vulnerability assessment, see Table 3 for industrial building.

Tab. 3 - The vulnerability of an industrial building with regard to damage or failure of key equipment classified as verbal numerical scale, according to data compiled in the works [12,13].

Sign	Verbal description	Characteristics of vulnerability of protected asset
5	Extremely high	Loss of equipment or disposal of function causes an immediate cessation of operation, output, production or service. The user cannot continue without this facility in the activity.
4	High	Loss of equipment or disposal of function causes an cessation of operation within 1°day or decreases, output, production or service by 75%
3	Medium	Loss of equipment or disposal of function causes an cessation of operation within 1°week or decreases, output, production or service by 50%
2	Small	Loss of equipment or disposal of function causes an cessation of operation within 2°weeks or decreases, output, production or service by 25%
1	Negligible	Loss of equipment or disposal of function causes an cessation of operation within 1°month or decreases, output, production or service by 10%

CONCLUSION

Because the human through his / her intellect and historical experience protects and consciously develops resistance of areas, buildings, infrastructures and technologies to disasters by selecting elements, links and flows, their connections and specific preventive measures and activities up to a certain size of disaster (which is determined by its knowledge , capabilities and financial, technical possibilities, etc.), the cascading failures caused by interconnection (the interdependences) occurs only at beyond design disasters above the size limit of the disaster, against which resistance is systematically provided [2].In addition, each area is different, has different structure, composition and arrangement, and therefore has a different vulnerability, which manifests itself during disasters [2], and therefore, cascade effects are very different and must be monitored separately.

The same argument applies to the human community, as rich and developed countries have far higher level of safety than the poor countries or rich countries economically, but in which the public interest is ignored and governance respects the interests of only certain social strata.

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